Products for DNA Research

2021 Catalog

glenresearch.com

GLEN RESEARCH

part of Maravai LifeSciences

Oligo synthesis success. The first time and every time.

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ABOUT US

Glen Research develops, manufactures and markets reagents for oligonucleotide synthesis, modification, labeling and purification. The company serves customers worldwide involved in basic research, diagnostics and therapeutics. Although Glen Research's original mission was to provide state-of-the-art reagents to researchers, the company also began offering standard reagents for oligonucleotide synthesis but with the innovation that every batch was accompanied by a Certificate of Analysis. The analytical techniques and quality criteria used for the evaluation and acceptance of these reagents were to become an industry standard years later. The company is headquartered in Sterling, Virginia. A privately held company, Glen Research was acquired by Maravai LifeSciences in December 2017.

OVER 30 YEARS OF ASSURED QUALITY FOR OLIGO SYNTHESIS

1987
Glen Research was incorporated in the Commonwealth of Virginia

1991
Company awarded SBIR grant for the investigation of large scale oligonucleotide synthesis using H-phosphonate chemistry

1993
Glen Research introduced the Sterling line of products, a new standard of quality for oligonucleotide synthesis

1995
Glen Research negotiated an exclusive agreement to supply 5'-biotin phosphoramidite worldwide

1996
Company negotiated an exclusive license with Gilead Sciences to supply C5-propynyl pyrimidine nucleosides and G-Clamp phosphoramidites

1997
Glen Research moves into a custom built building in Sterling, Virginia

1999
Company awarded patents for a chemical phosphorylation reagent compatible with DMT-ON purification

2002
Company made an agreement with Epoch Biosciences, Inc. to supply their proprietary dyes and nucleosides to the research market

2003
Glen Research negotiated an agreement with GE Healthcare Biosciences Corp. to supply Cyanine Dyes to the research market

2004
Company awarded patents for a truly universal support for oligonucleotide synthesis - US III.

2006
In collaboration with Berry & Associates, Inc., Glen Research awarded patents for pyrrolo-C analogues (fluorescent C analogues).

2008
Glen Research obtained a license for the sale of Glen UnySupport from Ionis Pharmaceuticals

2013
In collaboration with Nelson Biotechnologies, Inc., company awarded patent for serinol phosphoramidites and supports

2017
Glen Research is acquired by Maravai LifeSciences

2019
Glen Research receives its ISO 9001:2015 certification for Quality Management Systems

CATALOG

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

Welcome to the Glen Research Catalog containing the most complete selection of products for DNA and RNA research. The Table of Contents at the beginning and the Index at the end of the Catalog are the most comprehensive we have produced. There are always limitations to printed catalogs in a fast-moving technology sector and a complete and up-to-date catalog is also maintained on our web site.

All minor bases, modifiers and RNA products are packaged for Applied Biosystems instruments. We can provide vials and columns for a wide variety of other instruments. As shown in the table to the left, we can accommodate catalog numbers for unusual products to fit all popular instruments. The table to the left is reproduced on all relevant spreads of this catalog.

We are unique in conducting a QC test for supports to show the length of oligo that can be prepared before a drop-off in coupling due to steric effects begins to occur. The drop-off point is recorded in the Certificate of Analysis or Analytical Report. Unless otherwise specified, our minor base and modification supports are 1000Å CPG, which results in improved performance and the ability to make much longer oligos. Polystyrene supports are also available for some of our most popular items.

For reasons of quality assurance, we do not transfer powders or oils from stock Applied Biosystems vials to vials for other instruments. Powders may be hygroscopic and electrostatic, making transfer difficult, and oils have to be dissolved and the solvent evaporated. For best performance, it is preferable for the customer to dissolve the product and immediately transfer the solution to the correct instrument vial. Consequently, the product will be delivered in an industry-standard septum-capped vial along with a clean dry vial for the appropriate instrument.

Glen Research will only guarantee products purchased through our official distributors. A complete listing of authorized distributors can be found on our website at: https://www.glenresearch.com/international-distributors.

QUALITY AND PERFORMANCE ASSURED

Glen Research has developed and implemented a Quality Management System (QMS) designed to enhance customer satisfaction by focusing on processes for continual improvement and on assurance of conformity to customer needs, with full consideration of applicable regulatory requirements.

STERLING QUALITY

The benchmark for excellence in DNA and RNA synthesis. All Sterling materials must pass stringent purity and identity tests prior to acceptance. Sterling products are formulated, filtered, and packaged in optimal environments using specially cleaned and dried glassware and columns. Color-coded labeling and post-packaging analysis guarantee accuracy and Sterling Quality.

STERLING PERFORMANCE

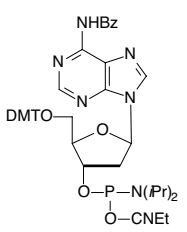
The standard of accomplishment for DNA and RNA synthesis. Every batch of Sterling reagents is analyzed by titration to confirm exact formulation. Every batch of Sterling monomers, supports and activators is synthesis-tested to ensure optimal performance. Certificates of Analysis provide your guarantee of Sterling Performance.

STERLING is a trademark of Glen Research Corporation.

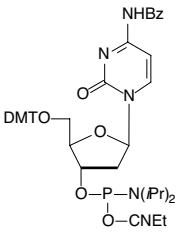
Glen Research offers the highest level of Quality Assurance for reagents for DNA and RNA synthesis - Sterling Quality and Performance. We now apply the Sterling criteria of quality and performance to all of Glen Research's established products.

STERLING

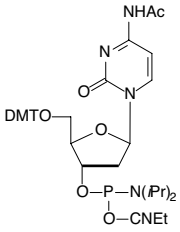
The common monomers and supports, whose structures are illustrated below, are available for the variety of synthesizers listed on the following pages.



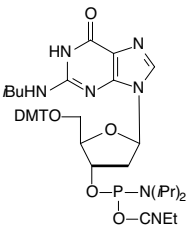
dA-CE Phosphoramidite



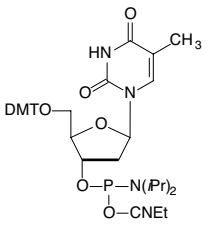
dC-CE Phosphoramidite



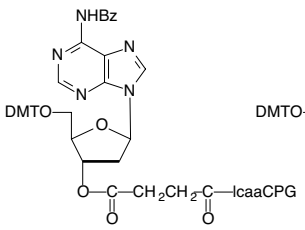
Ac-dC-CE Phosphoramidite



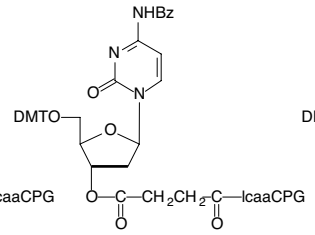
dG-CE Phosphoramidite



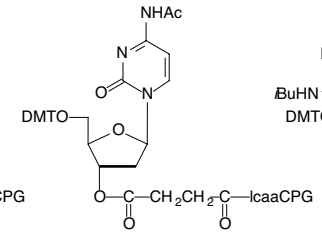
dT-CE Phosphoramidite



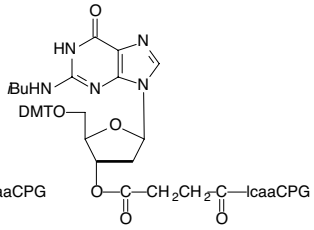
dA-lcaa-CPG



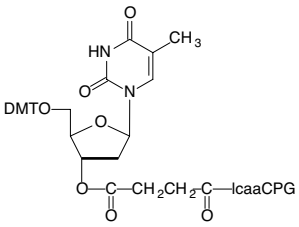
dC-lcaa-CPG



Ac-dC-lcaa-CPG



dG-lcaa-CPG

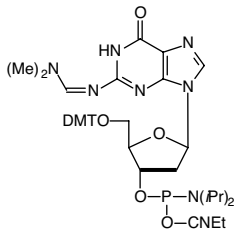


dT-lcaa-CPG

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.



dmf-dG-CE Phosphoramidite

ABI INSTRUMENTS

1. 60mL septum-capped vials used on oldest ABI 380, 381 and 391 instruments. 200mL oxidizer and 450mL deblock screw-capped bottles also used on ABI 380, 381 and 391 instruments.
2. Small screw-capped vials used on ABI 392 and 394 instruments.
3. Larger screw-capped vials used on ABI 392. 394 and 3400 instruments.
4. Large bottles used on ABI 3900 instruments.

RELATED

Depurination Resistant dA.....26

STERLING CE PHOSPHORAMIDITES

Glen Research CE (β-cyanoethyl) Phosphoramidites are produced and packaged to ensure the highest performance on DNA synthesizers. Every Glen Research product is accompanied by a Certificate of Analysis and HPLC trace, showing the results of our QC testing. Every Glen Research monomer vial is specially cleaned to eliminate particulate contamination and tested to ensure a tight fit on synthesizers.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-02	0.25g
	10-1000-05	0.5g
	10-1000-10	1.0g
	10-1000-20	2.0g
	10-1000-40	4.0g
dC-CE Phosphoramidite	10-1010-02	0.25g
	10-1010-05	0.5g
	10-1010-10	1.0g
	10-1010-20	2.0g
	10-1010-40	4.0g
Ac-dC-CE Phosphoramidite	10-1015-02	0.25g
	10-1015-05	0.5g
	10-1015-10	1.0g
	10-1015-20	2.0g
	10-1015-40	4.0g
dG-CE Phosphoramidite	10-1020-02	0.25g
	10-1020-05	0.5g
	10-1020-10	1.0g
	10-1020-20	2.0g
	10-1020-40	4.0g
dmf-dG-CE Phosphoramidite	10-1029-02	0.25g
	10-1029-05	0.5g
	10-1029-10	1.0g
	10-1029-20	2.0g
	10-1029-40	4.0g
dT-CE Phosphoramidite	10-1030-02	0.25g
	10-1030-05	0.5g
	10-1030-10	1.0g
	10-1030-20	2.0g
	10-1030-40	4.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Glen Research uses freshly sublimed 1H-tetrazole for premium performance on Applied Biosystems synthesizers.

Item	Catalog No.	Pack
Activator		
Tetrazole in Acetonitrile	30-3100-45[1]	45mL
	30-3100-52[2]	200mL
	30-3100-57[3]	450mL
	30-3100-62[4]	2000mL
Diluent		
Acetonitrile, anhydrous	40-4050-45	60mL
	40-4050-50	100mL

STERLING CE PHOSPHORAMIDITES (CONT.)

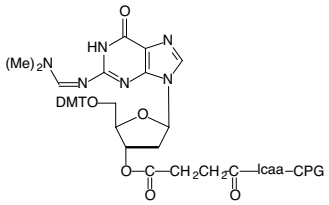
Item	Catalog No.	Pack
Cap Mix A		
Tetrahydrofuran/Pyridine/Acetic Anhydride	40-4110-45[1]	45mL
	40-4110-52[2]	200mL
	40-4110-57[3]	450mL
	40-4110-62[4]	2000mL
Cap Mix B		
16% 1-Methylimidazole in Tetrahydrofuran	40-4220-45[1]	45mL
(This Cap B solution is identical to the formulation produced by Applied Biosystems.)	40-4220-52[2]	200mL
	40-4220-62[4]	2000mL
Oxidizing Solution		
0.02M Iodine in Tetrahydrofuran/Pyridine/Water	40-4330-52[1,2]	200mL
	40-4330-57[3]	450mL
	40-4330-62[4]	2000mL
Deblocking Mix		
3% Trichloroacetic Acid/Dichloromethane	40-4140-57[1,2]	450mL
	40-4140-62[3,4]	2000mL

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCM = Dichloromethane
dmf = dimethylformamidine
I_2 = Iodine
lcaa = long chain alkylamino
MeIm = 1-Methylimidazole
µm = micromole(s)
nm = nanomole(s)
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran

RELATED

Alternative Solvents 34



dmf-dG-CPG

STERLING SUPPORTS

All Glen Research CPG supports use the standard long chain alkylamino (lcaa) linker but differ in the glass pore size, 500Å, 1000Å or 2000Å. The 500Å support is appropriate for shorter sequences, while the 1000Å supports perform better in the synthesis of longer (>30-mer) DNA sequences. The 2000Å support is best for very long (>150-mer) oligonucleotides. We have instituted an additional QC test for supports to show the length of oligo that can be prepared before a drop-off in coupling due to steric effects begins to occur. The drop-off point is recorded in the Certificate of Analysis. All Glen Research supports are fully end-capped to ensure that the CPG surface is totally inert, thereby avoiding the introduction of impurity sequences containing deletions at the 3'-terminus.

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. dA,dC,dG,dT (1 column of each base)	Catalog No. Ac-dC	Catalog No. d m f - d G	Pack
500Å Columns							
20-2100-42	20-2110-42	20-2120-42	20-2130-42	20-2140-42	20-2113-42		4x0.2µm
20-2100-41	20-2110-41	20-2120-41	20-2130-41	20-2140-41	20-2113-41		4x1.0µm
20-2100-13	20-2110-13	20-2120-13	20-2130-13		20-2113-13		1x10µm
1000Å Columns							
20-2101-45	20-2111-45	20-2121-45	20-2131-45	20-2141-45	20-2115-45	20-2129-45	4x40nm
20-2101-42	20-2111-42	20-2121-42	20-2131-42	20-2141-42	20-2115-42	20-2129-42	4x0.2µm
20-2101-41	20-2111-41	20-2121-41	20-2131-41	20-2141-41	20-2115-41	20-2129-41	4x1.0µm
20-2101-13	20-2111-13	20-2121-13	20-2131-13		20-2115-13	20-2129-13	1x10µm

STERLING SUPPORTS (CONT.)

ABI 3900 1000Å CPG COLUMNS

Glen Research's ABI 3900 1000Å CPG columns bring the lower cost of CPG to this platform while maintaining the high synthesis efficiency of 1000Å CPG. Our columns offer the following key attributes:

- No need to change instrument settings
- No need to change software parameters
- Easier handling post -synthesis compared to PS
- High quality 1000Å CPG for optimal synthesis results

BULK CPG LOADING

500Å supports	35-50µmoles/g
1000Å supports	25-40µmoles/g

RELATED

Universal Supports..... 28
Q-Supports 31
High Load Supports..... 33

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. dA,dC,dG,dT (1 column of each base)	Catalog No. Ac-dC	Catalog No. d m f - d G	Pack
2000Å Columns							
20-2102-42	20-2112-42	20-2122-42	20-2132-42	20-2142-42			4x0.2µm
Low Volume (LV) Polystyrene Columns							
26-2100-45	26-2110-45	26-2120-45	26-2130-45	26-2140-45			4x40nm
26-2100-42	26-2110-42	26-2120-42	26-2130-42	26-2140-42			4x0.2µm
ABI 3900 Polystyrene Columns							
26-2600-65	26-2610-65		26-2630-65			26-2629-65	200x40nm
26-2600-62	26-2610-62		26-2630-62			26-2629-62	200x200nm
ABI 3900 1000Å CPG Columns							
20-2101-65			20-2131-65		20-2115-65	20-2129-65	200x40nm
20-2101-62			20-2131-62		20-2115-62	20-2129-62	200x200nm
20-2101-61			20-2131-61		20-2115-61	20-2129-61	200x1.0µm
500Å Bulk CPG							
20-2000-01	20-2010-01	20-2020-01	20-2030-01		20-2013-01		0.1g
20-2000-02	20-2010-02	20-2020-02	20-2030-02		20-2013-02		0.25g
20-2000-10	20-2010-10	20-2020-10	20-2030-10		20-2013-10		1.0g
1000Å Bulk CPG							
20-2001-01	20-2011-01	20-2021-01	20-2031-01		20-2015-01	20-2029-01	0.1g
20-2001-02	20-2011-02	20-2021-02	20-2031-02		20-2015-02	20-2029-02	0.25g
20-2001-10	20-2011-10	20-2021-10	20-2031-10		20-2015-10	20-2029-10	1.0g
2000Å Bulk CPG							
20-2002-01	20-2012-01	20-2022-01	20-2032-01				0.1g
20-2002-02	20-2012-02	20-2022-02	20-2032-02				0.25g
20-2002-10	20-2012-10	20-2022-10	20-2032-10				1.0g

Item	Catalog No.	Pack
Empty Synthesis Columns-TWIST 40nm, 0.2um or 1um	20-0030-00	Pack of 10
Empty Synthesis Columns - TWIST 10um/15um	20-0040-00	Pack of 10
Replacement Frits - TWIST 10um/15um	20-0040-0F	Pack of 20

TWIST is a trademark of Glen Research Corporation.

ABI 3900 POLYSTYRENE MODIFIER COLUMNS

Some of our more popular minor base and modifier supports are available on polystyrene in columns fully compatible with the Applied Biosystems 3900 synthesizer. These include our popular Universal Support III, which will allow DNA, RNA or LNA oligos to be produced on the 3900 with ANY base at the 3' terminus. At the same time, we are offering 1 µmole columns of Universal Support III for the 3900 instrument. Structures and more complete descriptions are found in the relevant catalog sections for each item. ABI 3900 columns can be prepared with virtually any of the CPG supports in this catalog. It is no longer necessary to adjust the flow using our ABI 3900 CPG columns, as noted in the box to the right. Modified CPG columns are only available in 200 nmole size - simple add 'A' to the regular catalog number to order.

Item	Catalog No.	Pack
Universal Support III PS		
200 nmole columns	26-5110-52	Pack of 10
40 nmole columns (ABI 3900 Format)	26-5110-55	Pack of 10
Glen UnySupport™ PS		
200 nmole columns	26-5140-52	Pack of 10
40 nmole columns	26-5140-55	Pack of 10
3'-Phosphate PS		
200 nmole columns	26-2900-52	Pack of 10
40 nmole columns	26-2900-55	Pack of 10
3'-PT-Amino-Modifier C6 PS		
200 nmole columns	26-2956-52	Pack of 10
40 nmole columns	26-2956-55	Pack of 10
3'-(6-FAM) PS		
200 nmole columns	26-2961-52	Pack of 10
40 nmole columns	26-2961-55	Pack of 10
3'-Dabcyl PS		
200 nmole columns	26-5912-52	Pack of 10
40 nmole columns	26-5912-55	Pack of 10
3'-TAMRA PS		
200 nmole columns	26-5910-52	Pack of 10
40 nmole columns	26-5910-55	Pack of 10
3'-BiotinTEG PS		
200 nmole columns	26-2955-52	Pack of 10
40 nmole columns	26-2955-55	Pack of 10

RELATED

Universal Supports 28

ABI 3900 1000Å CPG COLUMNS

Glen Research's ABI 3900 1000Å CPG columns bring the lower cost of CPG to this platform while maintaining the high synthesis efficiency of 1000Å CPG. Our columns offer the following key attributes:

- No need to change instrument settings
- No need to change software parameters
- Easier handling post -synthesis compared to PS
- High quality 1000Å CPG for optimal synthesis results

STERLING CE PHOSPHORAMIDITES

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.

RELATED

Depurination Resistant dA..... 26

EXPEDITE INSTRUMENTS

1. For use on Expedite 8905 instruments.
2. For use on Expedite 8909 instruments.

Glen Research CE (β-cyanoethyl) Phosphoramidites are produced and packaged to ensure the highest performance on DNA synthesizers. Every Glen Research product is accompanied by a Certificate of Analysis and HPLC trace, showing the results of our QC testing. Every Glen Research monomer vial is specially cleaned to eliminate particulate contamination.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-C2	0.25g
	10-1000-C5	0.5g
	10-1000-1C	1.0g
	10-1000-2C	2.0g
dC-CE Phosphoramidite	10-1010-C2	0.25g
	10-1010-C5	0.5g
	10-1010-1C	1.0g
	10-1010-2C	2.0g
Ac-dC-CE Phosphoramidite	10-1015-C2	0.25g
	10-1015-C5	0.5g
	10-1015-1C	1.0g
	10-1015-2C	2.0g
dG-CE Phosphoramidite	10-1020-C2	0.25g
	10-1020-C5	0.5g
	10-1020-1C	1.0g
	10-1020-2C	2.0g
dmf-dG-CE Phosphoramidite	10-1029-C2	0.25g
	10-1029-C5	0.5g
	10-1029-1C	1.0g
	10-1029-2C	2.0g
dT-CE Phosphoramidite	10-1030-C2	0.25g
	10-1030-C5	0.5g
	10-1030-1C	1.0g
	10-1030-2C	2.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Glen Research uses freshly sublimed 1H-tetrazole for premium performance on Expedite synthesizers.

Item	Catalog No.	Pack
Activator		
Tetrazole in Acetonitrile	30-3102-66[1]	60mL
	30-3102-52[2]	200mL
	30-3100-57[2]	450mL
Diluent		
Acetonitrile, anhydrous	40-4050-45	60mL
	40-4050-50	100mL

STERLING SOLVENTS/REAGENTS (CONT.)

Item	Catalog No.	Pack
Anhydrous Wash		
Acetonitrile, anhydrous	40-4050-53[1]	300mL
	40-4050-57[2]	450mL
Cap Mix A		
Tetrahydrofuran/Acetic Anhydride	40-4012-66[1]	60mL
	40-4012-52[2]	200mL
	40-4012-57[2]	450mL
Cap Mix B		
10% 1-Methylimidazole in Tetrahydrofuran/Pyridine	40-4122-66[1]	60mL
	40-4122-52[2]	200mL
	40-4122-57[2]	450mL
Oxidizing Solution		
0.02M Iodine in Tetrahydrofuran/Water/Pyridine	40-4132-66[1]	60mL
	40-4132-52[2]	200mL
	40-4132-57[2]	450mL
Deblocking Mix		
3% Trichloroacetic Acid/Dichloromethane	40-4140-68[1]	180mL
	40-4140-71[2]	1L

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCM = Dichloromethane
dmf = dimethylformamidine
I_2 = Iodine
lcaa = long chain alkylamino
MeIm = 1-Methylimidazole
µm = micromole(s)
nm = nanomole(s)
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran

RELATED

Alternative Solvents 34

BULK CPG LOADING

500Å supports	35-50µmoles/g
1000Å supports	25-40µmoles/g

STERLING SUPPORTS

All Glen Research supports use the standard long chain alkylamino (lcaa) linker but differ in the glass pore size, 500Å, 1000Å or 2000Å. The 500Å support is appropriate for shorter sequences, while the 1000Å supports perform better in the synthesis of longer (>30-mer) DNA sequences. The 2000Å support is best for very long (>150-mer) oligonucleotides. We have instituted an additional QC test for supports to show the length of oligo that can be prepared before a drop-off in coupling due to steric effects begins to occur. The drop-off point is recorded in the Certificate of Analysis. All Glen Research supports are fully end-capped to ensure that the CPG surface is totally inert, thereby avoiding the introduction of impurity sequences containing deletions at the 3'-terminus.

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. dA,dC,dG,dT (1 column of each base)	Catalog No. Ac-dC	Catalog No. dmf-dG	Pack
500Å Columns							
20-2200-42	20-2210-42	20-2220-42	20-2230-42	20-2240-42	20-2213-42		4x0.2µm
20-2200-41	20-2210-41	20-2220-41	20-2230-41	20-2240-41	20-2213-41		4x1.0µm
20-2200-14	20-2210-14	20-2220-14	20-2230-14		20-2213-14		1x15µm
1000Å Columns							
20-2201-45	20-2211-45	20-2221-45	20-2231-45	20-2241-45	20-2215-45	20-2229-45	4x40nm
20-2201-42	20-2211-42	20-2221-42	20-2231-42	20-2241-42	20-2215-42	20-2229-42	4x0.2µm
20-2201-41	20-2211-41	20-2221-41	20-2231-41	20-2241-41	20-2215-41	20-2229-41	4x1.0µm
20-2201-14	20-2211-14	20-2221-14	20-2231-14		20-2215-14	20-2229-14	1x15µm

STERLING SUPPORTS (CONT.)

RELATED

Universal Supports 28
Q-Supports 31
High Load Supports 33

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. dA,dC,dG,dT (1 column of each base)	Catalog No. Ac-dC	Catalog No. dmf-dG	Pack
2000Å Columns							
20-2202-42	20-2212-42	20-2222-42	20-2232-42	20-2242-42			4x0.2µm
500Å Bulk CPG							
20-2000-01	20-2010-01	20-2020-01	20-2030-01		20-2013-01		0.1g
20-2000-02	20-2010-02	20-2020-02	20-2030-02		20-2013-02		0.25g
20-2000-10	20-2010-10	20-2020-10	20-2030-10		20-2013-10		1.0g
1000Å Bulk CPG							
20-2001-01	20-2011-01	20-2021-01	20-2031-01		20-2015-01	20-2029-01	0.1g
20-2001-02	20-2011-02	20-2021-02	20-2031-02		20-2015-02	20-2029-02	0.25g
20-2001-10	20-2011-10	20-2021-10	20-2031-10		20-2015-10	20-2029-10	1.0g
2000Å Bulk CPG							
20-2002-01	20-2012-01	20-2022-01	20-2032-01				0.1g
20-2002-02	20-2012-02	20-2022-02	20-2032-02				0.25g
20-2002-10	20-2012-10	20-2022-10	20-2032-10				1.0g

Item	Catalog No.	Pack
Empty Synthesis Columns, 40nm, 0.2um Expedite Style	20-0021-02	Pack of 10
Empty Synthesis Columns, 1um Expedite Style	20-0021-01	Pack of 10
Replacement Filters-Expedite	20-0021-0F	Pack of 20
Empty Synthesis Columns - TWIST 10um/15um	20-0040-00	Pack of 10
Replacement Frits - TWIST 10um/15um	20-0040-0F	Pack of 20

TWIST is a trademark of Glen Research Corporation.
Expedite is a trademark of Applied Biosystems.

DNA PHOSPHORAMIDITES - SPECIAL PACKAGING

We offer our high quality DNA phosphoramidites specifically packaged for high throughput and large-scale synthesis customers. These customers normally require high quality materials produced under the guidelines of a validated quality management system while still being priced aggressively. These products include the usual Glen Research certification and guarantees and they are available in larger packs or in bulk. The core catalog numbers for regular DNA phosphoramidites are shown below. For these products, please request a quote.

Item	Catalog No.
dA-CE Phosphoramidite	10-1000-SP
dC-CE Phosphoramidite	10-1010-SP
Ac-dC-CE Phosphoramidite	10-1015-SP
dG-CE Phosphoramidite	10-1020-SP
dmf-dG-CE Phosphoramidite	10-1029-SP
dT-CE Phosphoramidite	10-1030-SP

INSTRUMENT TYPES

Glen Research packages these monomers in a variety of industry-standard vials and bottles. Please provide the exact specification of the bottle required prior to receiving a quotation.

STERLING CE PHOSPHORAMIDITES

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.

RELATED

Depurination Resistant dA..... 26
Alternative Activators 34

MerMade synthesizers belong to a family of synthesizers, including the column-based MerMade 4, MerMade 6 and 12 instruments and the parallel array synthesizers, MerMade 192 and MerMade 192E, manufactured by BioAutomation Corporation. Their website can be found at: http://www.BioAutomation.com. Phosphoramidite monomers are packaged in 30mL and 240mL amber bottles for dissolving at a concentration of 1g/20mL and are connected directly to the instrument. Some instruments may also be configured to accept Applied Biosystems serum vials, as shown on page 6.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-02M	0.25g
	10-1000-05M	0.5g
	10-1000-10M	1.0g
	10-1000-5S	5.0g
	10-1000-1S	10.0g
dC-CE Phosphoramidite	10-1010-02M	0.25g
	10-1010-05M	0.5g
	10-1010-10M	1.0g
	10-1010-5S	5.0g
	10-1010-1S	10.0g
Ac-dC-CE Phosphoramidite	10-1015-02M	0.25g
	10-1015-05M	0.5g
	10-1015-10M	1.0g
	10-1015-5S	5.0g
	10-1015-1S	10.0g
dG-CE Phosphoramidite	10-1020-02M	0.25g
	10-1020-05M	0.5g
	10-1020-10M	1.0g
	10-1020-5S	5.0g
	10-1020-1S	10.0g
dmf-dG-CE Phosphoramidite	10-1029-02M	0.25g
	10-1029-05M	0.5g
	10-1029-10M	1.0g
	10-1029-5S	5.0g
	10-1029-1S	10.0g
dT-CE Phosphoramidite	10-1030-02M	0.25g
	10-1030-05M	0.5g
	10-1030-10M	1.0g
	10-1030-5S	5.0g
	10-1030-1S	10.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Parallel synthesizers typically use 5-ethylthio-1H-tetrazole (ETT) as activator to minimize the chance of crystallization. ETT is used at a concentration of 0.25M in acetonitrile, which is far below the level at which crystallization may occur.

Item	Catalog No.	Pack
Activator		
0.25M 5-Ethylthio-1H-Tetrazole in Acetonitrile	30-3140-57	450mL
	30-3140-61	960mL
	30-3140-62	2000mL

STERLING SOLVENTS/REAGENTS (CONT.)

Item	Catalog No.	Pack
Diluent		
Acetonitrile, anhydrous	40-4050-50	100mL
Cap Mix A		
THF/2,6-Lutidine/Acetic Anhydride	40-4010-57	450mL
	40-4010-61	960mL
	40-4010-62	2000mL
Cap Mix B		
16% 1-Methylimidazole in Tetrahydrofuran	40-4220-57	450mL
	40-4220-61	960mL
	40-4220-62	2000mL
Ozidizing Solution		
0.02M Iodine in Tetrahydrofuran/Pyridine/Water	40-4330-57	450mL
	40-4330-61	960mL
	40-4330-62	2000mL
Deblocking Mix		
3% Dichloroacetic acid in Dichloromethane	40-4040-57	450mL
	40-4040-61	960mL
	40-4040-62	2000mL
3% Trichloroacetic Acid/Dichloromethane	40-4140-57	450mL
	40-4140-61	960mL
	40-4140-62	2000mL

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCM = Dichloromethane
dmf = dimethylformamidine
I_2 = Iodine
MeIm = 1-Methylimidazole
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran

RELATED

Alternative Solvents 34
Universal Supports 28
Q-Supports 31
High Load Supports 33

STERLING SUPPORTS

Columns containing 1000Å CPG are available in packs of 200 to fit MerMade plates. Regular 500Å or 1000Å supports may also be used to fill the wells of regular 96 well plates. However, this requires each plate to be prepared with each nucleoside accurately in all wells. A universal support clearly removes the need for four specific supports and makes preparing plates straightforward. Glen UnySupport™ 40 nmole frits can also be used.

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. Ac-dC	Catalog No. dmf-dG	Pack
Mermade 1000Å Columns						
20-2001-65		20-2021-65	20-2031-65	20-2015-65	20-2029-65	200x50nm
20-2001-62		20-2021-62	20-2031-62	20-2015-62	20-2029-62	200x200nm
20-2001-61		20-2021-61	20-2031-61	20-2015-61	20-2029-61	48x1.0µm

Item	Catalog No.	Pack
Glen UnySupport™ 1000		
1 µmole columns	20-5141-91	Pack of 96
200 nmole columns	20-5141-92	Pack of 96
40 nmole columns	20-5141-95	Pack of 96
Empty MerMade Columns		
Empty MerMade Columns (50nm)	20-0050-05	Pack of 48
Empty MerMade Columns (200nm and 1µm)	20-0050-02	Pack of 48

STERLING CE PHOSPHORAMIDITES

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.

RELATED

Depurination Resistant dA..... 26

Glen Research CE (β-cyanoethyl) Phosphoramidites are produced and packaged to ensure the highest performance on DNA synthesizers. Every Glen Research product is accompanied by a Certificate of Analysis and HPLC trace, showing the results of our QC testing. Every Glen Research monomer vial is specially cleaned to eliminate particulate contamination.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-20	2.0g
	10-1000-50	5.0g
dC-CE Phosphoramidite	10-1010-20	2.0g
	10-1010-50	5.0g
Ac-dC-CE Phosphoramidite	10-1015-20	2.0g
	10-1015-50	5.0g
dG-CE Phosphoramidite	10-1020-20	2.0g
	10-1020-50	5.0g
dmf-dG-CE Phosphoramidite	10-1029-20	2.0g
	10-1029-50	5.0g
dT-CE Phosphoramidite	10-1030-20	2.0g
	10-1030-50	5.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination.

Item	Catalog No.	Pack
Diluent		
Acetonitrile, anhydrous	40-4050-45	60mL
	40-4050-50	100mL
Activator		
0.40M Tetrazole in Acetonitrile	30-3105-71	1L
Cap Mix A		
Acetonitrile/1-Methylimidazole	40-4015-71	1L
20% 1-Methylimidazole in Acetonitrile/ 2,6-Lutidine	40-4115-71	1L
Cap Mix B		
Acetonitrile/Acetic Anhydride/2,6-Lutidine*	40-4028-71	1L
20% Acetic Anhydride in Acetonitrile	40-4224-71	1L
5% Phenoxyacetic Anhydride in Acetonitrile	40-4128-71	1L
Oxidizing Solution		
0.05M Iodine in Pyridine/Water	40-4035-71	1L
Deblocking Mix		
3% Dichloroacetic Acid in Dichloromethane	40-4040-71	1L
3% Trichloroacetic Acid in Dichloromethane	40-4140-71	1L
3% Dichloroacetic Acid in Toluene	40-4240-71	1L

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCA = Dichloroacetic Acid
DCM = Dichloromethane
I_2 = Iodine
MeIm = 1-Methylimidazole
µm = micromole(s)

RELATED

Alternative Solvents 34

*Cap Mix B is a two part formulation that is combined immediately before shipment.

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.

RELATED

Depurination Resistant dA..... 26
Alternative Activators 34

STERLING CE PHOSPHORAMIDITES

Dr. Oligo synthesizers belong to a family of synthesizers, including the parallel array synthesizers, Dr. Oligo 96, Dr. Oligo 192, Dr. Oligo 384 and Dr. Oligo 768, manufactured by Biolytic® Lab Performance, Inc. in Fremont, CA. Their web site can be found at: http://www.biolytic.com. Phosphoramidite monomers are packaged in 30mL and 240mL amber bottles for dissolving at a concentration of 1g/20mL and are connected directly to the instrument. Some instruments may also be configured to accept Applied Biosystems serum vials.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-02M	0.25g
	10-1000-05M	0.5g
	10-1000-10M	1.0g
	10-1000-5S	5.0g
	10-1000-1S	10.0g
dC-CE Phosphoramidite	10-1010-02M	0.25g
	10-1010-05M	0.5g
	10-1010-10M	1.0g
	10-1010-5S	5.0g
	10-1010-1S	10.0g
Ac-dC-CE Phosphoramidite	10-1015-02M	0.25g
	10-1015-05M	0.5g
	10-1015-10M	1.0g
	10-1015-5S	5.0g
	10-1015-1S	10.0g
dG-CE Phosphoramidite	10-1020-02M	0.25g
	10-1020-05M	0.5g
	10-1020-10M	1.0g
	10-1020-5S	5.0g
	10-1020-1S	10.0g
dmf-dG-CE Phosphoramidite	10-1029-02M	0.25g
	10-1029-05M	0.5g
	10-1029-10M	1.0g
	10-1029-5S	5.0g
	10-1029-1S	10.0g
dT-CE Phosphoramidite	10-1030-02M	0.25g
	10-1030-05M	0.5g
	10-1030-10M	1.0g
	10-1030-5S	5.0g
	10-1030-1S	10.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Parallel synthesizers typically use 5-ethylthio-1H-tetrazole (ETT) as activator to minimize the chance of crystallization. ETT is used at a concentration of 0.25M in acetonitrile, which is far below the level at which crystallization may occur.

Item	Catalog No.	Pack
Activator		
0.25M 5-Ethylthio-1H-Tetrazole in Acetonitrile	30-3140-57	450mL
	30-3140-62	2000mL

STERLING SOLVENTS/REAGENTS (CONT.)

Item	Catalog No.	Pack
Diluent		
Acetonitrile, anhydrous	40-4050-50	100mL
Cap Mix A		
Tetrahydrofuran/2,6-Lutidine/Acetic Anhydride	40-4010-57	450mL
	40-4010-62	2000mL
Cap Mix B		
16% 1-Methylimidazole in Tetrahydrofuran	40-4220-57	450mL
	40-4220-62	2000mL
Oxidizing Solution		
0.02M Iodine in Tetrahydrofuran/Pyridine/H2O	40-4330-57	450mL
	40-4330-62	2000mL
Deblocking Mix		
3% Dichloroacetic acid in Dichloromethane	40-4040-57	450mL
	40-4040-62	2000mL
3% Trichloroacetic acid in Dichloromethane	40-4140-57	450mL
	40-4140-62	2000mL

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCM = Dichloromethane
dmf = dimethylformamidine
I_2 = Iodine
MeIm = 1-Methylimidazole
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran

RELATED

Alternative Solvents 34
Universal Supports 28
Q-Supports 31
High Load Supports 33
Glen-Pak™ DNA 151

STERLING SUPPORTS

Dr. Oligo instruments are designed for flexibility in the use of supports and columns. They can use fritted plates with loose CPG and ABI 3900 style polystyrene and CPG columns. Glen UnySupport™ 40 nmole frits can also be used.

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. Ac-dC	Catalog No. dmf-dG	Pack
ABI 3900 Polystyrene Columns						
26-2600-65	26-2610-65		26-2630-65		26-2629-65	200x40nm
26-2600-62	26-2610-62		26-2630-62		26-2629-62	200x200nm
ABI 3900 1000Å CPG Columns						
20-2101-65			20-2131-65	20-2115-65	20-2129-65	200x40nm
20-2101-62			20-2131-62	20-2115-62	20-2129-62	200x200nm
20-2101-61			20-2131-61	20-2115-61	20-2129-61	200x1.0µm

OLIGONUCLEOTIDE PURIFICATION

Biolytic Labs also offers the innovative Dr. Oligo Processor for high throughput purification of oligonucleotides using Glen-Pak™ DNA Purification Cartridges: https://www.biolytic.com/p-6814-dr-oligo-processor-fully-automated.aspx.

STERLING CE PHOSPHORAMIDITES

QUALITY ASSURANCE

Every batch of these CE Phosphoramidites is tested as follows:

1. **HPLC**
   a) Identity is confirmed by comparison with a reference sample.
   b) Purity is determined by HPLC to be ≥98.0%.
2. **TLC**
   Purity is verified by TLC.
3. **^{31}P NMR**
   Purity is determined by ^{31}P NMR to be ≥98%.
4. **Coupling Test**
   Coupling efficiency is determined to be ≥99%.
5. **Solution Test**
   A 0.1M solution is determined to be clear and free of particulate contamination.
6. **Loss on Drying**
   Volatile contaminants are determined to be ≤2%.

RELATED

Depurination Resistant dA..... 26

EXPEDITE INSTRUMENTS

1. For use on Expedite 8905 instruments.
2. For use on Expedite 8909 instruments.

Glen Research CE (β-cyanoethyl) Phosphoramidites are produced and packaged to ensure the highest performance on DNA synthesizers. Every Glen Research product is accompanied by a Certificate of Analysis and HPLC trace, showing the results of our QC testing. Every Glen Research monomer vial is specially cleaned to eliminate particulate contamination.

Item	Catalog No.	Pack
dA-CE Phosphoramidite	10-1000-C2	0.25g
	10-1000-C5	0.5g
	10-1000-1C	1.0g
	10-1000-2C	2.0g
	10-1000-5S	5.0g
	10-1000-1S	10.0g
dC-CE Phosphoramidite	10-1010-C2	0.25g
	10-1010-C5	0.5g
	10-1010-1C	1.0g
	10-1010-2C	2.0g
	10-1010-5S	5.0g
	10-1010-1S	10.0g
Ac-dC-CE Phosphoramidite	10-1015-C2	0.25g
	10-1015-C5	0.5g
	10-1015-1C	1.0g
	10-1015-2C	2.0g
	10-1015-5S	5.0g
	10-1015-1S	10.0g
dG-CE Phosphoramidite	10-1020-C2	0.25g
	10-1020-C5	0.5g
	10-1020-1C	1.0g
	10-1020-2C	2.0g
	10-1020-5S	5.0g
	10-1020-1S	10.0g
dmf-dG-CE Phosphoramidite	10-1029-C2	0.25g
	10-1029-C5	0.5g
	10-1029-1C	1.0g
	10-1029-2C	2.0g
	10-1029-5S	5.0g
	10-1029-1S	10.0g
dT-CE Phosphoramidite	10-1030-C2	0.25g
	10-1030-C5	0.5g
	10-1030-1C	1.0g
	10-1030-2C	2.0g
	10-1030-5S	5.0g
	10-1030-1S	10.0g

STERLING SOLVENTS/REAGENTS

All solvents and reagents are prepared to our exacting specifications to ensure the highest synthesis efficiency and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Glen Research uses freshly sublimed 1H-tetrazole for premium performance on Expedite synthesizers.

Item	Catalog No.	Pack
Activator		
Tetrazole in Acetonitrile	30-3102-52	200mL
	30-3100-57	450mL
	30-3100-62	2000mL
Diluent		
Acetonitrile, anhydrous	40-4050-50	100mL
Cap Mix A		
Tetrahydrofuran/Acetic Anhydride	40-4012-52	200mL
	40-4012-57	450mL
	40-4012-62	2000mL
Cap Mix B		
10% 1-Methylimidazole in Tetrahydrofuran/Pyridine	40-4122-52	200mL
	40-4122-57	450mL
	40-4122-62	2000mL
Oxidizing Solution		
0.02M Iodine in Tetrahydrofuran/Water/Pyridine	40-4132-52	200mL
	40-4132-57	450mL
	40-4132-62	2000mL
Deblocking Mix		
3% Trichloroacetic Acid/Dichloromethane	40-4140-62	2000mL

ABBREVIATIONS

Ac_2O = Acetic Anhydride
CE = Cyanoethyl
CPG = Controlled Pore Glass
DCM = Dichloromethane
dmf = dimethylformamidine
I_2 = Iodine
lcaa = long chain alkylamino
MeIm = 1-Methylimidazole
µm = micromole(s)
nm = nanomole(s)
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran

RELATED

Alternative Solvents 34

BULK CPG LOADING

500Å supports	35-50µmoles/g
1000Å supports	25-40µmoles/g

STERLING SUPPORTS

RELATED

Universal Supports 28
Q-Supports 31
High Load Supports 33

All Glen Research supports use the standard long chain alkylamino (lcaa) linker but differ in the glass pore size, 500Å, 1000Å or 2000Å. The 500Å support is appropriate for shorter sequences, while the 1000Å supports perform better in the synthesis of longer (>30-mer) DNA sequences. The 2000Å support is best for very long (>150-mer) oligonucleotides. We have instituted an additional QC test for supports to show the length of oligo that can be prepared before a drop-off in coupling due to steric effects begins to occur. The drop-off point is recorded in the Certificate of Analysis. All Glen Research supports are fully end-capped to ensure that the CPG surface is totally inert, thereby avoiding the introduction of impurity sequences containing deletions at the 3'-terminus.

Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Catalog No. dA,dC,dG,dT (1 column of each base)	Catalog No. Ac-dC	Catalog No. dmf-dG	Pack
500Å Columns							
20-2200-42	20-2210-42	20-2220-42	20-2230-42	20-2240-42	20-2213-42		4x0.2µm
20-2200-41	20-2210-41	20-2220-41	20-2230-41	20-2240-41	20-2213-41		4x1.0µm
20-2200-14	20-2210-14	20-2220-14	20-2230-14		20-2213-14		1x15µm
1000Å Columns							
20-2201-45	20-2211-45	20-2221-45	20-2231-45	20-2241-45	20-2215-45	20-2229-45	4x40nm
20-2201-42	20-2211-42	20-2221-42	20-2231-42	20-2241-42	20-2215-42	20-2229-42	4x0.2µm
20-2201-41	20-2211-41	20-2221-41	20-2231-41	20-2241-41	20-2215-41	20-2229-41	4x1.0µm
20-2201-14	20-2211-14	20-2221-14	20-2231-14		20-2215-14	20-2229-14	1x15µm
2000Å Columns							
20-2202-42	20-2212-42	20-2222-42	20-2232-42	20-2242-42			4x0.2µm
500Å Bulk CPG							
20-2000-01	20-2010-01	20-2020-01	20-2030-01		20-2013-01		0.1g
20-2000-02	20-2010-02	20-2020-02	20-2030-02		20-2013-02		0.25g
20-2000-10	20-2010-10	20-2020-10	20-2030-10		20-2013-10		1.0g
1000Å Bulk CPG							
20-2001-01	20-2011-01	20-2021-01	20-2031-01		20-2015-01	20-2029-01	0.1g
20-2001-02	20-2011-02	20-2021-02	20-2031-02		20-2015-02	20-2029-02	0.25g
20-2001-10	20-2011-10	20-2021-10	20-2031-10		20-2015-10	20-2029-10	1.0g
2000Å Bulk CPG							
20-2002-01	20-2012-01	20-2022-01	20-2032-01				0.1g
20-2002-02	20-2012-02	20-2022-02	20-2032-02				0.25g
20-2002-10	20-2012-10	20-2022-10	20-2032-10				1.0g

DEPURINATION RESISTANT CE PHOSPHORAMIDITES

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

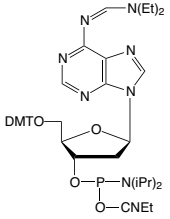
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

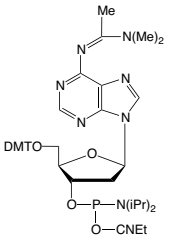
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

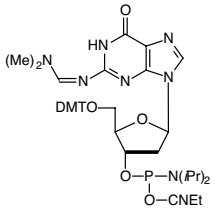
(Please inquire for availability of vials and columns for other instrument types.)



def-dA



dma-dA



dmf-dG

Depurination is defined as the cleavage of the glycosidic bond attaching a purine base to the sugar moiety. Electron withdrawing acyl protecting groups like benzoyl and isobutyryl on the purine amino group(s) destabilize the glycosidic bond, whereas electron donating formamidine protecting groups stabilize the glycosidic bond. The consequence of depurination during oligonucleotide synthesis is the loss of the purine base to form an internucleotide linkage containing the abasic sugar at that position. This site is stable during further synthesis cycles but, upon deprotection with basic reagents, the oligonucleotide is cleaved at that position leading to two shorter fragments. The fragment towards the 5' terminus still contains the DMT group. If DMT-ON purification is being used, the depurinated fragments are co-purified along with the full length product as truncated oligonucleotides.

The most commonly used dA-CE Phosphoramidite containing benzoyl protecting groups suffers substantial degradation by depurination after excessive exposure to TCA. At the same time, two depurination resistant dA monomers, protected with diethylformamidine (def) and dimethylacetamidine (dma), are essentially stable to depurination during the same exposure to TCA.

Both new depurination resistant dA monomers (def and dma protected), were rapidly deprotected in ammonium hydroxide and are fully compatible with regular deprotection strategies. Def-protected-dA was rapidly deprotected with AMA at 65° in 20 minutes, which makes it fully compatible with regular AMA deprotection. In contrast, the dma-protected-dA required 80 minutes with AMA at 65° for complete deprotection.

Dmf-dG is also a depurination resistant CE Phosphoramidite with the isobutyryl group of the original monomer replaced with dimethylformamidine (dmf).

Although depurination does occur in regular oligonucleotide synthesis, the degradation is at an extremely low level. However in certain other circumstances, depurination may become more significant, such as synthesis of long oligos, chip-based synthesis, and large-scale synthesis.

Item	Catalog No.	Pack
def-dA-CE Phosphoramidite	10-1504-02	0.25g
	10-1504-05	0.5g
	10-1504-10	1.0g
dmf-dG-CE Phosphoramidite	10-1029-02	0.25g
	10-1029-05	0.5g
	10-1029-10	1.0g
	10-1029-20	2.0g
	10-1029-40	4.0g

ULTRAMILD CE PHOSPHORAMIDITES

An alternative protecting scheme for the normal CE phosphoramidites should allow UltraMILD deprotection and should not react with a wider variety of tags and labels. A set of monomers using phenoxyacetyl (Pac) protected dA and 4-isopropyl-phenoxyacetyl (iPr-Pac) protected dG, along with acetyl protected dC, met the desired criteria for UltraMILD deprotection.

We recommend the use of phenoxyacetic anhydride (Pac_2O) in Cap A,which removes the possibility of exchange of the iPr-Pac protecting group on the dG with acetate from the acetic anhydride capping mix. Cleavage and deprotection can be carried out in 2 hours at room temperature with ammonium hydroxide or 4 hours with 0.05M potassium carbonate in methanol.

Item	Catalog No.	Pack
Pac-dA-CE Phosphoramidite	10-1601-02	0.25g
	10-1601-05	0.5g
	10-1601-10	1.0g
Ac-dC-CE Phosphoramidite	10-1015-02	0.25g
	10-1015-05	0.5g
	10-1015-10	1.0g
iPr-Pac-dG-CE Phosphoramidite	10-1621-02	0.25g
	10-1621-05	0.5g
	10-1621-10	1.0g

ULTRAMILD SUPPORTS

Item	Catalog No. Pac-dA	Catalog No. Ac-dC	Catalog No. iPr-Pac-dG	Pack
UltraMild CPG (Bulk)	20-2601-01	Listed	20-2621-01	0.1g
	20-2601-02	on	20-2621-02	0.25g
	20-2601-10	Page 8	20-2621-10	1.0g
ABI Columns	20-2701-45	20-2115-45	20-2721-45	4X40nm
	20-2701-42	20-2115-42	20-2721-42	4X0.2µm
	20-2701-41	20-2115-41	20-2721-41	4X1µm
	20-2701-13	20-2115-13	20-2721-13	10µm
Expedite Columns	20-2801-45	20-2215-45	20-2821-45	4X40nm
	20-2801-42	20-2215-42	20-2821-42	4X0.2µm
	20-2801-41	20-2215-41	20-2821-41	4X1µm
	20-2801-14	20-2215-14	20-2821-14	15µm

ULTRAMILD SOLVENTS/REAGENTS

Item	Catalog No.	Pack
Cap Mix A		
THF/Pyridine/Pac_2O	40-4210-52	200mL
(Applied Biosystems)	40-4210-57	450mL
THF/Pac_2O	40-4212-52	200mL
(Expedite)	40-4212-57	450mL
Deprotection Solution		
0.05M Potassium Carbonate in Methanol	60-4600-30	30mL
	60-4600-52	200mL
	60-4600-57	450mL

RELATED

Universal Support III..... 30

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

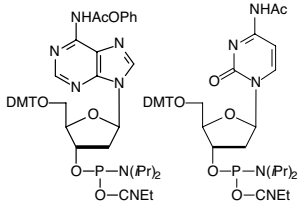
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

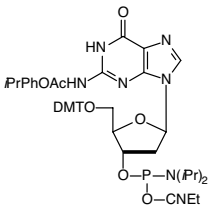
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



Pac-dA Ac-dC



iPr-Pac-dG

GLEN UNYSUPPORT

A recent development has been the use of a support based on a molecule which is "conformationally preorganized" to accelerate the dephosphorylation reaction.[1,2] By using a rigid bicyclic molecule on the support, the rate of elimination is markedly faster than the original Universal Support. The structure of Glen UnySupport™ is shown below. The N-phenyl version, developed at Isis Pharmaceuticals as UnyLinker™, is available from several companies for large scale oligo synthesis. Glen UnySupport is the N-methyl version, which is preferred for high throughput oligonucleotide synthesis since methylamine rather than aniline is formed on deprotection. We are happy to offer Glen UnySupport in a variety of popular formats under license from Ionis Pharmaceuticals.

Item	Catalog No.	Pack
Bulk Supports		
Glen UnySupport (500Å CPG)	20-5040-01	0.1g
	20-5040-02	0.25g
	20-5040-10	1.0g
Glen UnySupport (1000Å CPG)	20-5041-01	0.1g
	20-5041-02	0.25g
	20-5041-10	1.0g
High Load Glen UnySupport	25-5040-01	0.1g
	25-5040-02	0.25g
	25-5040-10	1.0g
Glen UnySupport PS	26-5040-01	0.1g
	26-5040-02	0.25g
	26-5040-10	1.0g
Columns		
The 1000Å columns and frits below are routinely stocked.		
ABI Format (not LV)		
1 µmole columns	20-5141-41	Pack of 4
0.2 µmole columns	20-5141-42	Pack of 4
40 nmole columns	20-5141-45	Pack of 4
10 µmole column (TWIST Format)	20-5141-13	Pack of 1
40 nmole frits	20-5441-95	Pack of 96
Female-Female Luer Adapter for 40 nmole frits	20-0060-00	Pack of 10
ABI 3900 Format		
Glen UnySupport PS		
200 nmole columns	26-5140-52	Pack of 10
40 nmole columns	26-5140-55	Pack of 10
Expedite Format		
1 µmole columns	20-5241-41	Pack of 4
0.2 µmole columns	20-5241-42	Pack of 4
40 nmole columns	20-5241-45	Pack of 4
15 µmole column (TWIST Format)	20-5241-14	Pack of 1
96 Well Format (MerMade, etc.)		
1 µmole columns	20-5141-91	Pack of 96
200 nmole columns	20-5141-92	Pack of 96
40 nmole columns	20-5141-95	Pack of 96

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

REFERENCES

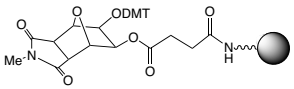
(1) A.P. Guzaev, and M. Manoharan, ***J Am Chem Soc***, 2003, **125**, 2380-2381.
(2) R.K. Kumar, A.P. Guzaev, C. Rentel, and V.T. Ravikumar, ***Tetrahedron***, 2006, **62**, 4528.

ELIMINATION CONDITIONS

Reagent	Conditions
Ammonium hydroxide	80°C/2h 55°C/8h
Ammonium hydroxide/ 40% Methylamine (AMA)	80°C/0.5h 65°C/1h 55°C/8h
Methylamine Gas	65°C/0.5h/30psi
Potassium Carbonate in Methanol	RT/17h
t-Butylamine/Water (1:3 v/v)	60°C/4h

INTELLECTUAL PROPERTY

This product is covered by US Patent 7,202,264 owned by Ionis Pharmaceuticals, Inc..



Glen UnySupport

GLEN UNYSUPPORT FC

The extended time required to cleave the succinate linkage of the original Glen UnySupport can be problematical, especially in high-throughput production of oligos, due to the outgassing of ammonia and/or methylamine. This reduction in concentration of gas can necessitate the evaporation of the cleavage solution and addition of fresh Ammonium Hydroxide:MethylAmine 1:1 (AMA) or ammonium hydroxide (NH_4OH) to ensure complete deprotection and dephosphorylation of the product oligos. Using a diglycolate linkage in Glen UnySupport FC instead of the succinate in Glen UnySupport, a significant increase in the rate of cleavage has been achieved. The minimum cleavage times for both versions are as follows:

	AMA	**NH_4OH**
Glen UnySupport	10 min.	40 min.
Glen UnySupport FC	2 min.	5 min.

With the cleavage time of Glen UnySupport FC reduced to less than 5 minutes, there is minimal loss of volatile gas and, therefore, no need to evaporate the cleavage solution and replenish with fresh AMA or ammonium hydroxide solutions.

We offer Glen UnySupport FC attached to 1000Å CPG in a variety of formats suited to high throughput synthesis, as well as in bulk for more routine use.

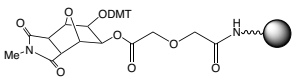
Item	Catalog No.	Pack
Bulk Support		
Glen UnySupport FC (1000Å CPG)	22-5041	Discontinued

ELIMINATION CONDITIONS

Reagent	Conditions
Ammonium hydroxide	80°C/2h 55°C/8h
Ammonium hydroxide/ 40% Methylamine (AMA)	80°C/0.5h 65°C/1h 55°C/8h
Methylamine Gas	65°C/0.5h/30psi
Potassium Carbonate in Methanol	RT/17h
t-Butylamine/Water (1:3 v/v)	60°C/4h

INTELLECTUAL PROPERTY

This product is covered by US Patent 7,202,264 owned by Ionis Pharmaceuticals, Inc..



Glen UnySupport FC

UNIVERSAL SUPPORT III

REFERENCES

(1) A.V. Azhayev, *Tetrahedron*, 1999, **55,** 787-800.
(2) A.V. Azhayev and M. Antopolsky, *Tetrahedron*, 2001, **57,** 4977-4986.

INTELLECTUAL PROPERTY

This product is covered by US Patent No.: 6,770,754 and European Patent No.: 1404695.

CLEAVAGE AND DEPROTECTION

1. Cleavage

For standard and UltraFast deprotection protocols, cleave the oligo from the support using 2M ammonia in methanol at room temperature for 30 minutes. (Only for oligonucleotides greater than 50 nucleotides in length, rinse the support with a further volume of water. Combine the two washes and evaporate to dryness.)

2. Deprotection

Standard
Add 1 volume of 30% ammonium hydroxide, seal and deprotect using the conditions appropriate for removal of the protecting groups on the nucleobases.

UltraFast
Add 1 volume of AMA (ammonium hydroxide/40% aqueous methylamine 1:1) seal and deprotect at 65°C for 10 minutes.

UltraMild Using Ammonium Hydroxide
Add 1 volume of ammonium hydroxide, seal and leave at room temperature for 8 hours.

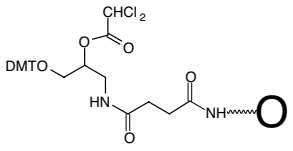
UltraMild Cleavage and Deprotection

Using Potassium Carbonate in Methanol
Cleave the oligo from the support using 50 mM potassium carbonate in methanol at room temperature for 30 minutes. Seal and leave overnight at room temperature.

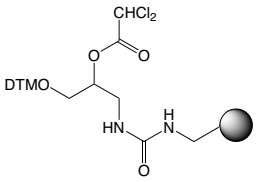
The key step in the use of any universal support in oligonucleotide synthesis is the dephosphorylation of the 3'-phosphate group to form the desired 3'-hydroxyl group. Azhayev[1,2] has excelled in the investigation of neighboring group assistance in the dephosphorylation reaction. Amide groups may be considered to be weak N-H acids and can display basic properties in ammonium hydroxide or aqueous methylamine. In the original work[1,2], (±)-3-amino-1,2-propanediol was used to form a novel universal support (1). A succinate linker attaches the 3-amino group to the support and the 2-OH is protected with a base-labile group to set up an amide assisted elimination in mildly basic conditions. In this way, the dephosphorylation reaction would eliminate the desired 3'-OH oligonucleotide into solution and the product of any ß-elimination competing side reaction would remain bound to the support. A further improvement has been achieved by using a carbamate group to connect the universal linker to the support, as in our product Universal Support III (2). Using Universal Support III, an oligo yield of >80% can be achieved on polymeric supports, with purity equivalent to the same oligo prepared normally.

Conditions for Cleavage and Deprotection are outlined in the table opposite. Universal Support III has been shown to generate oligonucleotides with the same efficacy in polymerase extension reactions as regular oligos. Despite the mild elimination reaction, oligonucleotides up to 75mer in length can be prepared routinely without loss of oligo during the synthesis cycles. This support is also used for the production of siRNA oligos.

Item	Catalog No.	Pack
Bulk Support		
Universal Support III PS	26-5010-01	0.1g
	26-5010-02	0.25g
	26-5010-10	1.0g
ABI Format (not LV)		
Universal Support III PS		
1 µmole columns	26-5110-41	Pack of 4
0.2 µmole columns	26-5110-42	Pack of 4
40 nmole columns	26-5110-45	Pack of 4
10 µmole column (TWIST Format)	26-5110-13	Pack of 1
Expedite Format		
1 µmole columns	26-5210-41	Pack of 4
0.2 µmole columns	26-5210-42	Pack of 4
40 nmole columns	26-5210-45	Pack of 4
15 µmole column (TWIST Format)	26-5210-14	Pack of 1
96 Well Format (MerMade, etc.)		
Universal Support III PS		
1 µmole columns	26-5110-91	Pack of 96
200 nmole columns	26-5110-92	Pack of 96
40 nmole columns	26-5110-95	Pack of 96
ABI 3900 Format		
Universal Support III PS		
200 nmole columns	26-5110-52	Pack of 10
40 nmole columns	26-5110-55	Pack of 10



Universal Support (1)



Universal Support III (2)

Q-SUPPORTS

Oligonucleotides are routinely prepared on supports to which the first nucleoside is attached via a succinate linkage. Over the years, the succinate linkage has demonstrated stability during the synthesis process but has sufficient lability to be cleaved quickly in the deprotection step. However, if the cleavage step is carried out with ammonium hydroxide manually or on the synthesizer, it consumes one hour of precious time while releasing only about 80% of the oligonucleotide. This step is, therefore, a bottleneck in the productivity of many synthesis groups.

Is it possible to find a replacement to the succinate group which offers good stability to the synthesis reagents while offering a much faster cleavage step? The oxalate group has been shown to be very labile during cleavage but its stability to the normal synthesis reagents is not good, requiring changes for successful use. In a practical but elegant study[1] of various bifunctional carboxylic acids, Richard Pon's group identified hydroquinone-O,O'-diacetic acid as the most satisfactory alternative to the succinate group. Nucleosides with this linker arm (Q-linker) are attached to supports with the same ease as the succinyl linker arm.

The cleavage time in ammonium hydroxide at room temperature was found to be 2 minutes, but what about the stability during synthesis? How significant was premature cleavage of oligonucleotide on the synthesizer because of the basic reagents in the capping mixes and oxidizer? Pon showed that the Q-linker is stable to the capping reagents but very slightly labile to the oxidizer (8% cleavage in overnight exposure which would correspond to about 2,000 normal synthesis cycles).

We tested the significance of premature cleavage by preparing sixteen 20mer oligonucleotides on a 0.2µmole scale, eight with succinate and eight with Q-linkers. The succinate supported oligos were cleaved for 1 hour at room temperature, while those on the Q-support were cleaved for 2 minutes. Both sets were then deprotected normally with ammonium hydroxide. The Q-supports actually gave 5% better yields of product than the succinate supports. Oligo purities were equivalent in both sets.

The Q-linker is absolutely compatible with all hydrolytic cleavage procedures, but especially mild procedures like potassium carbonate in methanol. Pon also showed that it is preferable for RNA supports, improving the cleavage time for 2'-silyl protected nucleoside supports from 2 hours (60-65% cleavage) to 5 minutes (95% cleavage).

We are offering Q-linkers of the four regular nucleosides on 500Å CPG in 0.2 and 1µmole scales.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

REFERENCE

(1) R.T. Pon and S.Y. Yu, ***Tetrahedron Lett***, 1997, **38**, 3327-3330.

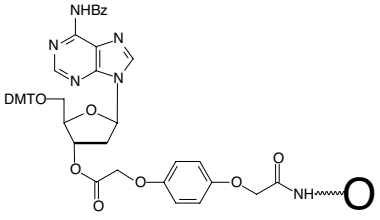
Q/SUCCINATE COMPARISON

Q-Support (2 minutes cleavage)	**Succinate** (60 minutes cleavage)
132 ODU*	125 ODU*

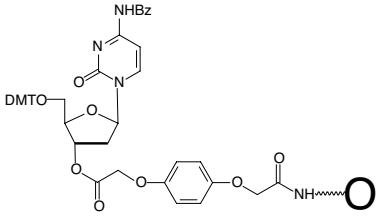
**Average crude yield from eight 1µmole columns deprotected normally.*

Q-SUPPORTS (CONT.)

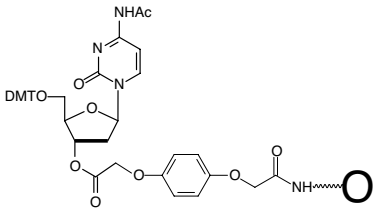
Catalog No. dA	Catalog No. dC	Catalog No. Ac-dC	Catalog No. dmf-dG	Catalog No. dT	Pack
500Å Bulk Support					
21-2000-01	21-2010-01	21-2013-01	21-2029-01	21-2030-01	0.1g
21-2000-02	21-2010-02	21-2013-02	21-2029-02	21-2030-02	0.25g
21-2000-10	21-2010-10	21-2013-10	21-2029-10	21-2030-10	1.0g
ABI Format (not LV)					
21-2100-41	21-2110-41	21-2113-41	21-2129-41	21-2130-41	4X1µm
21-2100-42	21-2110-42	21-2113-42	21-2129-42	21-2130-42	4X0.2µm
Expedite Format					
21-2200-41	21-2210-41	21-2213-41	21-2229-41	21-2230-41	4X1µm
21-2200-42	21-2210-42	21-2213-42	21-2229-42	21-2230-42	4X0.2µm



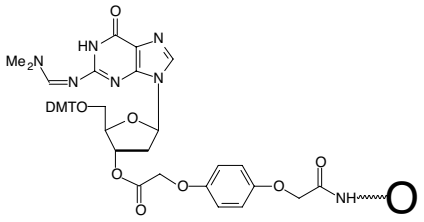
dA-Q



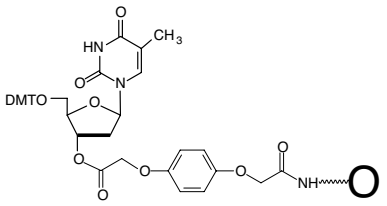
dC-Q



Ac-dC-Q



dmf-dG-Q

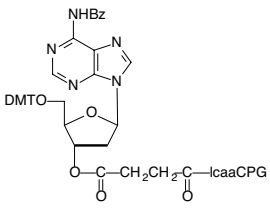


dT-Q

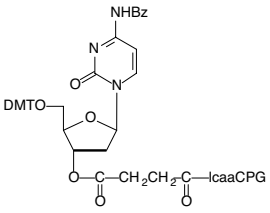
HIGH LOAD CPG

Our high loading support is based on controlled pore silica and it retains the usual 500Å pores. The spacer is also conventional. The only significant difference is the loading which is in the range 80 - 130µmoles/g or about 2.5 times the loading of normal 500Å CPG. Typical loadings for our high load CPG are in the 100 - 120µmoles/g range. As a consequence of the high loading, this support should not be used for sequences longer than 40mers. This high loading support is available in columns for most synthesizers. The 2.5µmole column is identical to our standard 1µmole column (with the exception of the loading). It should be used on occasions when greater than 1µmole is desired but when a 10 or 15µmole synthesis is too high. It should be run using the 1µmole cycle. The 25µmole column is identical to the 10µmole column used on Applied Biosystems synthesizers. It is run using the 10µmole cycle. The 35µmole column is used as an alternative to the 15µmole Expedite column. Again no changes to the standard cycle are recommended. The support is of course available in bulk for use on large-scale synthesizers. A word of caution is in order. When using a column with a higher load than recommended by the instrument manufacturer, there is a much smaller margin for error. All reagents must be fresh and anhydrous diluent and activator must be used. Should you decide to prepare higher-loading columns, ensure that the molar excess of monomer to support nucleoside is at least 5X and preferably 10X.

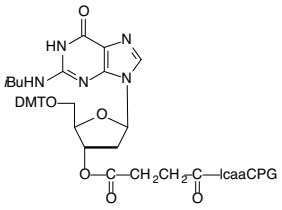
Item	Catalog No. dA	Catalog No. dC	Catalog No. dG	Catalog No. dT	Pack
Columns					
(ABI)	25-2100-46	25-2110-46	25-2120-46	25-2130-46	4X2.5µm
	25-2100-17	25-2110-17	25-2120-17	25-2130-17	1X25µm
(Expedite)	25-2200-46	25-2210-46	25-2220-46	25-2230-46	4X2.5µm
	25-2200-18	25-2210-18	25-2220-18	25-2230-18	1X35µm
Bulk					
	25-2000-02	25-2010-02	25-2020-02	25-2030-02	0.25g
	25-2000-10	25-2010-10	25-2020-10	25-2030-10	1.0g



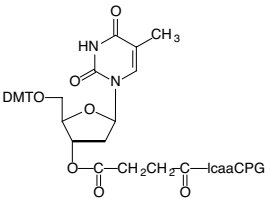
dA-CPG



dC-CPG



dG-CPG



dT-CPG

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

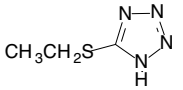
RELATED

Glen UnySupport..... 28

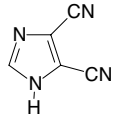
ALTERNATIVE SOLVENTS/REAGENTS

ABBREVIATIONS

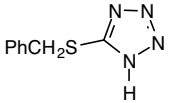
Ac_2O = Acetic Anhydride
DCA = Dichloroacetic Acid
DCM = Dichloromethane
DMAP = Dimethylaminopyridine
I_2 = Iodine
MeIm = 1-Methylimidazole
TCA = Trichloroacetic Acid
THF = Tetrahydrofuran



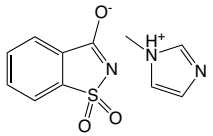
5-Ethylthio-1H-tetrazole



DCI



5-Benzylthio-1H-tetrazole



Saccharin 1-Methylimidazole

INTELLECTUAL PROPERTY

SMI is sold under license from Avecia Biotechnology Inc.

Glen Research offers alternative solvents and reagents in suitable bottles and formulations for use on various DNA synthesizers. All solvents and reagents are prepared to our exacting specifications to ensure the highest coupling efficiencies and are passed through a 0.2 micron filter during packaging to eliminate particulate contamination. Glen Research offers the activators below in powder form for later dissolution in anhydrous acetonitrile or as a prepared solution.

Item	Catalog No.	Pack
Activator		
5-Ethylthio-1H-tetrazole (ETT)	30-3040-10	1g
(Dissolve 1g in 31mL anhydrous	30-3040-20	2g
acetonitrile for a 0.25M solution)	30-3040-25	25g
0.25M 5-Ethylthio-1H-tetrazole in Acetonitrile	30-3140-45	45mL
(Applied Biosystems)	30-3140-52	200mL
	30-3140-57	450mL
	30-3140-62	2L
(Expedite)	30-3142-52	200mL
	30-3140-57	450mL
4,5-Dicyanoimidazole (DCI), crystalline	30-3050-10	1g
(Dissolve 1g in 34mL anhydrous	30-3050-25	25g
acetonitrile for a 0.25M solution)		
4,5-Dicyanoimidazole (DCI)	30-3060-50	5g
(Dissolve 1g in 34mL anhydrous	30-3060-30	30g
acetonitrile for a 0.25M solution)	30-3060-K5	500g
	30-3060-1K	1000g
0.25M ,5-Dicyanoimidazole (DCI) in Acetonitrile	30-3150-45	45mL
(Applied Biosystems)	30-3150-52	200mL
	30-3150-57	450mL
	30-3150-62	2L
(Expedite)	30-3152-52	200mL
	30-3150-57	450mL
5-Benzylthio-1H-tetrazole (BTT)	30-3070-10	1g
(Dissolve 1g in 21.3mL anhydrous	30-3070-20	2g
acetonitrile for a 0.25M solution)	30-3070-25	25g
0.25M 5-Benzylthio-1H-tetrazole in Acetonitrile	30-3170-45	45mL
(Applied Biosystems)	30-3170-52	200mL
	30-3170-57	450mL
	30-3170-62	2L
(Expedite)	30-3172-52	200mL
	30-3170-57	450mL
Saccharin 1-Methylimidazole (SMI)	30-3080	Discontinued
	30-3180	Discontinued
	30-3182	Discontinued

ALTERNATIVE SOLVENTS/REAGENTS (CONT.)

Item	Catalog No.	Pack
Cap Mix A		
Tetrahydrofuran/2,6-Lutidine/Acetic Anhydride	40-4010-52	200mL
	40-4010-57	450mL
	40-4010-62	2L
Tetrahydrofuran/Acetic Anhydride (9:1)	40-4012-62	2L
Cap Mix B		
6.5% Dimethylaminopyridine in Tetrahydrofuran *(Cap B solutions containing DMAP are preferred by some researchers for preparing long oligos.)*	40-4020-52	200mL
10% 1-Methylimidazole in Tetrahydrofuran	40-4120-52	200mL
	40-4120-57	450mL
	40-4120-62	2L
10% 1-Methylimidazole in Tetrahydrofuran/Pyridine (8:1)	40-4122-62	2L
Oxidizing Solution		
0.02M Iodine in Tetrahydrofuran/Pyridine/Water (70:20:10)	40-4132-62	2L
0.02M Iodine in Tetrahydrofuran/Pyridine/Water (88:20:2) (Low-Water Oxdizer)	40-4032-52	200mL
	40-4032-52E	200mL
	40-4032-57	450mL
	40-4032-62	2L
Deblocking Mix		
3% Dichloroacetic acid in Dichloromethane *[Dichloroacetic acid (DCA) solutions are more mildly acidic than the* Trichloroacetic (*TCA) equivalents, possibly causing less depurination of dA sites.)*	40-4040-57	450mL
	40-4040-62	2L
2.5% *Dichloroacetic acid* in Dichloromethane	40-4042-57	450mL
	40-4042-62	2L

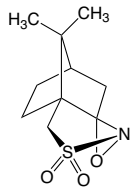
CSO FOR NON-AQUEOUS OXIDATION

RELATED

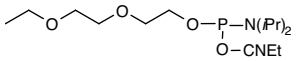
0.1M CSO in PACE Chemistry.....41

INTELLECTUAL PROPERTY

This capping reagent is supplied under license.



CSO



UniCap Phosphoramidite

Iodine-based oxidizers have been the standard for DNA and RNA synthesis since the advent of automated synthesizers. They are fast and efficient oxidizers, typically requiring less than 30 seconds for complete oxidation of phosphite triesters to phosphate triesters. However, while iodine-based oxidizers work well for most applications, there are some circumstances where non-aqueous oxidizers may be advantageous, especially where the bases or linkages being produced are sensitive to the presence of water and/or iodine during synthesis.

The use of (1S)-(+)-(10-camphorsulfonyl)-oxaziridine (CSO) has been investigated as a non-aqueous oxidizer in DNA synthesis. For example, we found that a 0.5M solution of CSO in acetonitrile worked well as an oxidizer for the synthesis of oligos containing multiple incorporations of 7-deaza-dG, compared with iodine oxidation which caused substantial degradation. CSO has also worked well in the synthesis of a long poly-dI oligo, which could not be prepared using iodine oxidation due to the sensitivity of the base.

CSO has been used for synthesizing oligos that incorporate the phosphonoacetate modification. A solution of 0.1M CSO is recommended for the oxidation of PACE modifications as the phosphonite internucleotide linkage is more easily oxidized than the phosphite internucleotide linkage. When synthesizing DNA-phosphonoacetate chimeric oligos, a 0.5M CSO solution is recommended.

Item	Catalog No.	Pack
0.5M CSO in Anhydrous Acetonitrile (ABI)	40-4632-52	200mL
0.5M CSO in Anhydrous Acetonitrile (Expedite)	40-4632-52E	200mL
0.5M CSO in Anhydrous Acetonitrile	40-4632-57	450mL
	40-4632-62	2L

(A minimum oxidation time of 3 minutes is required on small scales.)

UNICAP PHOSPHORAMIDITE

The phosphoramidite of diethylene glycol monoethyl ether, UniCap, is the basis for an alternative capping reagent. To use UniCap as a capping amidite on the Expedite 8909 or AB synthesizers, dilute it to the standard amidite concentration and place the vial in position 5 on the instrument. Cycles can be modified by adding coupling steps for amidite reservoir 5 after the last column coupling step. The standard capping steps can be left out of the cycle. UniCap Phosphoramidite was originally developed for oligo synthesis on the surface of chips and is the capping reagent of choice for this application.

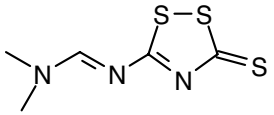
Item	Catalog No.	Pack
UniCap Phosphoramidite	10-4410-02	0.25g
	10-4410-05	0.5g
	10-4410-10	1.0g
	10-4410-20	2.0g

SULFURIZING REAGENTS

Glen Research's Sulfurizing Reagents are used to prepare phosphorothioate linkages using CE phosphoramidite chemistry. Each reagent exhibits the following attributes:

1) Reliably soluble, making them safe to use on automated synthesizers.
2) Reaction is fast (30 seconds), making the process convenient on small scales and readily amenable to scale-up.
3) Process is efficient, with better than 96% of the linkages being phosphorothioate and the remainder being phosphodiester.

Sulfurizing Reagent II (3-((Dimethylamino-methylidene)amino)-3H-1,2,4-dithiazole-3-thione, DDTT) exhibits all the properties of Beaucage Reagent while adding stability in solution on the synthesizer AND offering strong ability to sulfurize RNA linkages. Sulfurizing Reagent II is available in powder form and as a stable solution.



Sulfurizing Reagent II

Item	Catalog No.	Pack
Sulfurizing Reagent II (DDTT)	40-4037-10	1g
(Dissolve at a concentration of 1g/100mL to form an approximate 0.05M solution)	40-4037-20	2g
0.05M Sulfurizing Reagent II (DDTT) in Pyridine/Acetonitrile	40-4137-51	100mL
	40-4137-52	200mL
	40-4137-57	450mL

5’-CE PHOSPHORAMIDITES

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

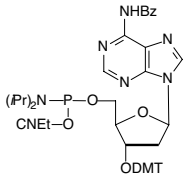
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

Glen Research 5’-CE (ß-cyanoethyl) Phosphoramidites are designed for the production of 5’-5’ or 3’-3’ linkages, useful in antisense studies, or to synthesize oligonucleotide segments in the opposite sense from normal synthesis (Reverse Synthesis), for structural studies. These monomers are packaged in ABI-style vials (see note box).

Item	Catalog No.	Pack
dA-5’-CE Phosphoramidite	10-0001-02	0.25g
	10-0001-05	0.5g
	10-0001-10	1.0g
dC-5’-CE Phosphoramidite	10-0101-02	0.25g
	10-0101-05	0.5g
	10-0101-10	1.0g
dmf-dG-5’-CE Phosphoramidite	10-9201-02	0.25g
	10-9201-05	0.5g
	10-9201-10	1.0g
dT-5’-CE Phosphoramidite	10-0301-02	0.25g
	10-0301-05	0.5g
	10-0301-10	1.0g



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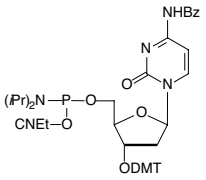

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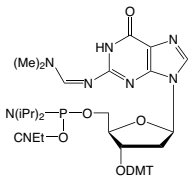
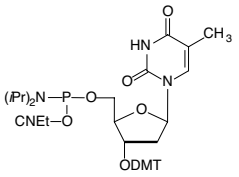


Dmf-dG-5’-CE Phosphoramidite

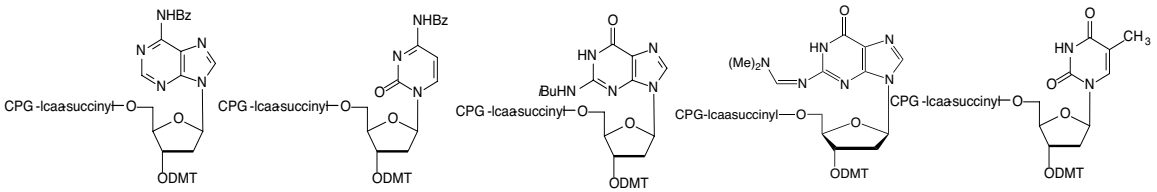


dT-5’-CE Phosphoramidite

5’-SUPPORTS

The following supports are used to produce oligonucleotides with nuclease resistant 3’-3’ linkages at the 3’ terminus (by attaching regular 3’-CE phosphoramidites) or to produce oligonucleotide sections in the opposite sense (by attaching 5’-CE phosphoramidites). ABI-style columns are supplied unless otherwise requested (see note box).

Item	Catalog No.	Pack
dA-5’-CPG	20-0002-01	0.1g
	20-0002-10	1.0g
1 µmole columns	20-0012-41	Pack of 4
0.2 µmole columns	20-0012-42	Pack of 4
10 µmole column (ABI)	20-0012-13	Pack of 1
15 µmole column (Expedite)	20-0012-14	Pack of 1
dC-5’-CPG	20-0102-01	0.1g
	20-0102-10	1.0g
1 µmole columns	20-0112-41	Pack of 4
0.2 µmole columns	20-0112-42	Pack of 4
10 µmole column (ABI)	20-0112-13	Pack of 1
15 µmole column (Expedite)	20-0112-14	Pack of 1
dG-5’-CPG	20-0202-01	0.1g
	20-0202-10	1.0g
1 µmole columns	20-0212-41	Pack of 4
0.2 µmole columns	20-0212-42	Pack of 4
10 µmole column (ABI)	20-0212-13	Pack of 1
15 µmole column (Expedite)	20-0212-14	Pack of 1
dmf-dG-5’-CPG	20-9202-01	0.1g
	20-9202-10	1.0g
1 µmole columns	20-9212-41	Pack of 4
0.2 µmole columns	20-9212-42	Pack of 4
10 µmole column (ABI)	20-9212-13	Pack of 1
15 µmole column (Expedite)	20-9212-14	Pack of 1
dT-5’-CPG	20-0302-01	0.1g
	20-0302-10	1.0g
1 µmole columns	20-0312-41	Pack of 4
0.2 µmole columns	20-0312-42	Pack of 4
10 µmole column (ABI)	20-0312-13	Pack of 1
15 µmole column (Expedite)	20-0312-14	Pack of 1



METHYL PHOSPHONAMIDITES

Methyl Phosphonamidites may be used in DNA synthesizers following conventional CE Phosphoramidite protocols to produce oligonucleotides containing one or more methyl phosphonate linkages. However, deprotection and purification techniques differ and a description of the procedures is included in the Technical Bulletin. We also offer the dC monomer with acetyl base protection.[1] This protecting group is removed with ammonium hydroxide during the cleavage step, eliminating modification at the dC sites during the deprotection step using ethylenediamine in ethanol.

Item	Catalog No.	Pack
dA-Me Phosphonamidite	10-1100-02	0.25g
	10-1100-05	0.5g
Ac-dC-Me Phosphonamidite	10-1115-02	0.25g
	10-1115-05	0.5g
dG-Me Phosphonamidite	10-1120-02	0.25g
	10-1120-05	0.5g
dT-Me Phosphonamidite	10-1130-02	0.25g
	10-1130-05	0.5g

REFERENCE

(1) M.P. Reddy, F. Farooqui, and N.B. Hanna, Tetrahedron Lett., 1996, 37, 8691-8694.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

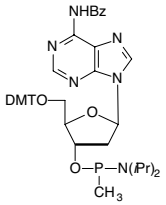
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

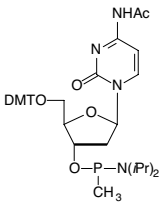
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



dA-Me Phosphonamidite



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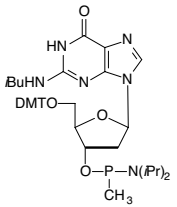
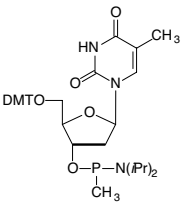


dG-Me Phosphonamidite



dT-Me Phosphonamidite

PACE PHOSPHORAMIDITES

Phosphonoacetate (PACE) modified oligonucleotides show great potential as biological modifiers in a wide variety of research applications. PACE monomers are part of a family of Phosphonocarboxylate monomers. The monomers can be easily incorporated into complex oligonucleotides and are compatible with a wide variety of other sugar or heterobase modifications. PACE DNA can be conjugated through the carboxylic acid functional group. They have been shown to be active in siRNA duplexes and accelerate the initial rate of cleavage by RNase H-1 when incorporated with phosphorothioates. However, the most interesting observation to date is that they exhibit an unprecedented enhancement in penetration of cultured cells.

PACE monomers are fully soluble in acetonitrile at a recommended concentration of 0.1M and are compatible with standard DNA synthesizers. As an optimal cycle, we recommend using DCI as an activator (30-3150-XX) and a 15 minute coupling time. Following coupling, cap using Unicap (10-4410-XX) with a regular coupling time and then oxidize using 0.5M CSO for 3 minutes. Alternatively, a 33 minute coupling time using 0.45M tetrazole, oxidation using low-water iodine (40-4032-XX) followed by capping with 6.5% DMAP as Cap B will give acceptable results. For deprotection, pre-treat the synthesis column with 1.5% DBU in anhydrous acetonitrile for 60 minutes at room temperature to remove 1,1-dimethyl-2-cyanoethyl protecting groups. Rinse the column with acetonitrile, dry under argon and complete the deprotection with 40% aqueous methylamine for 2 hours at room temperature.

Item	Catalog No.	Pack
dA-PACE Phosphoramidite	10-1140	Discontinued
Ac-dC-PACE Phosphoramidite	10-1150	Discontinued
dG-PACE Phosphoramidite	10-1160	Discontinued
dT-PACE Phosphoramidite	10-1170	Discontinued

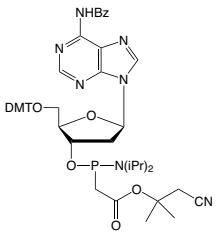
INTELLECTUAL PROPERTY

These products are covered by patents, US 6,693,187 and 7,067,641, and patents pending owned by Metasense Technologies. Purchase of all or any of these products includes a limited license to use the products solely for the manufacture of oligonucleotides for research use only. This license specifically excludes the use of the product or oligonucleotides containing the product for: (a) therapeutic or diagnostic applications (including kits, pools, libraries and other products or services that incorporate oligonucleotides containing the product), (b) any in vivo toxicity/safety study in support of an investigational new drug application (or foreign counterpart), or (c) resale (including sale of kits, pools, libraries and other products or services that incorporate the product or oligonucleotides containing the product). If such activities have commercial application, a separate license is required from Metasense Technologies. Neither the product nor any product created through its use may be used in human clinical trials.

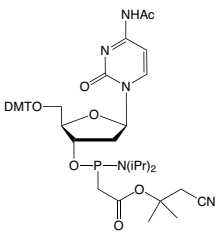
A simple agreement must be signed before end-users and custom oligo services may purchase these products for use as defined above.
https://www.glenresearch.com

RELATED

DCI 34
UniCap 36
0.5M CSO 36
2'-OMe-PACE 149



dA-PACE Phosphoramidite



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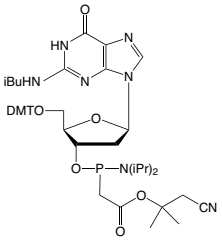
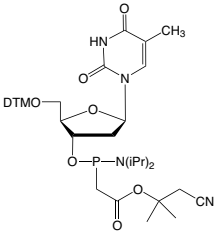


dG-PACE Phosphoramidite



dT-PACE Phosphoramidite

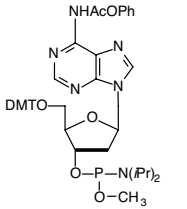
METHYL PHOSPHORAMIDITES

For many years, Glen Research has supplied methyl phosphoramidites in addition to ß-cyanoethyl (CE) phosphoramidites for the few situations where the more labile cyanoethyl group is not an advantage. Some of our customers, probably remembering that the methyl group was removed specifically with thiophenol, have tried to use these monomers to prepare the interesting, uncharged, and nuclease-resistant methyl phosphotriester linkage. Unfortunately, this linkage is labile to ammonium hydroxide and the regular phosphodiester linkage is formed (along with a small amount of chain scission). We offer UltraMild methyl phosphoramidites for this application. Oligos produced from these monomers can be deprotected with potassium carbonate in methanol to produce methyl phosphotriester linkages. Since these linkages are diastereomeric and uncharged, the oligos may be hard to handle. Consequently, it is likely that chimeras will be produced using these monomers along with the regular UltraMild CE phosphoramidites. If many dG residues are included in the oligonucleotide, we recommend the use of phenoxyacetic anhydride (Pac2O) in Cap A. This modification removes the possibility of exchange of the isopropyl-phenoxyacetate (iPr-Pac) protecting group on the dG with acetate from the acetic anhydride capping mix.

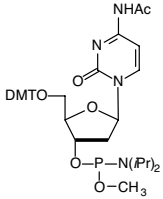
Item	Catalog No.	Pack
Pac-dA-Me Phosphoramidite	10-1301-02	0.25g
	10-1301-05	0.5g
	10-1301-10	1.0g
Ac-dC-Me Phosphoramidite	10-1315-02	0.25g
	10-1315-05	0.5g
	10-1315-10	1.0g
iPr-Pac-dG-Me Phosphoramidite	10-1321-02	0.25g
	10-1321-05	0.5g
	10-1321-10	1.0g
dT-Me Phosphoramidite	10-1330-02	0.25g
	10-1330-05	0.5g
	10-1330-10	1.0g

ULTRAMILD SOLVENTS/REAGENTS

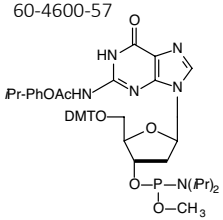
Item	Catalog No.	Pack
Cap Mix A		
THF/Pyridine/Pac_2O	40-4210-52	200mL
(Applied Biosystems)	40-4210-57	450mL
THF/Pac_2O	40-4212-52	200mL
(Expedite)	40-4212-57	450mL
Deprotection Solution		
0.05M Potassium Carbonate in Methanol	60-4600-30	30mL
	60-4600-52	200mL
	60-4600-57	450mL



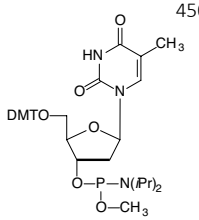
Pac-dA-Me Phosphoramidite



Ac-dC-Me Phosphoramidite



iPr-Pac-dG-Me Phosphoramidite



dT-Me Phosphoramidite

H-PHOSPHONATE MONOMERS

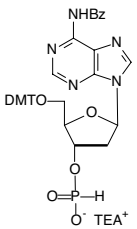
Our H-Phosphonate line has been discontinued. Please contact Glen Support.

Item	Catalog No.	Pack
dA-H-Phosphonate, TEA Salt	10-1200	Discontinued
dC-H-Phosphonate, DBU Salt	10-1210	Discontinued
dG-H-Phosphonate, TEA Salt	10-1220	Discontinued
dT-H-Phosphonate, TEA Salt	10-1230	Discontinued

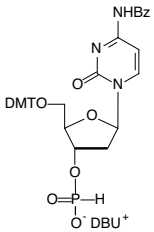
H-PHOSPHONATE REAGENTS

Our H-Phosphonate solvents and reagents have been discontinued. H-Phosphonate reagents are easily prepared using high purity products and the formulations shown below.

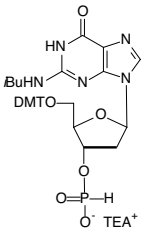
Item
1-Adamantanecarbonyl chloride is available from Aldrich, Catalog No. 117722. Dilute to 0.1M. *(Activator for monomers and capping reagent)*
Acetonitrile/Pyridine (50:50), anhydrous *(Monomer Diluent)*
Acetonitrile/Pyridine (95:5), anhydrous *(Activator Diluent)*
1% Isopropyl Phosphite in Acetonitrile/Pyridine (50:50) *(Capping Reagent)*
Acetonitrile/Pyridine (50:50) *(Neutralizer and Wash Solvent)*
4% I_2 in Pyridine/H_2O/THF (10:10:80) THF/H_2O/TEA (80:10:10) *(Both reagents are required for oxidation of H-phosphonate linkages)*



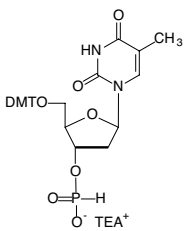
dA-H-Phosphonate



dC-H-Phosphonate



dG-H-Phosphonate



dT-H-Phosphonate

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

ABBREVIATIONS

I_2 = Iodine
TEA = Triethylamine
THF = Tetrahydrofuran

BETA-L-DNA MONOMERS

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

REFERENCES

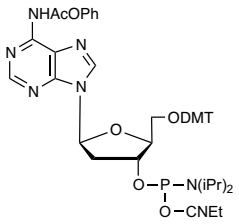
(1) J. Nielsen, W.K.D. Brill, and M.H. Caruthers, ***Tetrahedron Letters***, 1988, **29**, 2911-2914.
(2) L. Cummins, D. Graff, G. Beaton, W.S. Marshall, and M.H. Caruthers, ***Biochemistry***, 1996, **35**, 8734-41.
(3) X. Yang, and D.G. Gorenstein, ***Curr Drug Targets***, 2004, **5**, 705-15.
(4) W.S. Marshall, and M.H. Caruthers, ***Science***, 1993, **259**, 1564-70.
(5) J.L. Tonkinson, et al., ***Antisense Research and Development***, 1994, **4**, 269-278.
(6) X. Yang, et al., ***Bioorg Med Chem Lett***, 1999, **9**, 3357-62.
(7) X. Yang, et al., ***Ann N Y Acad Sci***, 2006, **1082**, 116-9.
(8) X. Yang, et al., ***Nucleic Acids Res***, 2002, **30**, e132.

RELATED

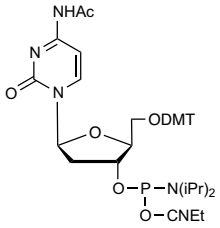
2'-OMe-RNA Thiophosphoramidites..... 39

beta L-DNA is the mirror image version of naturally occurring D-DNA. L-DNA and D-DNA share identical structures that differ only in terms of stereochemistry and generally have identical physical and chemical properties. The difference in their stereochemistry results in differences in their interactions with chiral molecules, D-DNA will only bind to its D-DNA complement to form right-handed helices, and likewise, L-DNA will only bind to its L-DNA complement to form left-handed helices. For this reason, enzymes that interact with D-DNA, including nucleases, typically won't interact with L-DNA. The unique properties of L-DNAs have made them attractive for many biological applications such as Aptamers, Molecular Beacons, Molecular Tagging, and Drug Nanocarriers. Note that the procedure for synthesizing L-DNA oligonucleotides is very similar to that of D-DNA oligonucleotides. Please see our Glen Report version 31.2 for more details.

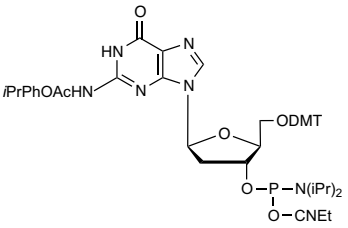
Item	Catalog No.	Pack
beta-L-Pac-dA-CE Phosphoramidite	10-2101-02	0.25g
	10-2101-05	0.5g
	10-2101-10	1.0g
beta-L-Ac-dC-CE Phosphoramidite	10-2115-02	0.25g
	10-2115-05	0.5g
	10-2115-10	1.0g
beta-L-*i*Pr-Pac-dG-CE Phosphoramidite	10-2121-02	0.25g
	10-2121-05	0.5g
	10-2121-10	1.0g
beta-L-dT-CE Phosphoramidite	10-2130-02	0.25g
	10-2130-05	0.5g
	10-2130-10	1.0g



beta-L-Pac-dA



beta-L-Ac-dC



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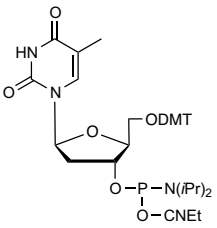

beta-L-dT

LOCKED ANALOG PHOSPHORAMIDITES

Locked Nucleic Acid (LNA) was first described by Wengel and co-workers in 1998[1] as a novel class of conformationally restricted oligonucleotide analogues. LNA is a bicyclic nucleic acid where a ribonucleoside is linked between the 2'-oxygen and the 4'-carbon atoms with a methylene unit. Oligonucleotides containing LNA exhibit unprecedented thermal stabilities towards complementary DNA and RNA[2], which allows excellent mismatch discrimination. In fact, the high binding affinity of LNA oligos allows for the use of short probes in, for example, SNP genotyping[3], allele specific PCR and mRNA sample preparation. LNA is recommended for use in any hybridization assay that requires high specificity and/or reproducibility, e.g., dual labelled probes, in situ hybridization probes, molecular beacons and PCR primers. Furthermore, LNA offers the possibility to adjust Tm values of primers and probes in multiplex assays. LNA can be mixed with DNA and RNA, as well as other nucleic acid analogues, modifiers and labels. LNA oligonucleotides are water soluble, and can be separated by gel electrophoresis and precipitated by ethanol.

Glen Research is pleased to offer these highly useful reagents - Locked Analog (LA) Phosphoramidites - as tools for this technology.

REFERENCES

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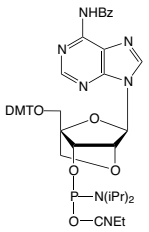
(2) L. Kværnø and J. Wengel, ***Chem. Comm.***, 1999, (7), 657-658.

(3) P. Mouritzen, A.T. Nielsen, H.M. Pfundheller, Y. Choleva, L. Kongsbak, and S. Møller, ***Expert Review of Molecular Diagnostics***, 2003, **3**(1), 27-38.

Item	Catalog No.	Pack
Bz-A-LA-CE Phosphoramidite	10-2000-05	0.5g
	10-2000-10	1.0g
5-Me-Bz-C-LA-CE Phosphoramidite	10-2011-05	0.5g
	10-2011-10	1.0g
dmf-G-LA-CE Phosphoramidite	10-2029-05	0.5g
	10-2029-10	1.0g
T-LA-CE Phosphoramidite	10-2030-05	0.5g
	10-2030-10	1.0g



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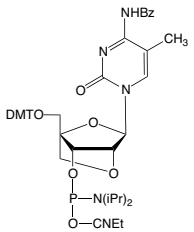

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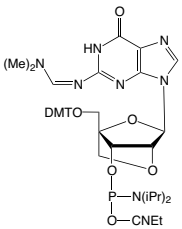

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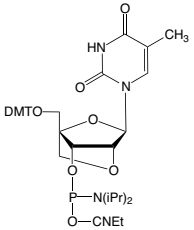

T-LNA

TRIMER PHOSPHORAMIDITES

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(1) A.L. Kayushin, M.D. Korosteleva, A.I. Miroshnikov, W. Kosch, D. Zubov, and N. Piel, ***Nucleic Acids Research***, 1996, **24**, 3748-3755.
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(4) T. Mauriala, S. Auriola, A. Azhayev, A. Kayushin, M. Korosteleva, and A. Miroshnikov, ***J Pharm Biomed Anal,*** 2004, **34**, 199-206.
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(6) L.R. Krumpe, K.M. Schumacher, J.B. McMahon, L. Makowski, and T. Mori, ***BMC Biotechnol***, 2007, **7**, 65-72.
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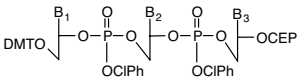


General Structure of Trimer Phosphoramidites, where B=A^{bz}, C^{bz}, G^{ibu}, T

Trimer phosphoramidites[1-4] have proven to be extremely valuable because they allow codon-based mutagenesis, which circumvents the common problems of codon-bias, frame-shift mutations, and the introduction of nonsense or stop codons.[5] This is accomplished by introducing a mixture of all 20 amino acid codons (or subset thereof) at any location within the sequenced to be mutated. This leads to the production of clonal libraries of exceptional diversity with order-of-magnitude increases in amino acid sequence variance while either maintaining a uniform amino acid distribution[6] or one that is biased toward a desired set of amino acids.[7]

However, difficulties arise when trying to introduce mutations in multiple distal regions of a gene simultaneously. The synthesis of long oligonucleotides is required, which inevitably leads to lower sequence fidelity due to deletion mutants, depurination events and, to a lesser extent, mutations arising from deamination of cytidine, for example.

An elegant solution to this problem is the use of Antisense Trimer Phosphoramidites. These trimers are the reverse complement of the cannonical 'sense' codons. When these antisense codons are put into the noncoding strand of a template DNA and amplified by PCR, they will code for the sense codon in the opposite strand of DNA. This allows the powerful technique of PCR Assembly[8] to generate not only kilobase-sized genes from short 50mer oligonucleotides, but to simultaneously mutate multiple distal regions of that gene, as shown in Figure 1.

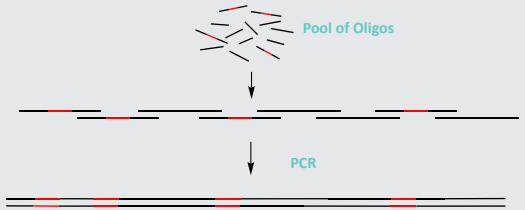
The sense and their corresponding antisense codons are listed in Table 1. Conveniently, many of our existing sense trimers can act as antisense codons. For example, AAC, which codes for asparagine, has the anticodon GTT, which is the sense codon for valine. However, some of the existing trimers, while they can act as an antisense codon, are not good choices for use. For example, TGG, which codes for tryptophan, could be used as an antisense codon for proline because CCA is one of proline's synonymous codons. However, CCA has a relatively low Codon Adaptation Index (CAI) value[9] in E. coli, which could limit protein expression in that commonly used organism. For this reason, the anticodon CGG was chosen for optimal expression in E. coli, as were the other new antisense codons shown in bold in Table 1.

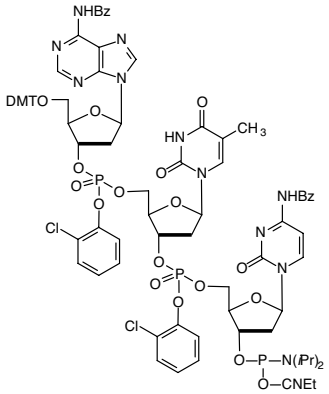
Included in Table 1 are the reaction factors (RFs) for each of the sense and antisense trimers. The reaction factor is critical since the trimers will likely be mixed and they exhibit different rates of reaction when coupling during oligonucleotide synthesis. An example where the RF is used to compensate for differing rates of coupling follows. The RF for AAC is 1.0 and for TAC is 1.6. Therefore, 1.6 equivalents of TAC are needed for every 1.0 equivalent of AAC for equal coupling rates. So to obtain 25 umoles of trimer mix that yields, on average, a 1:1 ratio of AAC/TAC at the mutation site, 9.6 umoles of AAC would be added to 15.4 umoles of TAC.

All of the trimers are available individually so the researchers can prepare custom trimer mixes. Two pre-made catalog trimer mixes are available: 13-1991-xx, for incorporating all 20 amino acid codons equally into a sequence and 13-1992-xx, for incorporating 19 amino acid codons (-Cys). For a custom trimer mix of a particular subset of codons or a trimer mix that represents a set of trimers that is biased toward a particular codon or codons, please contact support@glenresearch.com for a quotation and projected delivery date.

There is a concern that the sequence of the trimers has to be verified. For example, CAT coding for histidine, has to be differentiated from TAC, coding for tyrosine. These two trimers have virtually identical lipophilicity and their identity cannot be clearly confirmed by HPLC. This problem has been solved[4] using HPLC electrospray mass spectrometric analysis of the trimers, which provides data confirming molecular weight and sequence.

Figure 1: Simultaneous Mutation of Multiple Distal Regions of Gene





ATC Trimer

TABLE 1: RF of Trimer Phosphoramidites

Sense codons (5'->3')	*Reaction Factor (RF)*	*Antisense codons (5'->3')*	*Reaction Factor (RF)*
AAA (Lys)	1.10	**TTT**	**1.70**
AAC (Asn)	1.00	GTT	1.90
ACT (Thr)	1.60	GGT	1.10
ATC (Ile)	1.50	**GAT**	**1.40**
ATG (Met)	1.30	CAT	1.30
CAG (Gln)	2.00	CTG	1.20
CAT (His)	1.30	ATG	1.30
CCG (Pro)	1.80	**CGG**	**0.80**
CGT (Arg)	1.40	**GCG**	**0.60**
CTG (Leu)	1.20	CAG	2.00
GAA (Glu)	1.40	TTC	1.30
GAC (Asp)	1.60	ATC	1.50
GCT (Ala)	1.50	TGC	1.50
GGT (Gly)	1.10	**ACC**	**0.90**
GTT (Val)	1.90	AAC	1.00
TAC (Tyr)	1.60	**GTA**	**1.50**
TCT (Ser)	1.30	**AGA**	**1.40**
TGC (Cys)	1.50	**GCA**	**1.00**
TGG (Trp)	1.10	**CCA**	**1.10**
TTC (Phe)	1.30	GAA	1.40

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

Item	Catalog No.	Pack
Sense Trimers		
AAA Trimer Phosphoramidite	13-1000-95	50 µm
(Lys)	13-1000-90	100 µm
AAC Trimer Phosphoramidite	13-1001-95	50 µm
(Asn)	13-1001-90	100 µm
ACT Trimer Phosphoramidite	13-1013-95	50 µm
(Thr)	13-1013-90	100 µm
ATC Trimer Phosphoramidite	13-1031-95	50 µm
(Ile)	13-1031-90	100 µm
ATG Trimer Phosphoramidite	13-1032-95	50 µm
(Met)	13-1032-90	100 µm
CAG Trimer Phosphoramidite	13-1102-95	50 µm
(Gln)	13-1102-90	100 µm
CAT Trimer Phosphoramidite	13-1103-95	50 µm
(*His)*	13-1103-90	100 µm
CCG Trimer Phosphoramidite	13-1112-95	50 µm
(Pro)	13-1112-90	100 µm
CGT Trimer Phosphoramidite	13-1123-95	50 µm
(Arg)	13-1123-90	100 µm
CTG Trimer Phosphoramidite	13-1132-95	50 µm
(Leu)	13-1132-90	100 µm
GAA Trimer Phosphoramidite	13-1200-95	50 µm
(Glu)	13-1200-90	100 µm
GAC Trimer Phosphoramidite	13-1201-95	50 µm
(Asp)	13-1201-90	100 µm
GCT Trimer Phosphoramidite	13-1213-95	50 µm
(Ala)	13-1213-90	100 µm
GGT Trimer Phosphoramidite	13-1223-95	50 µm
(Gly)	13-1223-90	100 µm
GTT Trimer Phosphoramidite	13-1233-95	50 µm
(Val)	13-1233-90	100 µm
TAC Trimer Phosphoramidite	13-1301-95	50 µm
(Tyr)	13-1301-90	100 µm
TCT Trimer Phosphoramidite	13-1313-95	50 µm
(Ser)	13-1313-90	100 µm
TGC Trimer Phosphoramidite	13-1321-95	50 µm
(Cys)	13-1321-90	100 µm
TGG Trimer Phosphoramidite	13-1322-95	50 µm
(Trp)	13-1322-90	100 µm
TTC Trimer Phosphoramidite	13-1331-95	50 µm
(Phe)	13-1331-90	100 µm
Trimer Phosphoramidite Mix 1	13-1991-95	50 µm
(Mix of above 20 trimers)	13-1991-90	100 µm
Trimer Phosphoramidite Mix 2	13-1992-95	50 µm
(Mix of above 20 trimers less TGC-Cys)	13-1992-90	100 µm

Item	Catalog No.	Pack
Antisense Trimers		
AAC Trimer Phosphoramidite	13-1001-95	50 µm
(Anti Val)	13-1001-90	100 µm
ACC Trimer Phosphoramidite	13-1011-95	50 µm
(Anti Gly)	13-1011-90	100 µm
AGA Trimer Phosphoramidite	13-1020-95	50 µm
(Anti Ser)	13-1020-90	100 µm
ATC Trimer Phosphoramidite	13-1031-95	50 µm
(Anti Asp)	13-1031-90	100 µm
ATG Trimer Phosphoramidite	13-1032-95	50 µm
(Anti His)	13-1032-90	100 µm
CAG Trimer Phosphoramidite	13-1102-95	50 µm
(Anti Leu)	13-1102-90	100 µm
CAT Trimer Phosphoramidite	13-1103-95	50 µm
(*Anti Met)*	13-1103-90	100 µm
CCA Trimer Phosphoramidite	13-1110-95	50 µm
(Anti Trp)	13-1110-90	100 µm
CGG Trimer Phosphoramidite	13-1122-95	50 µm
(Anti Pro)	13-1122-90	100 µm
GAA Trimer Phosphoramidite	13-1200-95	50 µm
(Anti Phe)	13-1200-90	100 µm
GAT Trimer Phosphoramidite	13-1203-95	50 µm
(Anti Ile)	13-1203-90	100 µm
GCA Trimer Phosphoramidite	13-1210-95	50 µm
(Anti Cys)	13-1210-90	100 µm
GCG Trimer Phosphoramidite	13-1212-95	50 µm
(Anti Arg)	13-1212-90	100 µm
GGT Trimer Phosphoramidite	13-1223-95	50 µm
(Anti Thr)	13-1223-90	100 µm
GTA Trimer Phosphoramidite	13-1230-95	50 µm
(Anti Tyr)	13-1230-90	100 µm
TGC Trimer Phosphoramidite	13-1321-95	50 µm
(Anti Ala)	13-1321-90	100 µm
TTC Trimer Phosphoramidite	13-1331-95	50 µm
(Anti Glu)	13-1331-90	100 µm
TTT Trimer Phosphoramidite	13-1333-95	50 µm
(Anti Lys)	13-1333-90	100 µm

BASES AFFECTING DUPLEX STABILITY

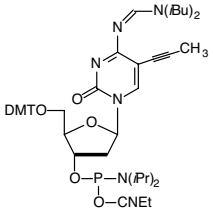
Substitution of C-5 propynyl-dC (pdC) for dC and C-5 propynyl-dU (pdU) for dT are effective strategies to enhance base pairing. Using these base substitutions, duplex stability and melting temperatures are raised by the following amounts: C-5 propynyl-C 2.8° per substitution; C-5 propynyl-U 1.7° per substitution. AP-dC (G-clamp) substitutes for dC and is another very important modified nucleoside that enhances hybridization by 7-21° per substitution depending upon the sequence and location of the AP-dC. The ability of these modified bases to enhance binding while maintaining specificity has proven useful in antisense research and in the synthesis of high affinity probes. AP-dC is also a fluorescent nucleoside and should find uses in DNA structural research.

dW is a C-nucleoside that acts as a strong adenine base paring analog. In addition to the typical two hydrogen bonds found between T and A, dW can also interact with A via van der Waals forces. The result is a dW–A interaction that approaches the strength of a C–G base pair while also exhibiting enhanced base-pairing fidelity. dW can be used in place of T as a single substitution or a complete replacement for oligonucleotide hybridization applications.

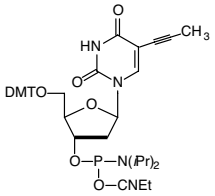
Item	Catalog No.	Pack
pdC-CE Phosphoramidite	10-1014-90	100 µmole
	10-1014-02	0.25g
	10-1014-05	0.5g
pdU-CE Phosphoramidite	10-1054-90	100 µmole
	10-1054-02	0.25g
	10-1054-05	0.5g
AP-dC-CE Phosphoramidite (G-Clamp)	10-1097-95	50 µmole
	10-1097-90	100 µmole
	10-1097-02	0.25g
dW-CE Phosphoramidite	10-1527-95	50 µmole
	10-1527-90	100 µmole
	10-1527-02	0.25g

C-5 methyl pyrimidine nucleosides are known to stabilize duplexes relative to the non-methylated bases. Therefore, enhanced binding can be achieved using 5-methyl-dC in place of dC, duplex melting temperature being increased by 1.3°. Ac-5-Me-dC-CE Phosphoramidite is fully compatible with AMA deprotection and none of the N4-Me transamination mutant is observed on deprotection.

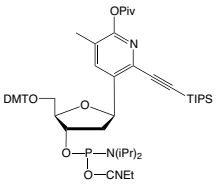
Item	Catalog No.	Pack
5-Me-dC-CE Phosphoramidite	10-1060-90	100 µmole
	10-1060-02	0.25g
Ac-5-Me-dC-CE Phosphoramidite	10-1560-90	100 µmole
	10-1560-02	0.25g



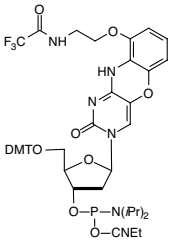
pdC



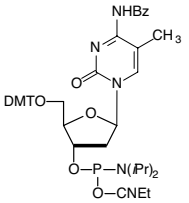
pdU



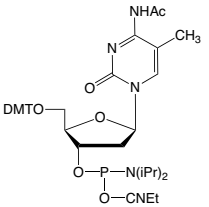
dW



AP-dC



5-Me-dC



Ac-5-Me-dC

BASES AFFECTING DUPLEX STABILITY (CONT.)

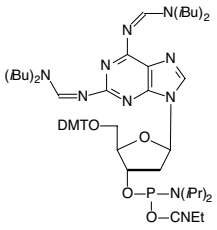
The simplest approach to the design of high affinity primers and probes is to substitute A sites with 2-amino-A, since the 2-amino-A-T base pair is equivalent in strength to the G-T base pair. 2-Amino-A also destabilizes A-G wobble mismatches, thus increasing specificity. In 1998, we introduced a 2-amino-dA monomer which exhibits fast and effective deprotection in ammonium hydroxide and it is stabilized to depurination during synthesis. We now recommend the use of 0.5 M CSO in anhydrous acetonitrile (40-4632-xx) for best results with multiple additions of 2-amino-dA. This is because the bis formamidine protected 2-amino-dA leads to significant strand scission when standard iodine oxidation is used during synthesis. For this reason, we have also added Pac-2-Amino-dA, a monomer with optimized protection to meet the following criteria: stable during oligonucleotide synthesis, oxidation, and detritylation; labile towards common deprotection conditions (NH_3, AMA, $MeNH_2$); and the nucleobase protecting groups are cleaved under fairly mild conditions.

Item	Catalog No.	Pack
2-Amino-dA-CE Phosphoramidite (2,6-diaminopurine)	10-1085-95	50 µmole
	10-1085-90	100 µmole
	10-1085-02	0.25g
Pac-2-Amino-dA-CE Phosphoramidite (2,6-diaminopurine)	10-1585-95	50 µmole
	10-1585-90	100 µmole
	10-1585-02	0.25g

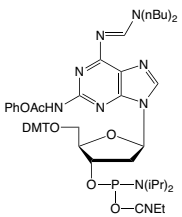
Sequences with high GC content may contain mismatches and still hybridize because of the high stability of the G-C base pair. The N4-ethyl analogue of dC (N4-Et-dC) hybridizes specifically to natural dG but the stability of the base pair is reduced to about the level of an AT base pair.

Coupling N6-Me-dA (10-1003) and N4-Et-dC (10-1068) with 1H-tetrazole leads to a trace of branching at the secondary amine positions, while DCI leads to around 15% branching. In collaboration with Berry and Associates, the acetyl protected monomers were prepared. Acetyl protection was chosen since it would block branching reactions. Oligonucleotides synthesized using these monomers proved to be compatible with all popular deprotection strategies from UltraMild to UltraFast. When the acetyl protected monomers were compared with the unprotected monomers using DCI as activator, branching was reduced from 15% to zero.

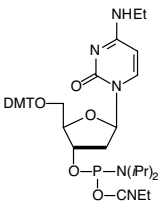
Item	Catalog No.	Pack
N4-Et-dC-CE Phosphoramidite	10-1068-95	50 µmole
	10-1068-90	100 µmole
	10-1068-02	0.25g
N4-Ac-N4-Et-dC-CE Phosphoramidite	10-1513-95	50 µmole
	10-1513-90	100 µmole
	10-1513-02	0.25g
N6-Me-dA-CE Phosphoramidite	10-1003-90	100 µmole
	10-1003-02	0.25g
N6-Ac-N6-Me-dA-CE Phosphoramidite	10-1503-90	100 µmole
	10-1503-02	0.25g



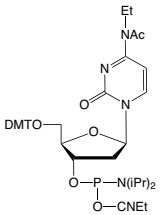
2-Amino-dA



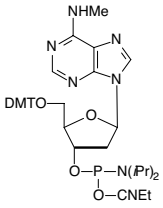
Pac-2-Amino-dA



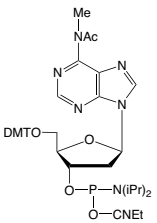
N4-Et-dC



N4-Ac-N4-Et-dC



N6-Me-dA



N6-Ac-N6-Me-dA

RELATED

0.5M CSO 36
N6-Me-dA 39

OTHER INSTRUMENT TYPES

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Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

INTELLECTUAL PROPERTY

"Spermine phosphoramidite" synthon is the subject matter of U.S. Divisional Patent Application No. 14/745,871, European Patent No. 1973927 and foreign equivalents for which Polyplus-transfection is the co-owner. Product is sold for research purposes only. Product shall not be used to manufacture oligospermine-oligonucleotide conjugates for use in diagnostics, clinical or commercial applications including use in humans. There is no implied license to manufacture oligospermine-oligonucleotide conjugates for diagnostic, clinical, or commercial applications, including but not limited to contract research. Please contact Polyplus-transfection at licensing@polyplus-transfection.com to obtain a license for such use.

ZNA® is a registered trademark of Polyplus-transfection SA.

RELATED

CDPI3 MGB™ Labeling 121
2-Amino-dA 51
Pac-2-Amino-dA 51
2-Thio-dT 62
dmf-5-Me-isodC 57
dmf-isodG 57

ZIP NUCLEIC ACIDS (ZNA®)

Spermine phosphoramidite is used to produce oligospermine-oligonucleotide conjugates - Zip Nucleic Acids (ZNA®) Oligos. The name reflects the presumed mode of action. The conjugates are believed to use the oligospermine to seek out and move along (scan) oligonucleotide strands until the probe complementary sequence is located. The oligospermine then performs the function of stabilizing the formed duplex by reducing electrostatic repulsion, thereby leading to significantly increased binding affinities. ZNA® Oligos have found use in the following applications: Multiplex PCR; PCR of AT-rich Regions; RT qPCR; Detection of MicroRNA; Improved SNP Discrimination; and Antisense and Antigene Effects. Spermine phosphoramidite is simple to use in oligonucleotide synthesis and can be added multiple times at the 3' or 5' terminus. Deprotection and isolation are also straightforward. HPLC analysis of the conjugates requires high pH to suppress the ionization of the spermine residues.

Item	Catalog No.	Pack
Spermine Phosphoramidite	10-1939-95	50 µmole
	10-1939-90	100 µmole
	10-1939-02	0.25g

CDPI$_3$ MGB™ LABELING

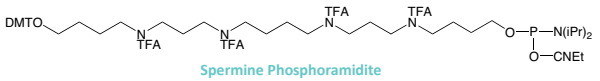
Synthetic oligonucleotides with covalently-attached CDPI$_3$ have enhanced DNA affinity and improved the hybridization properties of sequence-specific DNA probes. Short CDPI$_3$-oligonucleotides hybridize with single-stranded DNA to give more stable DNA duplexes than unmodified ODNs of similar length. The simplest approach to MGB probe design is to use an MGB support, add a quencher molecule as the first addition and complete the synthesis with a 5'-fluorophore. Alternatively, a fluorophore support could be used with the 5' terminus containing a quencher molecule followed by a final MGB addition at the 5' terminus. Glen Research offers 5'-CDPI$_3$ MGB™ Phosphoramidite and 3'-CDPI$_3$ MGB™ CPG.

SELECTIVELY BINDING COMPLEMENTARY (SBC) OLIGOS

SBC oligos exhibit high affinity for natural oligonucleotides but they show little affinity for other SBC oligos even of a complementary sequence. Oligos in which A has been replaced with 2-amino-A and T with 2-thio-T represent an excellent example of SBC oligos. While 2-amino-A forms a very stable base pair with T containing three hydrogen bonds, the stability of the base pair with 2-thio-T is greatly diminished. However, 2-thio-T base pairs perfectly well with A. As an example, SBC 20mers annealed against a DNA 20mer target exhibited Tm values 10 °C higher than the corresponding DNA-DNA hybrid, whereas the SBC-SBC hybrid yielded Tm values 30 °C lower.

UNNATURAL BASE PAIRS

Unnatural base pairs display unique abilities in duplex DNA and in nucleic acid and protein biosyntheses. A standard Watson and Crick base pair is formed between iso-C and iso-G, but the hydrogen bonding pattern is quite different from the natural base pairs A-T and C-G. Iso-bases can, therefore, increase specificity of nucleic acid hydridization when introduced as a third base pair. It has also been demonstrated that iso-bases 5-Me-iso-dC and iso-dG can function as degenerate pyrimidine and purine bases, respectively. Iso-dG further functioned as a degenerate base opposite B (C, T, and G) ambiguous sites.



Spermine Phosphoramidite

CAPS FOR INCREASED DUPLEX STABILITY AND BASE-PAIRING FIDELITY

New cap structures allow for the preparation of hybridization probes with increased affinity for complementary sequences. The monomers used to prepare capped oligonucleotides are phosphoramidites that can be readily introduced via automated DNA synthesis at the end of solid phase syntheses. The caps favor the formation of stable Watson-Crick duplexes by stacking on the terminal base pair (Figures 1 and 2).

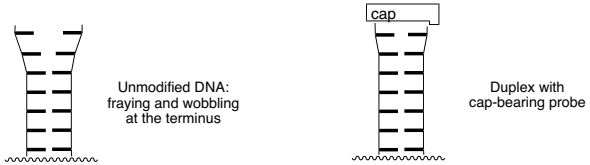


FIGURE 1: STACKING OF CAP ON 5′ TERMINAL BASE PAIR

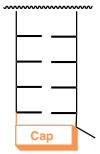
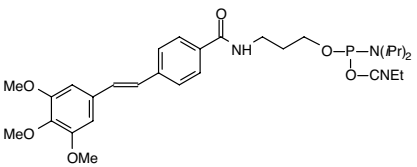


FIGURE 2: STACKING OF Uaq CAP ON 3′ TERMINAL BASE PAIR

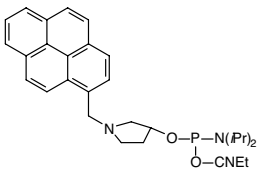
Melting point increases of over 10 °C per modification can be realized for short duplexes.[1,2] The caps fit canonical Watson-Crick base pairs and do not stack well on mismatched base pairs. This leads to increased base pairing selectivity at the terminal and the penultimate position of oligonucleotides featuring the caps. Base pairing fidelity is usually low at the termini, where fraying occurs frequently in the absence of caps. The beneficial effects of the caps are also realized when longer target strands are bound, so there is no need for blunt ends for the duplexes formed.[1,2] The caps, when attached to the 5′ terminus of an oligonucleotide, also facilitate purification as their lipophilicity leads to prolonged retention on reversed phase columns or cartridges. Finally, capping of termini may discourage the degradation of oligonucleotides by exonucleases.

3′-Uaq Cap CPG, a Uridine support modified with a 2′- anthraquinone residue, is the most effective oligonucleotide cap known to date.[3,4] For short hybrid duplexes between DNA probes and RNA target strands, the increase in Tm is up to 18 °C and the modification is effective in increasing the Tm of DNA:DNA, RNA:RNA, and DNA:RNA hybrid duplexes. 3′-Uaq Cap also increases probe specificity by depressing the melting point of terminal mismatches.

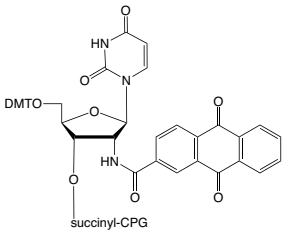
Item	Catalog No.	Pack
5′-Trimethoxystilbene Cap Phosphoramidite	10-1986-90	100 µmole
	10-1986-02	0.25g
5′-Pyrene Cap Phosphoramidite	10-1987-90	100 µmole
	10-1987-02	0.25g
3′-Uaq Cap CPG	20-2980-01	0.1g
	20-2980-10	1.0g
1 µmole columns	20-2980-41	Pack of 4
0.2 µmole columns	20-2980-42	Pack of 4
10 µmole column (ABI)	20-2980-13	Pack of 1
15 µmole column (Expedite)	20-2980-14	Pack of 1



5′-Trimethoxystilbene Cap



5′-Pyrene Cap



3′-Uaq Cap CPG

REFERENCES

(1) Dogan, Z.; Paulini, R.; Rojas Stütz, J. A.; Narayanan, S.; Richert, C. *J. Amer. Chem. Soc.* **2004**, *126*, 4762-4763.
(2) Narayanan, S.; Gall, J.; Richert, C. *Nucleic Acids Res.* **2004**, *32*, 2901-2911.
(3) A. Patra, C. Richert, *J. Amer. Chem. Soc.*, 2009, **131**, 12671-12681.
(4) C. Ahlborn, K. Siegmund, C. Richert, *J. Amer. Chem. Soc.*, 2007, **129**, 15218-15232.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

DNA METHYLATION

RELATED

5-Me-dC.....50
5-hmdU.....65

REFERENCES

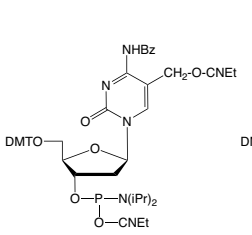
(1) S. Kriaucionis, and N. Heintz, ***Science***, 2009, **324**, 929-30.
(2) M. Tahiliani, et al., ***Science***, 2009, **324**, 930-935.
(3) M. Münzel, et al., ***Angewandte Chemie-International Edition***, 2010, **49**, 5375-5377.
(4) D. Globisch, et al., ***PLoS One***, 2010, **5**, e15367.
(5) S.C. Wu, and Y. Zhang, ***Nat Rev Mol Cell Biol***, 2010, **11**, 607-20.
(6) M. Münzel, D. Globisch, C. Trindler, and T. Carell, ***Org Lett***, 2010, **12**, 5671-3.
(7) A.S. Schroder, et al., ***Angewandte Chemie-International Edition***, 2014, **53**, 315-318.

One of the fastest growing fields in biology and cancer research is epigenetics. While the underlying genetic code defines which proteins and gene products are synthesized, it is epigenetic control that defines when and where they are expressed. This dynamic control of gene expression is essential for X chromosome inactivation, embryogenesis, cellular differentiation and appears integral to memory formation and synaptic plasticity.

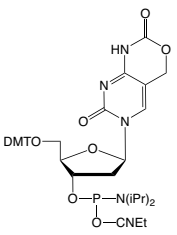
In 2009, two reports[1,2] described the discovery of 5-hydroxymethyl-2'-deoxyCytidine (hmdC), a novel dC modification in Purkinje neurons and embryonic stem cells. Later, a third report found this modification to be strongly enriched in brain tissues associated with higher cognitive functions.[3] This dC modification is generated by the action of α-ketoglutarate dependent ten eleven translocation (TET) enzymes, which oxidizes 5-Me-dC to hmdC. This finding stimulated discussion about active demethylation pathways that could occur, e.g., *via* base excision repair (BER), with the help of specialized DNA glycosylases. Alternatively, one could envision a process in which the hydroxymethyl group of hmdC is further oxidized to 5-formyl-dC (fdC) or 5-carboxy-dC (cadC) followed by elimination of either formic acid or carbon dioxide[4,5].

Glen Research has supported this research since its inception by providing the building blocks for the synthesis of oligonucleotides containing all the new dC derivatives - hmdC, fdC and cadC. The first generation hmdC phosphoramidite was fairly very well accepted but requires fairly harsh deprotection conditions. Therefore, a second generation building block (5-Hydroxymethyl-dC II) developed by Carell and co-workers that is compatible with UltraMild deprotection was introduced.[6] 5-Formyl-dC III has been designed to meet all of the requirements to prepare an oligo containing all of the methylated variants.[7]

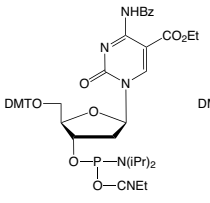
Item	Catalog No.	Pack
5-Hydroxymethyl-dC-CE Phosphoramidite	10-1062-95	50 µmole
	10-1062-90	100 µmole
	10-1062-02	0.25g
5-Carboxy-dC-CE Phosphoramidite	10-1066-95	50 µmole
	10-1066-90	100 µmole
	10-1066-02	0.25g
5-Formyl-dC-CE Phosphoramidite	10-1514-95	50 µmole
	10-1514-90	100 µmole
	10-1514-02	0.25g
5-Hydroxymethyl-dC II-CE Phosphoramidite	10-1510-95	50 µmole
	10-1510-90	100 µmole
	10-1510-02	0.25g
5-Formyl-dC III-CE Phosphoramidite	10-1564-95	50 µmole
	10-1564-90	100 µmole
	10-1564-02	0.25g



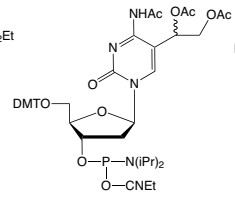
5-Hydroxymethyl-dC



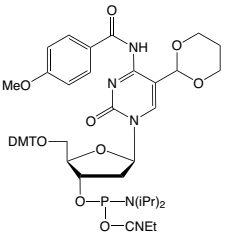
5-Hydroxymethyl-dC II



5-Carboxy-dC



5-Formyl-dC



5-Formyl-dC III

DUPLEX EFFECTS

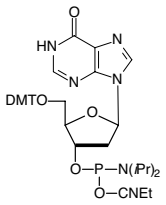
The design of primers is frequently complicated by the degeneracy of the genetic code. Three strategies are now available to confront this problem. In the first, a mixed base addition (N) is used to form the degenerate site. This approach is best if the number of degenerate sites is small. A second option is the use of 2'-deoxyInosine or 2'-deoxyNebularine which exhibit low, but unequal, hydrogen bonding to the other four bases. The third option is the use of a universal nucleoside. In this strategy, the base analog does not hybridize significantly to the other four bases and makes up some of the duplex destabilization by acting as an intercalating agent. 3-Nitropyrrole 2'-deoxynucleoside (M) is the first example of a set of universal bases. Subsequently, 5-nitroindole was determined to be an effective universal base and to be superior to 3-nitropyrrole, based on duplex melting experiments.

The modified bases designated P and K show considerable promise as degenerate bases. The pyrimidine derivative P, when introduced into oligonucleotides, base pairs with either A or G, while the purine derivative K base pairs with either C or T. A dP+dK mix also can serve as a mixed base with much less degeneracy than dA+dC+dG+dT (N).

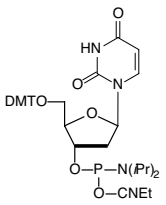
Item	Catalog No.	Pack
dA+dG-CE Phosphoramidites	10-1002-02	0.25g
dC+dT-CE Phosphoramidites	10-1013-02	0.25g
dA+dC+dG+dT-CE Phosphoramidites	10-1023-02	0.25g

Other pack sizes, mixed base combinations and custom doping of individual monomers are available on request.
Also, mixed base columns are available in 0.2 and 1.0 µmole sizes on request.

dI-CE Phosphoramidite	10-1040-90	100 µmole
	10-1040-02	0.25g
dI-CPG 500	20-2040-01	0.1g
1 µmole columns	20-2190-41	Pack of 4
0.2 µmole columns	20-2190-42	Pack of 4
dI-CPG 1000	20-2041-01	0.1g
1 µmole columns	20-2191-41	Pack of 4
0.2 µmole columns	20-2191-42	Pack of 4
dU-CE Phosphoramidite	10-1050-90	100 µmole
	10-1050-02	0.25g
dU-CPG 500	20-2050-01	0.1g
1 µmole columns	20-2150-41	Pack of 4
0.2 µmole columns	20-2150-42	Pack of 4
dU-CPG 1000	20-2051-01	0.1g
1 µmole columns	20-2151-41	Pack of 4
0.2 µmole columns	20-2151-42	Pack of 4



2'-deoxyInosine



2'-deoxyUridine

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Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

DUPLEX EFFECTS (CONT.)

OTHER INSTRUMENT TYPES

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Monomers

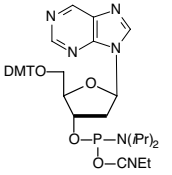
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

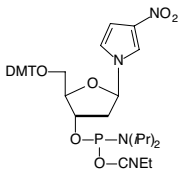
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

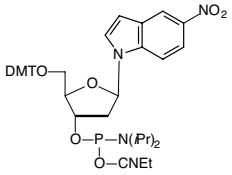
Item	Catalog No.	Pack
2′-DeoxyNebularine-CE Phosphoramidite (Purine)	10-1041-90 10-1041-02	100 µmole 0.25g
5-Nitroindole-CE Phosphoramidite	10-1044-90 10-1044-02	100 µmole 0.25g
dP-CE Phosphoramidite	10-1047-90 10-1047-02	100 µmole 0.25g
dK-CE Phosphoramidite	10-1048-90 10-1048-02	100 µmole 0.25g
dP+dK-CE Phosphoramidite	10-1049-90 10-1049-02	100 µmole 0.25g



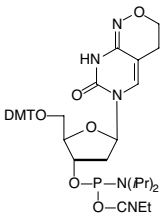
2′-deoxyNebularine



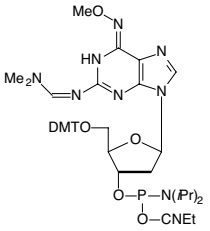
3-Nitropyrrole



5-Nitroindole



dP



dK

DUPLEX EFFECTS (CONT.)

Unnatural base pairs display unique abilities in duplex DNA and in nucleic acid and protein biosyntheses. A standard Watson and Crick base pair is formed between iso-C and iso-G, but the hydrogen bonding pattern is quite different from the natural base pairs A-T and C-G. (The 5-methyl analogue was chosen as the synthetic target due to the reported instability of 2'-deoxyisocytidine caused by deamination during oligonucleotide synthesis or deprotection.)

RELATED

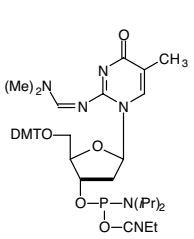
N4-Et-dC.....51
N4-Ac-N4-Et-dC.....51

Item	Catalog No.	Pack
dmf-5-Me-isodC-CE Phosphoramidite	10-1065-90 10-1065-02	100 µmole 0.25g
dmf-isodG-CE Phosphoramidite	10-1078-90 10-1078-02	100 µmole 0.25g

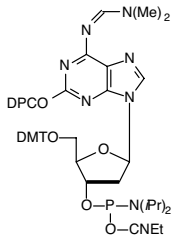
Tm MODULATION

Any technique that involves hybridization of multiple sequences simultaneously, as in DNA chip and reverse hybridization technologies, is subject to inaccuracies due to differences in GC content. Sequences with high GC content may contain mismatches and still hybridize, whereas a low GC content probe may match perfectly and yet disassociate from the target, leading to false positives and negatives, respectively.

An elegant way of circumventing this problem would be to use a modified base that normalized the stability of the GC and AT base pairs. The N4-ethyl analogue (N4-Et-dC) hybridizes specifically to natural dG but the stability of the base pair is reduced to about the level of an AT base pair. In a series of probes whose GC content ranged from 0 to 100%, the range in Tm values when N4-Et-dC was used was only 7 °C; when dC was used, that range was 39 °C.



dmf-5-Me-isodC



dmf-isodG

CLEANAMP® MONOMERS

RELATED

UltraMild DNA Synthesis 27

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CleanAmp® Primers offer an alternative to other Hot Start technologies and allow greater control of primer hybridization and extension during PCR. It has been demonstrated that CleanAmp® Primers outperform other technologies in multiple applications. Indeed, over a broad range of applications, CleanAmp® Primers reduce or eliminate off-target amplification. Greater amplicon yield is also achieved, due to improvement in specificity and sensitivity. By using either the slow-releasing Precision primers with two CleanAmp® phosphotriester linkages or the faster-releasing Turbo Primers with a single CleanAmp® phosphotriester linkage, the rate of formation of unmodified primer can be controlled to suit reaction needs.

Turbo Primers

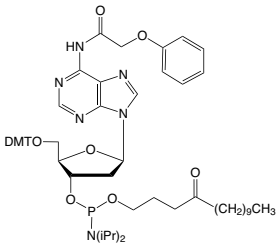
Fast cycling
Multiplex PCR
Improves amplicon yield
Reduces mis-priming/primer dimer formation

Precision Primers

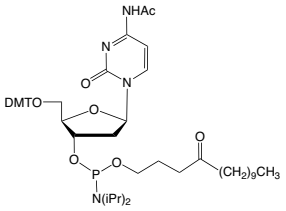
Standard cycling
One-step reverse-transcription PCR
Improved specificity and limit of detection
Greatest reduction in mis-priming/primer dimer formation

Synthesis of CleanAmp® Primers requires the use of UltraMild Chemistry.

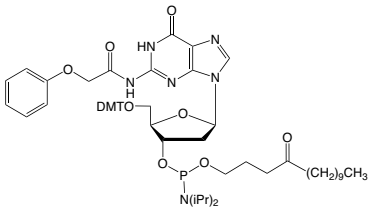
CleanAmp® Primers and monomers are available from TriLink BioTechnologies.



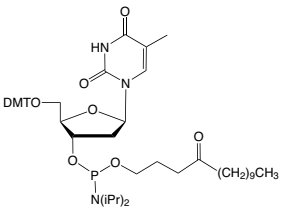
CleanAmp™-Pac-dA



CleanAmp™-Ac-dC



CleanAmp™-Pac-dG



CleanAmp™-dT

CHAIN TERMINATORS

In situations where ligation must be blocked at the 5′ terminus, 5′-OMe-dT may be used. 5′-OMe modification of a strand of siRNA using 5′-OMe-T can control guide strand selection and targeting specificity.[1] 5′-Amino-dT terminates an oligonucleotide with a 5′-amino group which may be used for attaching a peptide or a PNA sequence. To avoid polymerase extension at the 3′ terminus, 2′,3′-dideoxynucleoside and 3′-deoxynucleoside CPGs have proved to be effective. 2′,3′- Phosphoramidites are designed to be used with the 5′-phosphoramidites and supports. Since these phosphoramidites have no DMT group, they are not compatible with purification by the DMT-on technique. Ion exchange HPLC or PAGE should be used to purify these dideoxy terminated oligos to ensure that shorter sequences (containing 3′-OH) groups are removed. (3′-Termination can also be effected using a 3′-3′ linkage formed using 5′-supports, or 3′-spacer C3 CPG.)

Item	Catalog No.	Pack
5′-OMe-dT-CE Phosphoramidite	10-1031-90	100 µmole
	10-1031-02	0.25g
5′-Amino-dT-CE Phosphoramidite	10-1932-90	100 µmole
	10-1932-02	0.25g
3′-dA-CPG	20-2004-01	0.1g
1 µmole columns	20-2104-41	Pack of 4
0.2 µmole columns	20-2104-42	Pack of 4
3′-dC-CPG	20-2064-01	0.1g
1 µmole columns	20-2164-41	Pack of 4
0.2 µmole columns	20-2164-42	Pack of 4
3′-dG-CPG	20-2074-01	0.1g
1 µmole columns	20-2174-41	Pack of 4
0.2 µmole columns	20-2174-42	Pack of 4
3′-dT-CPG	20-2084-01	0.1g
1 µmole columns	20-2184-41	Pack of 4
0.2 µmole columns	20-2184-42	Pack of 4

RELATED

5′-Phosphoramidites..... 38
5′-Supports..... 39
3′-Spacer C3 CPG..... 88

REFERENCE

(1) P.Y. Chen, et al., ***RNA***, 2008, **14**, 263-274..

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

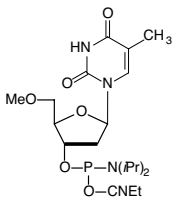
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

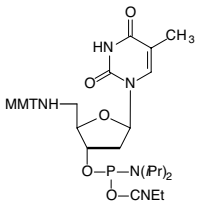
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

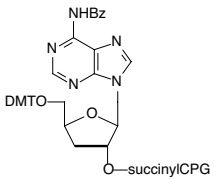
(Please inquire for availability of vials and columns for other instrument types.)



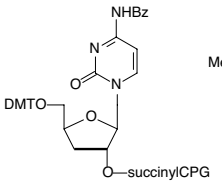
5′-OMe-Thymidine



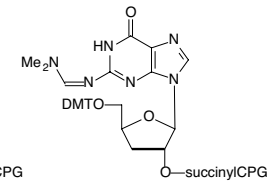
5′-Amino-dT



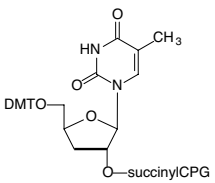
3′-dA-CPG



3′-dC-CPG



3′-dG-CPG



3′-dT-CPG

CHAIN TERMINATORS (CONT.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

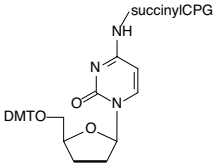
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

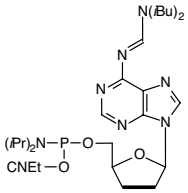
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

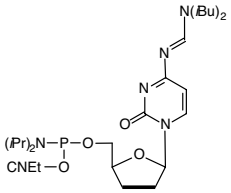
Item	Catalog No.	Pack
2′,3′-ddC-CPG	20-2017-01	0.1g
1 µmole columns	20-2117-41	Pack of 4
0.2 µmole columns	20-2117-42	Pack of 4
2′,3′-ddA-CE Phosphoramidite	10-7001-90	100 µmole
	10-7001-02	0.25g
2′,3′-ddC-CE Phosphoramidite	10-7101-90	100 µmole
	10-7101-02	0.25g
2′,3′-ddG-CE Phosphoramidite	10-7201-90	100 µmole
	10-7201-02	0.25g
2′,3′-ddT-CE Phosphoramidite	10-7301-90	100 µmole
	10-7301-02	0.25g



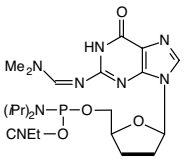
2′,3′-ddC-CPG



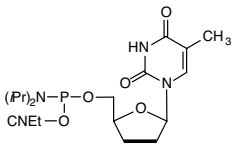
2′,3′-ddA



2′,3′-ddC



2′,3′-ddG



2′,3′-ddT

STRUCTURE/ACTIVITY RELATIONSHIP

The following products are used to investigate the effect on the activity of an oligonucleotide when key structural elements are changed. The 7-deaza purine monomers lack groups critical for hydrogen bonding. 7-Deaza-8-aza-A and 7-deaza-8-aza-G (PPG) monomers are isomers of A and G and have similar electron density. Their presence in oligos is slightly stabilizing relative to A and G. Unlike G, PPG does not lead to aggregation and G-rich oligos can be easily prepared and isolated. 5'-Fluorescein oligos with PPG at the 5'-terminus are much less quenched than the equivalent G oligos. As a purine analogue of Thymidine, 7-deaza-2'-deoxyXanthosine (7-deaza-dX) promises to have interesting effects on DNA structure of triplexes. 7-Deaza-dX also forms a non-standard base pair with a 2,4-diaminopyrimidine nucleoside analogue. Standard nucleobases have an unshared pair of electrons that project into the minor groove of duplex DNA. Enzymes that interact with DNA, polymerases, reverse transcriptases, restriction enzymes, etc., may use a hydrogen bond donating group to contact the hydrogen bond acceptor in the minor groove. 3-Deaza-2'-deoxyadenosine is very interesting in that it maintains the ability for regular Watson-Crick hydrogen bonding to T but is lacking the electron pair at the 3-position normally provided by N3.

STABILITY NOTES

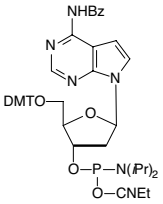
7-Deaza-dG is unstable to iodine oxidation. Add a maximum of 2 times when using iodine oxidation or use 0.5M (10-camphorsulfonyl)-oxaziridine (CSO) in anhydrous acetonitrile and 3 min. oxidation time. (See Glen Report-Vol.9, No.1, 1996,page 8.)

INTELLECTUAL PROPERTY

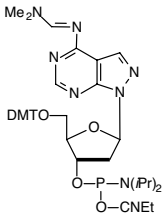
The use of PPG is subject to proprietary rights of ELITechGroup and it is sold under license from ELITechGroup.

(1) I.V. Kutyavin, et al., ***Nucleic Acids Res.***, 2002, **30**, 4952-4959.

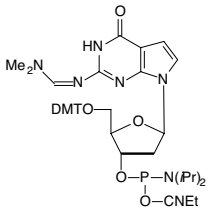
Item	Catalog No.	Pack
7-Deaza-dA-CE Phosphoramidite	10-1001-95	50 µmole
	10-1001-90	100 µmole
	10-1001-02	0.25g
7-Deaza-8-aza-dA-CE Phosphoramidite	10-1083-95	50 µmole
	10-1083-90	100 µmole
	10-1083-02	0.25g
7-Deaza-dG-CE Phosphoramidite	10-1021-95	50 µmole
	10-1021-90	100 µmole
	10-1021-02	0.25g
7-Deaza-8-aza-dG-CE Phosphoramidite (PPG)	10-1073-95	50 µmole
	10-1073-90	100 µmole
	10-1073-02	0.25g
7-Deaza-dX-CE Phosphoramidite	10-1076-95	50 µmole
	10-1076-90	100 µmole
	10-1076-02	0.25g
3-Deaza-dA-CE Phosphoramidite	10-1088-95	50 µmole
	10-1088-90	100 µmole
	10-1088-02	0.25g



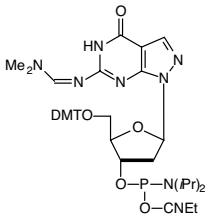
7-Deaza-2'-deoxyAdenosine



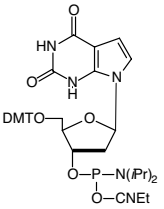
7-Deaza-8-Aza-2'-deoxyAdenosine



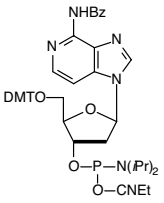
7-Deaza-2'-deoxyGuanosine



7-Deaza-8-Aza-2'-deoxyGuanosine



7-deaza-dX



3-Deaza-dA

STRUCTURE/ACTIVITY RELATIONSHIP (CONT.)

OTHER INSTRUMENT TYPES

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Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

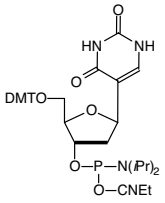
STABILITY NOTES

6-Thio-dG, 4-Thio-dT and 4-thio-dU are protected as the S-cyanoethyl ether which is stable during synthesis and readily removed by ammonium hydroxide. It is critical to add 50mM sodium hydrosulfide (NaSH) to the ammonium hydroxide used for deprotection. Especially if room temperature deprotection is carried out, this technique radically reduces the level of ammonolysis which would lead to undesired aminated bases. Moreover, it is also desirable to remove the cyanoethyl protecting group (1M DBU in acetonitrile, 2-5 h/RT) prior to the ammonium hydroxide cleavage and deprotection.

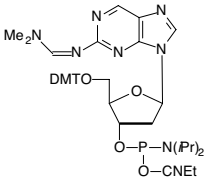
The C-nucleoside 2'-deoxypseudouridine, in contrast to dU, forms stable C:pseudoU-A triplets. 2-Aminopurine lacks groups critical for hydrogen bonding and is a mildly fluorescent base.

Demand for sulfur modified bases continues to expand for investigations of oligonucleotide structure, but primarily for cross-linking purposes. 6-Thio-dG, 4-Thio-dT and 4-thio-dU are very useful modifications for photo cross-linking and photoaffinity labeling experiments. Oligos containing 2-thio-dT are useful in examining protein-DNA interaction by acting as photosensitizing probes. The thiocarbonyl group in 2-thio-dT is especially interesting in that it is available to react with compounds associating with the minor groove of DNA. 2-Amino-A forms a very stable base pair with T containing three hydrogen bonds but the stability of the base pair with 2-thio-T is greatly diminished. Due to steric interactions between the 2-thio group of thymidine and the 2-amino group of 2-amino-A, the base pair contains only a single hydrogen bond. Oligos containing 2-amino-dA and 2-thio-dT exhibit high affinity for natural oligonucleotides but show little affinity for other similar oligos even of a complementary sequence.

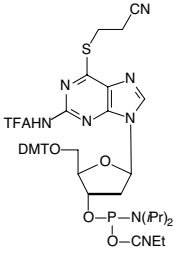
Item	Catalog No.	Pack
2'-deoxypseudoU-CE Phosphoramidite	10-1055-95	50 µmole
	10-1055-90	100 µmole
	10-1055-02	0.25g
2-Aminopurine-CE Phosphoramidite	10-1046-90	100 µmole
	10-1046-02	0.25g
6-Thio-dG-CE Phosphoramidite	10-1072-95	50 µmole
	10-1072-90	100 µmole
	10-1072-02	0.25g
4-Thio-dT-CE Phosphoramidite	10-1034-95	50 µmole
	10-1034-90	100 µmole
	10-1034-02	0.25g
4-Thio-dU-CE Phosphoramidite	10-1052-95	50 µmole
	10-1052-90	100 µmole
	10-1052-02	0.25g
2-Thio-dT-CE Phosphoramidite	10-1036-95	50 µmole
	10-1036-90	100 µmole
	10-1036-02	0.25g



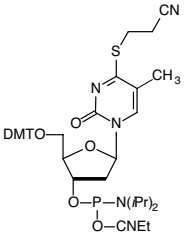
2'-dpseudoU



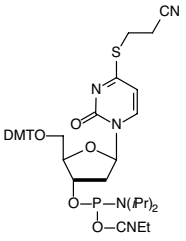
2-Aminopurine



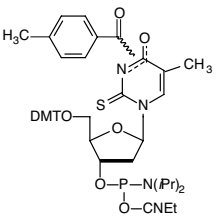
6-Thio-dG



4-Thio-dT



4-Thio-dU



2-Thio-dT

STRUCTURE/ACTIVITY RELATIONSHIP (CONT.)

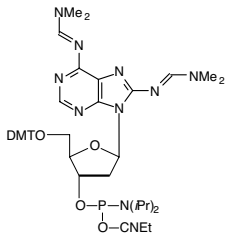
8-Amino-dA and 8-amino-dG are useful in triplex formation due to the presence of the additional amino groups.

2′-DeoxyXanthosine (dX) is a naturally occurring nucleoside that may be derived from oxidative deamination of 2′-deoxyGuanosine (dG). dX has a similar bonding pattern to thymidine and it may base pair with dA, with such purine-purine interactions causing duplex distortion. dX also featured in attempts to extend the genetic alphabet with a new base pair of dX and pyrimidine-2,4-diamine nucleoside. dX has also interested researchers in the field of DNA damage and repair since it is a product of nitric oxide-induced mutagenesis.

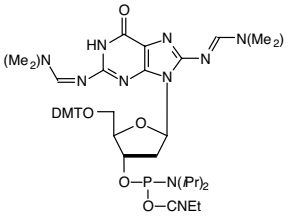
STABILITY NOTE

Synthetic oligonucleotides containing 8-amino-dG must be cleaved and deprotected with ammonium hydroxide containing 0.25M 2-mercaptoethanol to avoid oxidative degradation of 8-amino-dG sites.

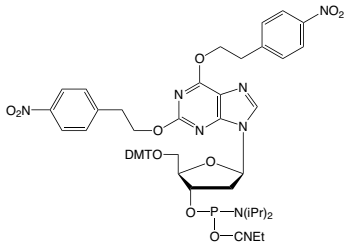
Item	Catalog No.	Pack
8-Amino-dA-CE Phosphoramidite	10-1086-95	50 µmole
	10-1086-90	100 µmole
	10-1086-02	0.25g
8-Amino-dG-CE Phosphoramidite	10-1079 -95	50 µmole
	10-1079 -90	100 µmole
	10-1079-02	0.25g
2′-dX-CE Phosphoramidite	10-1537-95	50 µmole
	10-1537-90	100 µmole
	10-1537-02	0.25g



8-Amino-dA



8-Amino-dG



dX

HALOGENATED NUCLEOSIDES

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

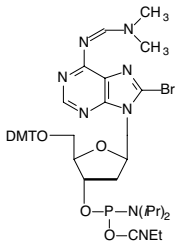
(Please inquire for availability of vials and columns for other instrument types.)

STABILITY NOTE

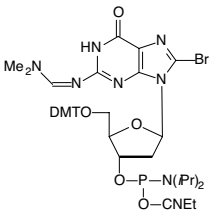
Oligonucleotides containing a bromo or iodo group are prepared conventionally with the exception that deprotection is carried out in ammonium hydroxide at room temperature for 24 hours. Under these conditions, degradation of the halogen group was less than 2%.

Brominated and iodinated nucleosides are used in X-ray crystallography studies of oligonucleotide structure. They are also photolabile and are used for cross-linking studies to probe the structure of protein-DNA complexes. Antibodies exist to Br-dU and oligonucleotides containing Br-dU can be used as probes. 5-Fluoro-dU can be used as a non-photoreactive alternative to 5-Br-dU with similar electron density. 5-F-dU base pairs more strongly than T to both dA and the dG mismatch. It is also useful for probing DNA structure using 19F NMR spectroscopy.

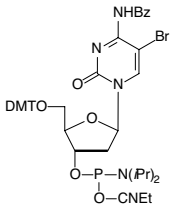
Item	Catalog No.	Pack
8-Br-dA-CE Phosphoramidite	10-1007-90	100 µmole
	10-1007-02	0.25g
8-Br-dG-CE Phosphoramidite	10-1027-90	100 µmole
	10-1027-02	0.25g
5-Br-dC-CE Phosphoramidite	10-1080-90	100 µmole
	10-1080-02	0.25g
5-I-dC-CE Phosphoramidite	10-1081-90	100 µmole
	10-1081-02	0.25g
5-Br-dU-CE Phosphoramidite	10-1090-90	100 µmole
	10-1090-02	0.25g
5-I-dU-CE Phosphoramidite	10-1091-90	100 µmole
	10-1091-02	0.25g
5-F-dU-CE Phosphoramidite	10-1092-90	100 µmole
	10-1092-02	0.25g
5-Br-dU-CPG	20-2090-01	0.1g
1 µmole columns	20-2090-41	Pack of 4
0.2 µmole columns	20-2090-42	Pack of 4



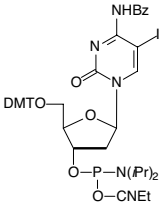
8-Bromo-2′-deoxyAdenosine



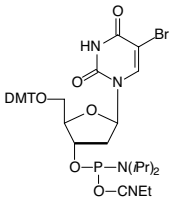
8-Bromo-2′-deoxyGuanosine



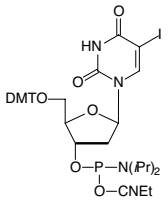
5-Bromo-2′-deoxyCytidine



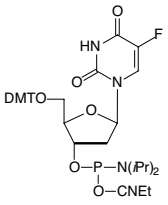
5-Iodo-2′-deoxyCytidine



5-Bromo-2′-deoxyUridine



5-Iodo-2′-deoxyUridine

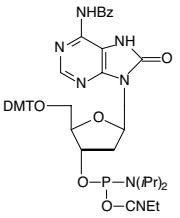


5-Fluoro-2′-deoxyUridine

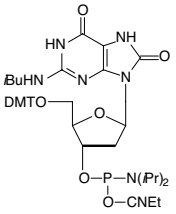
DNA DAMAGE/REPAIR

Cellular DNA is constantly being damaged by oxidation and alkylation, by free radicals, and by ultraviolet and ionizing radiation. The body has therefore evolved a number of repair enzyme systems to excise and repair these lesions. The 8-oxo purine monomers allow investigation of the structure and activity of oligonucleotides containing an 8-oxo mutation which is formed naturally when DNA is subjected to oxidative conditions or ionizing radiation. 5,6-Dihydro pyrimidines are naturally occurring compounds that are structural components of alanine transfer RNA. Dihydrouracil and the hydroxy pyrimidines are major base damage products formed by exposure of DNA to ionizing radiation.

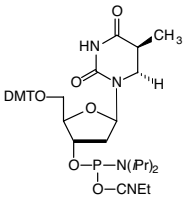
Item	Catalog No.	Pack
8-Oxo-dA-CE Phosphoramidite	10-1008-90	100 µmole
	10-1008-02	0.25g
8-Oxo-dG-CE Phosphoramidite	10-1028-95	50 µmole
	10-1028-90	100 µmole
	10-1028-02	0.25g
5,6-Dihydro-dT-CE Phosphoramidite	10-1530-90	100 µmole
	10-1530-02	0.25g
5,6-Dihydro-dU-CE Phosphoramidite	10-1550-90	100 µmole
	10-1550-02	0.25g
5-OH-dC-CE Phosphoramidite	10-1063-90	100 µmole
	10-1063-02	0.25g
5-OH-dU-CE Phosphoramidite	10-1053-90	100 µmole
	10-1053-02	0.25g
5-Hydroxymethyl-dU-CE Phosphoramidite	10-1093-90	100 µmole
	10-1093-02	0.25g



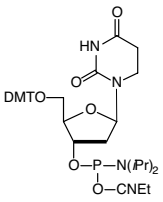
8-oxo-2'-deoxyAdenosine



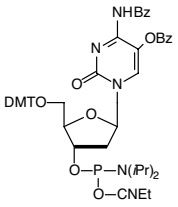
8-oxo-2'-deoxyGuanosine



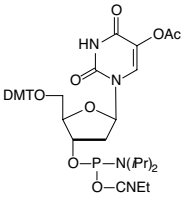
5,6-Dihydro-dT



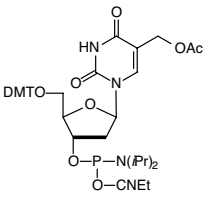
5,6-Dihydro-dU



5-OH-dC



5-OH-dU



5-Hydroxymethyl-dU

STABILITY NOTES

Synthetic oligonucleotides containing 8-oxo-dG must be cleaved and deprotected with ammonium hydroxide containing 0.25M 2-mercaptoethanol to avoid oxidative degradation of 8-oxo-dG sites.

Oligonucleotides synthesized using 5,6-dihydro-dU or 5,6-dihydro-dT and UltraMILD monomers can be cleaved using either concentrated ammonium hydroxide or 50 mM potassium carbonate in anhydrous methanol. Complete cleavage and deprotection can be accomplished at room temperature in 2-4 hours without damaging either the dihydro-dU or dihydro-dT bases.

RELATED

5-Hydroxymethyl-dC..... 54
dX 63

DNA DAMAGE/REPAIR (CONT.)

STABILITY NOTES

Synthetic oligonucleotides containing 8-amino-dG must be cleaved and deprotected with ammonium hydroxide containing 0.25M 2-mercaptoethanol to avoid oxidative degradation of 8-amino-dG sites.

Oligonucleotides synthesized using Thymidine Glycol and UltraMILD monomers can be cleaved using either concentrated ammonium hydroxide or 50 mM potassium carbonate in anhydrous methanol. Complete cleavage and deprotection can be accomplished at room temperature in 2-4 hours without damaging Thymidine Glycol base. The best method to remove the TBDMS groups was achieved using TEA.3HF at 40°C overnight.

REFERENCE

(1) K. Groebke, and C.J. Leumann, ***Helv Chim Acta***, 1990, **73**, 608-617.

RELATED

dSpacer 88
Pyrrolidine 67

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

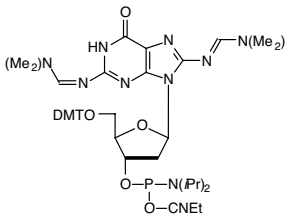
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

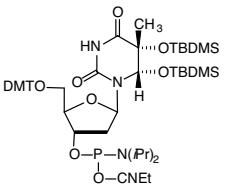
8-Amino-G is formed along with 8-oxo-G as the major mutagenic lesions formed in DNA damage caused by 2-nitropropane. 2-Nitropropane is an industrial solvent and a component of paints, dyes and varnishes, and is also present in cigarette smoke. Thymine glycol (5,6-dihydroxy-5,6-dihydrothymine) is formed when thymine is subjected to oxidative stress, including ionizing radiation. Oxidation of the 5,6 double bond of Thymidine generates two chiral centers at C5 and C6. The cis-5R,6S form is generated as the predominant product along with the other diastereomer, the cis-5S,6R form. The presence of thymidine glycol in DNA has significant biological consequences and many organisms possess specific repair enzymes for the excision of this lesion.

Hydrolysis of nucleoside residues in DNA occurs to generate abasic sites. Most commonly, dA sites are hydrolyzed causing depurination and leading to abasic residues. For researchers trying to determine if their source of depurination in chemical synthesis of DNA is reagent, fluidics or protocol-based, we offer a depurination-resistant dA monomer. A new chemical method allows the generation of abasic sites in double and single stranded oligonucleotides using very mild specific conditions and with very low probability of side reactions. Abasic II Phosphoramidite[1] has the advantage of simplicity in that the silyl group is removed post-synthesis using aqueous acetic acid. dSpacer has also been used successfully as a mimic of the highly base-labile abasic site.

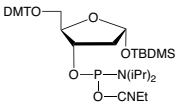
Item	Catalog No.	Pack
8-Amino-dG-CE Phosphoramidite	10-1079-95	50 µmole
	10-1079-90	100 µmole
	10-1079-02	0.25g
Thymidine Glycol CE Phosphoramidite	10-1096-95	50 µmole
	10-1096-90	100 µmole
	10-1096-02	0.25g
Abasic II Phosphoramidite (dR Precursor)	10-1927-95	50 µmole
	10-1927-90	100 µmole
	10-1927-02	0.25g



8-Amino-dG



Thymidine Glycol



Abasic II Phosphoramidite

DNA DAMAGE/REPAIR (CONT.)

INSTRUMENT TYPES

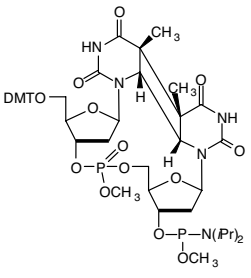
For these very expensive phosphoramidites, an ABI septum vial is the standard vial. Add E to the catalog no. for an Expedite vial or V to the catalog no. for an Expedite V vial.

One of the major sources of DNA damage in all organisms is the UV component of sunlight. The predominant reaction induced by UV light on DNA is dimerization of adjacent pyrimidine bases leading to cyclobutane dimers (CPDs). The dimers formed in the most significant quantity are the cis-syn cyclobutane dimer of two thymine bases. Although formed routinely, these dimer products are efficiently excised and repaired enzymatically by nucleotide excision repair (NER) or the dimerization is reversed by photolase enzymes. A further mode of oxidative damage is radiation-induced damage of DNA, which has been shown to lead to bridged cyclonucleosides. The purines, cyclo-dA and cyclo-dG, are predominantly formed, although the cyclo pyrimidines have also been detected. Cyclo-dA is doubly intriguing since it contains both damaged base and damaged sugar residues and, as such, should have a considerable biological impact. In a manner analogous to thymine dimer, cyclo purines cause significant distortion of the regular DNA helix and these lesions are repaired not by base excision repair (BER) but by NER.

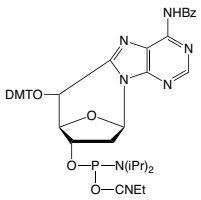
Item	Catalog No.	Pack
Cis-syn Thymine Dimer Phosphoramidite	11-1330-95	50 µmole
	11-1330-90	100 µmole
	11-1330-02	0.25g
5′,8-Cyclo-dA CE Phosphoramidite	10-1098	Discontinued
5′,8-Cyclo-dG CE Phosphoramidite	10-1598	Discontinued

Base excision repair (BER) is one of the most studied repair mechanisms. In this pathway, DNA glycosylases recognize the damaged bases and catalyze their excision through hydrolysis of the N-glycosidic bond. Attempts to understand the structural basis for DNA damage recognition by DNA glycosylases have been hampered by the short-lived association of these enzymes with their DNA substrates. To overcome this problem, the Verdine group at Harvard synthesized a pyrrolidine analog that mimics the charged transition state of the enzyme-substrate complex. When incorporated into double-stranded DNA, they found the pyrrolidine analog (PYR), introduced as the Pyrrolidine-CE Phosphoramidite, forms an extremely stable complex with the DNA glycosylase AlkA, exhibiting a dissociation constant in the pM range and potently inhibited the reaction catalyzed by the enzyme.

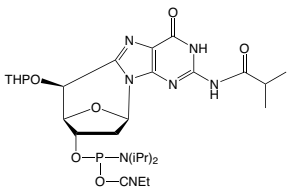
Item	Catalog No.	Pack
Pyrrolidine-CE Phosphoramidite (PYR)	10-1915-95	50 µmole
	10-1915-90	100 µmole
	10-1915-02	0.25g



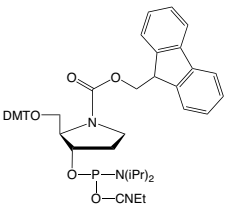
Cis-syn Thymine Dimer



5′,8-Cyclo-dA



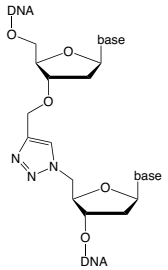
5′,8-Cyclo-dG



Pyrrolidine

CLICK DNA AND RNA LIGATION

BIOCOMPATIBLE TRIAZOLE LINKAGE



Ligation of an oligo containing a 5'-azide with an oligo containing a 3'-propargyl group using Click Chemistry leads to a triazole linkage that has been shown to have *in vivo* biocompatibility. This technique has been used to synthesize DNA constructs up to 300 bases in length. When the resultant triazole linkage was placed in a PCR template, various polymerases were able to copy the sequence correctly. The linkage has also been shown to be compatible with transcription and rolling circle amplification, as well as gene expression in *E. coli*. In the RNA world, a hammerhead ribozyme containing the triazole linkage at the substrate cleavage site has been shown to retain its activity. A large variety of applications is envisaged for this biocompatible chemical ligation. Support for this technology is offered with the help of Tom Brown's group at the University of Southampton.

Item	Catalog No.	Pack
3'-Propargyl-5-Me-dC CPG	20-2982-01	0.1g
	20-2982-10	1.0g
1 µmole columns	20-2982-41	Pack of 4
0.2 µmole columns	20-2982-42	Pack of 4
10 µmole column (ABI)	20-2982-13	Pack of 1
15 µmole column (Expedite)	20-2982-14	Pack of 1

RELATED

5'-I-dT in Click Chemistry.....94
Click Chemistry.....92

REFERENCES - CLICK LIGATION

(1) A.H. El-Sagheer, A.P. Sanzone, R. Gao, A. Tavassoli, and T. Brown, ***Proc Natl Acad Sci U S A***, 2011, **108**, 11338-43.
(2) A.H. el-Sagheer, and T. Brown, ***Chem Commun (Camb)***, 2011, **47**, 12057-8.
(3) A.P. Sanzone, A.H. El-Sagheer, T. Brown, and A. Tavassoli, ***Nucleic Acids Res***, 2012.
(4) A. Dallmann, et al., ***Chemistry***, 2011, **17**, 14714-7.
(5) A.H. El-Sagheer, and T. Brown, ***Proc Natl Acad Sci U S A***, 2010, **107**, 15329-34.

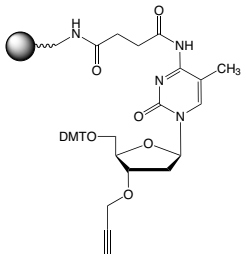
5'-LABELING OF MicroRNAs

Several methods have been developed for the detection of miRNAs, however, few allow the simultaneous detection of multiple miRNAs. To overcome this analytical deficiency, the Richert group at the University of Stuttgart has recently developed an ingenious method to selectively detect miRNAs on microarrays without interference from endogenous pre-mRNAs, mRNAs and other RNA species. In this method, a short oligonucleotide containing 3'-amino-dT and a 5' reporter molecule is chemically ligated to the microRNA in a one-step procedure by *in situ* activation of the microRNA. This is specifically achieved by taking advantage of the fact that miRNAs, unlike other RNAs, are 5'-phosphorylated. The reaction is template-directed (and thus sequence specific) and can be performed together with enzymatic 3'-extension/labeling, either in solution or on a support. The short DNA labeling strand may feature one of a variety of different labels, such as a biotin group or a fluorophore.

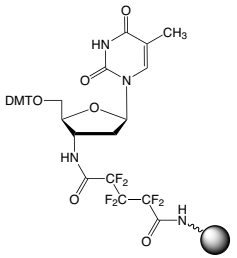
Item	Catalog No.	Pack
3'-Amino-dT CPG	20-2981-01	0.1g
	20-2981-10	1.0g
1 µmole columns	20-2981-41	Pack of 4
0.2 µmole columns	20-2981-42	Pack of 4
10 µmole column (ABI)	20-2981-13	Pack of 1
15 µmole column (Expedite)	20-2981-14	Pack of 1

REFERENCES - MicroRNA Labeling

(1) H. Vogel, and C. Richert, ***ChemBioChem***, 2012, **13**, 1474-82.
(2) R. Eisenhuth, and C. Richert, ***Journal of Organic Chemistry***, 2008, **74**, 26-37.
(3) E. Kervio, A. Hochgesand, U.E. Steiner, and C. Richert, ***Proc Natl Acad Sci U S A***, 2010, **107**, 12074-9.



3'-Propargyl-5-Me-dC CPG



3'-Amino-dT CPG

2’-5’ LINKED OLIGONUCLEOTIDES

Cellular DNA and RNA are made up of ribo- and 2’-deoxyribonucleic acids linked together via 3’-5’ phosphodiester linkages and by far comprise the bulk of polynucleic acids found in cells. Much less common are oligonucleotides which have 2’-5’ linkages. However, a unique feature of 2’-5’ linked oligonucleotides is their ability to bind selectively to complementary RNA. These features suggest a number of interesting uses for 2’-5’ linked oligos such as their use as RNA specific probes or in antisense oligos. Recently, oligos have been synthesized using 3’-deoxy-2’-phosphoramidites and 2’-deoxy-3’-phosphoramidites to produce chimeras with 2’-5’ linked ends and 3’-5’ linked central regions. It was found that 2’-5’ phosphorothioate oligos: 1) bind selectively to complementary RNA with the same affinity as phosphodiester oligos; 2) exhibit much less nonspecific binding to cellular proteins; 3) do not activate RNase H. A 3’-deoxynucleoside at the 3’-terminus of an otherwise normal oligonucleotide effectively blocks polymerase extension.

Item	Catalog No.	Pack
3’-dA-CE Phosphoramidite	10-1004-95	50 µmole
	10-1004-90	100 µmole
	10-1004-02	0.25g
3’-dC-CE Phosphoramidite	10-1064-95	50 µmole
	10-1064-90	100 µmole
	10-1064-02	0.25g
3’-dG-CE Phosphoramidite	10-1074-95	50 µmole
	10-1074-90	100 µmole
	10-1074-02	0.25g
3’-dT-CE Phosphoramidite	10-1084-95	50 µmole
	10-1084-90	100 µmole
	10-1084-02	0.25g
3’-dA-CPG	20-2004-01	0.1g
1 µmole columns	20-2104-41	Pack of 4
0.2 µmole columns	20-2104-42	Pack of 4
3’-dC-CPG	20-2064-01	0.1g
1 µmole columns	20-2164-41	Pack of 4
0.2 µmole columns	20-2164-42	Pack of 4

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

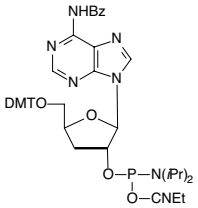
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

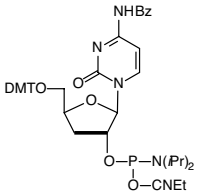
(Please inquire for availability of vials and columns for other instrument types.)

RELATED

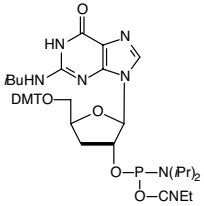
3’-deoxynucleoside CPG..... 39



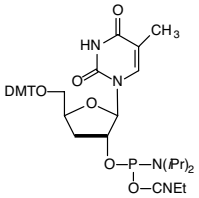
3’-dA



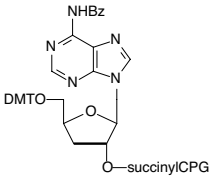
3’-dC



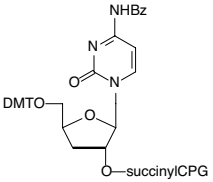
3’-dG



3’-dT



3’-dA-CPG



3’-dC-CPG

2’-5’ LINKED OLIGONUCLEOTIDES (CONT.)

RELATED

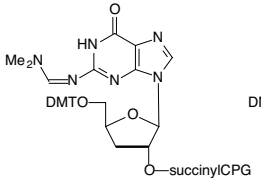
N6-Me-dA.....51

Item	Catalog No.	Pack
3’-dG-CPG	20-2074-01	0.1g
1 µmole columns	20-2174-41	Pack of 4
0.2 µmole columns	20-2174-42	Pack of 4
3’-dT-CPG	20-2084-01	0.1g
1 µmole columns	20-2184-41	Pack of 4
0.2 µmole columns	20-2184-42	Pack of 4

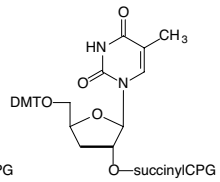
MUTAGENESIS

Cellular polynucleotides are alkylated by endogenous components, such as S-adenosylmethionine, or after reacting with two general classes of environmental and laboratory chemicals. SN1 chemical agents include alkylnitrosourea and N-alkyl-N-nitro-N-nitrosoguanidine that react with the N7 position of guanine, N3 of adenine, O6 of guanine, O2 or O4 of pyrimidines, and the non-phosphodiester oxygen atoms of the phosphate backbone. In contrast, SN2 chemical agents such as methyl methanesulfonate and dimethyl sulfate react primarily with the N1 position of adenine (1-Methyl-2’-deoxyadenosine) and N3 of cytosine. To avoid chain branching during synthesis when using DCI as activator, N6-Me-dA is offered with acetyl protection.

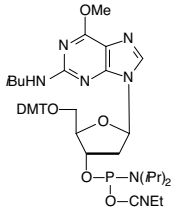
Item	Catalog No.	Pack
O6-Me-dG-CE Phosphoramidite	10-1070-90	100 µmole
	10-1070-02	0.25g
N6-Me-dA-CE Phosphoramidite	10-1003-90	100 µmole
	10-1003-02	0.25g
N6-Ac-N6-Me-dA-CE Phosphoramidite	10-1503-90	100 µmole
	10-1503-02	0.25g
O4-Me-dT-CE Phosphoramidite	10-1032	Discontinued
1-Me-dA-CE Phosphoramidite	10-1501-95	50 µmole
	10-1501-90	100 µmole
	10-1501-02	0.25g



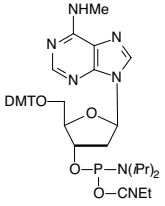
3’-dG-CPG



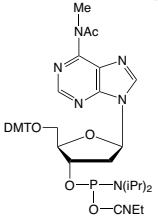
3’-dT-CPG



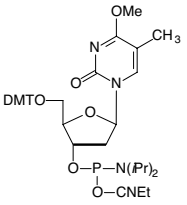
O6-Me-2’-deoxyGuanosine



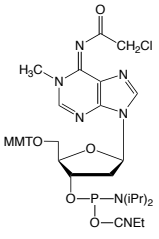
N6-Methyl-2’-deoxyAdenosine



N6-Ac-N6-Me-dA



O4-Me-Thymidine



1-Methyl-2’-deoxyAdenosine

IN SITU SYNTHESIS OF DNA ANALOGS

The convertible nucleoside strategy is one of the most versatile methods for producing modifications in bases to examine their effects on DNA structure and activity. In some cases, with versatility comes difficulty in that the convertible base is modified after oligonucleotide synthesis. The chemistry is sometimes complex and base composition analysis of the final oligonucleotide is required to verify structure. The convertible dU monomer can be used to introduce a variety of modifications at the convertible position, including N, O and S modifications. Convertible F-dC is by far the simplest approach to the preparation of oligonucleotides containing F-dC - normal ammonium hydroxide treatment effects the conversion to F-dC. Convertible dA has been used to prepare oligonucleotides containing multiple points for attachment to solid supports. In this way, high capacity affinity supports for the purification of DNA binding proteins have been prepared. 2-F-dI is a convertible nucleoside for the preparation of 2'-dG derivatives following the displacement of the 2-fluorine by primary amines.

Item	Catalog No.	Pack
TMP-F-dU-CE Phosphoramidite	10-1016-90	100 µmole
(Convertible F-dC)	10-1016-02	0.25g
O6-Phenyl-dI-CE Phosphoramidite	10-1042-90	100 µmole
(Convertible dA)	10-1042-02	0.25g
O4-Triazolyl-dU-CE Phosphoramidite	10-1051-90	100 µmole
(Convertible dU)	10-1051-02	0.25g
2-F-dI-CE Phosphoramidite	10-1082-95	50 µmole
(Convertible dG)	10-1082-90	100 µmole
	10-1082-02	0.25g

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

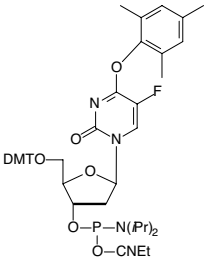
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

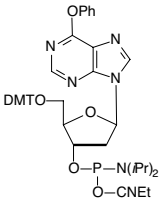
(Please inquire for availability of vials and columns for other instrument types.)

ABBREVIATION

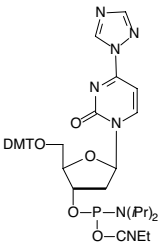
TMP = 2,4,6-trimethylphenyl



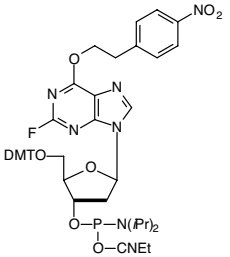
TMP-F-dU



O6-Phenyl-dI



O4-Triaz.-dU



2-F-dI

PROBING DNA STRUCTURE WITH FLUORESCENT NUCLEOSIDES

RELATED

2-Aminopurine 62
AP-dC (G-Clamp) 50
UltraMild Chemistry..... 27
Pyrrolo-C 136
Pyrrolo-CTP..... 140

INTELLECTUAL PROPERTY

Pyrrolo-dC is a joint development project of Berry & Associates, Inc. and Glen Research Corporation. Pyrrolo-dC is covered by US Patent No.: 7,144,995.

SPECTRAL PROPERTIES

The spectral properties of pyrrolo-dC, coupled with its unique base-pairing ability, make this fluorescent analog extremely valuable in probing DNA structure. When the pyrrolo-dC is base-paired, its fluorescence is significantly quenched through what is most likely base stacking or dG interactions. The quantum yield of fluorescence for pyrrolo-dC is quite sensitive to its hybridization state, making it ideally suited for probing the dynamic structure of DNA.

	QY	λ	ε (L/mol.cm)
single-stranded	0.07	260nm	4000
		347nm	3700
double-stranded	0.02		

(QY determined relative to quinine sulfate in 0.5M H2SO4)

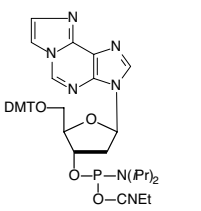
REFERENCES

1. D.A. Berry, et al., ***Tetrahedron Lett***, 2004, **45**, 2457-2461.
2. The Glen Report, 2007, **19**, 8-9.
3. P. Sandin, et al., ***Nucleic Acids Res.***, 2008, **36**, 157-167.
4. P. Sandin, et al., ***Nucleic Acids Res.***, 2005, **33**, 5019-5025.
5. K.C. Engman, et al., ***Nucleic Acids Res.***, 2004, **32**, 5087-5095.

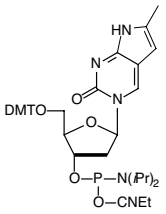
Etheno-dA is a fluorescent nucleoside which is especially useful in observing the transition between DNA structural types. It is quite base labile and should be deprotected with ammonium hydroxide at room temperature for 24 hours. Alternatively, UltraMild chemistry can be used. 2-Aminopurine and AP-dC (G-Clamp) are also useful fluorescent nucleosides.

Pyrrolo-dC is a fluorescent deoxycytidine analog that is an ideal probe of DNA structure and dynamics.[1,2] It base-pairs as a normal dC nucleotide. An oligo fully substituted with pyrrolo-dC has the same T_m as the control dC oligo with the same specificity for dG. Its small size does not perturb the structure of the DNA helix and it is well tolerated by a number of DNA and RNA polymerases. It is highly fluorescent and its excitation and emission are well to the red of most fluorescent nucleotide analogs, which eliminates or reduces background fluorescence from proteins. Pyrrolo-dCTP has potential uses in biological assay development.

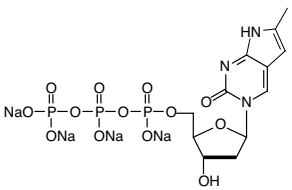
Item	Catalog No.	Pack
Etheno-dA-CE Phosphoramidite	10-1006-90	100 µmole
	10-1006-02	0.25g
Pyrrolo-dC-CE Phosphoramidite	10-1017-95	50 µmole
	10-1017-90	100 µmole
	10-1017-02	0.25g
Pyrrolo-dCTP (10 mM)	81-1017	Discontinued



Etheno-2'-deoxyAdenosine



Pyrrolo-dC



Pyrrolo-dCTP

PROBING DNA STRUCTURE WITH FLUORESCENT NUCLEOSIDES (CONT.)

By attaching pyrene or perylene to the 5 position of deoxyuridine through a triple bond, the fluorophore is electronically coupled to the deoxyuridine base. This electronic coupling of the base and the fluorophore makes the fluorescence sensitive to the base pairing of the dU portion of the molecule, allowing the discrimination between perfect and one base mismatched targets.

Item	Catalog No.	Pack
Pyrene-dU-CE Phosphoramidite	10-1590-95	50 µmole
	10-1590-90	100 µmole
	10-1590-02	0.25g
Perylene-dU-CE Phosphoramidite	10-1591-95	50 µmole
	10-1591-90	100 µmole
	10-1591-02	0.25g

SPECTRAL PROPERTIES

	Absorbance Maximum	Emission Maximum
Pyrene-dU	402nm	472nm
Perylene-dU	473nm	490nm

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

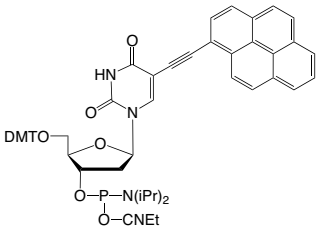
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

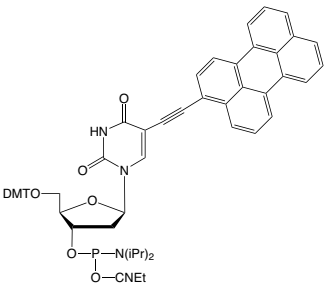
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



Pyrene-dU



Perylene-dU

PROBING DNA STRUCTURE WITH FLUORESCENT NUCLEOSIDES (CONT.)

RELATED

Ribo-tCo 140

SPECTRAL PROPERTIES

Absorption and emission data for tC and tC° are collected below:

tC	*QY*	λ	ε (L/mol.cm)
single-stranded	0.21	385nm	4000
double-stranded	0.19		

tC°	*QY*	λ	ε (L/mol.cm)
single-stranded	0.30	360nm	9000
double-stranded	0.21		

(QY determined relative to quinine sulfate in 0.5M H_2SO_4)

INTELLECTUAL PROPERTY

These products are offered in collaboration with ModyBase HB.

The tricyclic fluorescent nucleoside analogues, 1,3-diaza-2-oxophenothiazine, tC, and 1,3-diaza-2-oxophenoxazine, tC°, are deoxycytidine analogs that have been shown to base pair faithfully with dG with virtually no disruption of the normal duplex structure.[3-5] This means that the stability of the DNA duplex is not compromised as compared to the control regardless of DNA sequence. The fluorescence quantum yield of tC is essentially unchanged between single stranded and double stranded DNA - 0.21 for single stranded DNA and 0.19 for duplex DNA. Also, the fluorescence characteristics of tC are not sensitive to neighboring base combinations. tC° has been shown to be the brightest fluorescent nucleoside analogue in duplex context reported so far and even retains the majority of its fluorescence when surrounded by guanine residues. Indeed, tC° has been reported to be 25-50 times brighter than 2-aminopurine.

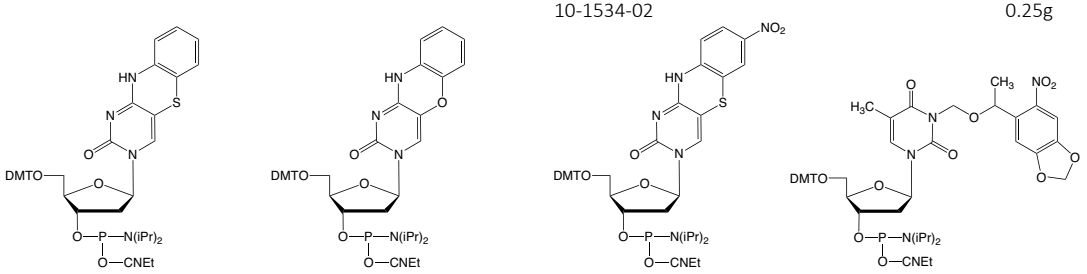
The base analogue tC_{nitro} is a FRET-acceptor together with tC° (or tC) as the donor molecule. This constitutes the first ever description of a nucleobase FRET-pair. This novel FRET-pair provides a unique tool for investigations of nucleic acid containing systems. tC_{nitro} is virtually non-fluorescent under normal conditions.

Item	Catalog No.	Pack
tC-CE Phosphoramidite	10-1516-95	50 µmole
	10-1516-90	100 µmole
	10-1516-02	0.25g
tC°-CE Phosphoramidite	10-1517-95	50 µmole
	10-1517-90	100 µmole
	10-1517-02	0.25g
tC_{nitro}-CE Phosphoramidite	10-1518-95	50 µmole
	10-1518-90	100 µmole
	10-1518-02	0.25g

PHOTO-REGULATION OF DNA FUNCTION

Glen Research's interest lies in the preparation of caged oligonucleotides whose function is restored after uncaging by UV light at a wavelength that causes no DNA damage. The Deiters group at North Carolina State University has described NPOM-Caged-dT, where the nucleobase is caged with the photolabile group, 6-nitropiperonyloxymethyl (NPOM), which can be removed using UV light at 365 nm. Oligonucleotides containing NPOM-Caged-dT every five or six bases do not hybridize to their complementary strand. Photo-uncaging of the caged oligonucleotide is then easily carried out with UV light at 365 nm for seconds to minutes to restore the activity of the oligonucleotide.

Item	Catalog No.	Pack
NPOM-Caged-dT-CE Phosphoramidite	10-1534-95	50 µmole
	10-1534-90	100 µmole
	10-1534-02	0.25g



tC tC° tC_{nitro} NPOM-Caged-dT

INHIBITION OF DNA METHYLTRANSFERASES

Zebularine (pyrimidin-2-one ribonucleoside) is a cytidine analogue that acts as a DNA demethylase inhibitor, as well as a cytidine deaminase inhibitor. This structure is very active biologically and Zebularine is now used as a potent anti-cancer drug. A 2'-deoxynucleoside analogue of Zebularine, 5-methyl-pyrimidin-2-one, 2'-deoxynucleoside, has been used to probe the initiation of the cellular DNA repair process by making use of its mildly fluorescent properties. This combination of biological activity and fluorescence properties would make 5-Me-2'-deoxyZebularine a strong addition to our array of nucleoside analogues.

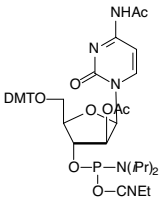
Cytosine-5-methyltransferases are found in everything from archaebacteria to mammals and when the regulation of cytosine-5-methyltransferases goes awry, cancer can result. The mechanism of action for this family of enzymes involves attack of a cysteine thiol group on the C6 position of cytosine, leading to a transient dihydrocytosine intermediate, which then facilitates the nucleophilic attack by C5 on the activated methyl group of the S-adenosyl-L-methionine cofactor. As with many enzymes, the intermediate can be trapped using a suicide substrate and 5-fluoro-cytosine has been used extensively in this role. An alternate strategy is to use a transition-state mimic that binds to the active site with high affinity. An excellent candidate was found in 5-aza-5,6-dihydrocytosine. Despite not being covalently bound to the enzyme, it was found[1,2] to be a more potent inhibitor of cytosine-5-methyltransferases than 5-fluoro-cytosine. 5-Aza-5,6-dihydro-dC is compatible with standard oligonucleotide synthesis and deprotection conditions and is an excellent tool for use in methyltransferase research.

Item	Catalog No.	Pack
5-Me-2'-deoxyZebularine-CE Phosphoramidite	10-1061-95	50 µmole
	10-1061-90	100 µmole
	10-1061-02	0.25g
5-Aza-5,6-dihydro-dC-CE Phosphoramidite	10-1511-95	50 µmole
	10-1511-90	100 µmole
	10-1511-02	0.25g

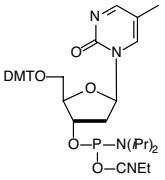
LARGE SCALE SYNTHESIS

The most common side reaction during deprotection of oligonucleotides on a large scale is the alkylation of dT residues by acrylonitrile, formed by ß-elimination of the cyanoethyl phosphate protecting groups, to generate N3-cyanoethyl-dT.

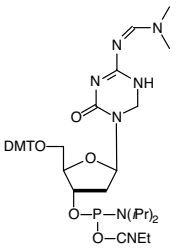
Item	Catalog No.	Pack
N3-Cyanoethyl-dT	10-1531-90	100 µmole
	10-1531-02	0.25g



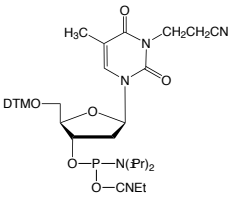
Ara-C



5-Me-2'-deoxyZebularine



5-Aza-5,6-Dihydro-dC



N3-Cyanoethyl-dT

REFERENCES

(1) G. Sheikhnejad, et al., *J Mol Biol*, 1999, **285,** 2021-2034.
(2) V.E. Marquez, et al., *Antisense Nucleic Acid Drug D*, 1999, **9**, 415-421.

RELATED

Convertible F-dC..... 39
5-Fluoro-2'-deoxyUridine 64
Pyrrolidine 67

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

NON-CANONICAL STRUCTURES

DNA and RNA structures are defined by Watson-Crick rules of hybridization. However, a variety of DNA and RNA structures have been defined which do not rely on simple A-T/U and G-C binding. Since these structures disobey the Watson-Crick canon, they are described as non-canonical. Non-canonical DNA and RNA segments are formed as a result of secondary structures. These include G-quadruplexes, triplex forming oligos, hairpins, cruciforms, and i-Motif structures.

G-QUADRUPLEX

Oligonucleotide structural analysis has demonstrated that DNA and RNA nucleic acid sequences containing G-tracts separated by other bases spontaneously fold into G-quadruplex structures. G-quadruplexes are formed when four adjacent guanine residues stack in a cyclic Hoogsteen hydrogen-bonding arrangement leading to four-stranded helical structures. The study of G-quadruplexes in basic genetic processes is an active area of research in telomerase activity, gene regulation, and functional genomics. Guanine analogues that have different hydrogen bonding characteristics - 7-deaza-8-aza-dG and 7-deaza-dG - have proved useful in analyzing G-quadruplex structures. Similarly, common DNA lesions - 8-oxo-dG and abasic sites - have been used to investigate their effect on G-quadruplex structure and activity.

TRIPLEX-FORMING OLIGONUCLEOTIDES

Triplex-forming oligonucleotides (TFO) bind in the major groove of duplex DNA in a sequence-specific manner through the formation of non Watson-Crick (Hoogsteen) hydrogen bonds. The formation of a triplex along the major groove competes with the binding of transcription factors and other proteins that are necessary for transcription, thereby inhibiting the expression of particular genes. A variety of nucleoside analogues have been used in TFO - 8-amino-dG, 8-amino-dA, 6-thio-dG and deoxypseudouridine.

i-MOTIF DNA STRUCTURES

Intercalated Motif (i-Motif) DNA structures may be formed in regions rich in 2'-deoxyCytidine. Especially at acidic pH, these structures could be described as C-Quadruplexes with two parallel stranded sequences also held together in an antiparallel orientation by cytosine-cytosine base pairs. Since these structures are stable at acidic pH, they can act as nanoswitches by change in pH. As they were not considered to be stable at physiological pH, they were not initially considered to be relevant to biological systems. However, the stability of the cytosine-cytosine base pair is enhanced by intercallating ligands and so a variety of i-Motif structures are now considered to be biologically significant. Since i-Motif structures have now been observed forming and dissolving in living cells, these structures are now the subject of active investigation of the meaning of their activity in human cells. Research is also being directed to the effect of common DNA lesions, like depurinated sites, 8-oxo-dG and 5-hydroxymethyl-dC, on these transient structures.

RELATED

7-Deaza-8-Aza-2'-deoxyGuanosine 61
8-oxo-2'-deoxyGuanosine 65
7-Deaza-2'-deoxyGuanosine 61
Abasic II Phosphoramidite 66
dSpacer 88
8-Amino-dG 66
8-Amino-dA 63
6-Thio-dG 62
2'-deoxypseudoU-CE Phosphoramidite 62
5-Hydroxymethyl-dC 54

APTAMER DEVELOPMENT

Aptamers, generated through repetitive selection using SELEX or an equivalent ***in vivo*** procedure, are chosen for their ability to bind desired target molecules, which are frequently small molecules useful in therapeutics. In some ways, they may be described as chemically engineered versions of antibodies. Of course, nucleic acid aptamers have advantages over antibodies in that they can be developed rapidly by *in vitro* methods, with the reproducibility of chemical synthesis and inherent stability of modified oligonucleotides. A full battery of base, sugar and internucleotide modifications is available for aptamer development.

2'-F-RNA has been used extensively in aptamer development, as well as 2'-F-ANA more recently. An article in The Glen Report by Jeff Carter, Director, Process Chemistry, SomaLogic, Inc. described[1] the use of a DNA backbone with 5-substituted dU analogues as low off-rate modified aptamer (SOMAmer®) reagents to enable multiplexed screening of thousands of serum or plasma proteins. These aptamers also include PC Biotin along with a fluorophore, in this case Cyanine 3, for subsequent detection.

REFERENCE

(1) J. Carter, ***The Glen Report***, 2015, **27.1,** 6-8.

RELATED

2'-F-RNA Phosphoramidites ... 147
2'-F-Arabinonucleic Acid (2'-F-ANA) ... 148
PC Biotin Phosphoramidite ... 104
Cyanine 3 Phosphoramidite ... 110

TERMINUS MODIFIERS

INTELLECTUAL PROPERTY

5′-Carboxy-Modifier C10 is offered for sale under license from TriLink BioTechnologies, Inc. It is intended for research and development purposes only, and may not be used for commercial, clinical, diagnostic or any other use. It is covered under US Patent No. 6,320,041.

RELATED

PC modifiers 90

ABBREVIATIONS

CNEt = Cyanoethyl
CPG = Controlled Pore Glass
DMT = 4,4′-Dimethoxytrityl
Fmoc = Fluorenylmethoxycarbonyl
iPr = Isopropyl
MMT = 4-Monomethoxytrityl
T = Trityl
TFA = Trifluroacetyl

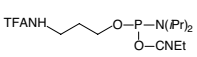
Glen Research 5′-Modifiers are designed for use in DNA synthesizers to functionalize the 5′-terminus of the target oligonucleotide. The 5′-Amino-Modifiers are available with a variety of chain lengths to fit exactly the desired application.

The DMS(O)MT-protected amino group is easier to deprotect compared to the MMT-protected one. The sulfoxy derivative survives conditions of oligonucleotide synthesis and can either be cleaved with standard deblock solution, or left intact for HPLC purification. At the same time, the DMS(O)MT group is fully compatible with cartridge purification. When detritylation on a cartridge is carried out, the DMS(O)MT+, which is more stable than MMT+, does not reattach itself to an amine. We now offer 5′-DMS(O)MT-Amino-Modifier C6 utilizing this new trityl based protecting group.

5′-Amino-Modifier TEG, a hydrophilic triethylene glycol ethylamine derivative, is 12 atoms in length and fully soluble in aqueous media.

Methacrylate C6 Phosphoramidite is a terminus modifier that attaches a methacrylate functional group to an oligonucleotide.

Item	Catalog No.	Pack
5′-Amino-Modifier C3-TFA	10-1923-90 10-1923-02	100 µmole 0.25g
5′-Amino-Modifier C6	10-1906-90 10-1906-02	100 µmole 0.25g
5′-Amino-Modifier C6-TFA	10-1916-90 10-1916-02	100 µmole 0.25g
5′-Amino-Modifier C12	10-1912-90 10-1912-02	100 µmole 0.25g
5′-Amino-Modifier 5	10-1905-90 10-1905-02	100 µmole 0.25g
5′-DMS(O)MT-Amino-Modifier C6	10-1907-90 10-1907-02	100 µmole 0.25g
5′-Amino-Modifier TEG	10-1917-90 10-1917-02	100 µmole 0.25g
Methacrylate C6 Phosphoramidite	10-1891-90 10-1891-02	100 µmole 0.25g



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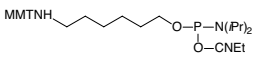

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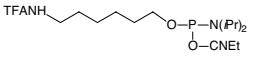

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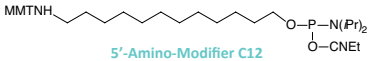
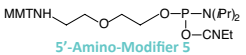
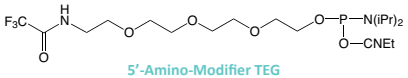


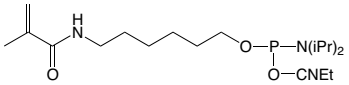
5′-Amino-Modifier C12



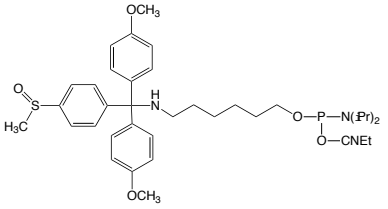
5′-Amino-Modifier 5



5′-Amino-Modifier TEG



Methacrylate C6 Phosphoramidite



5′-DMS(O)MT-Amino-Modifier C6

TERMINUS MODIFIERS (CONT.)

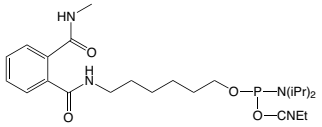
Our more recent 5'-amino modifiers, protected by a novel phthalic acid diamide (PDA) protecting group, are stable solids. In contrast to the TFA protected amino modifiers, which are viscous oils, the analogous PDA protected compounds are granular powders. This important property of these compounds allows straightforward handling, storage and aliquoting and leads to a significant increase in stability.

Deprotection with methylamine in gas phase or aqueous solution or AMA leads to fast and complete removal of the PDA protecting group. However, ammonium hydroxide will not drive the equilibrium reaction to completion and only partial deprotection occurs - overnight deprotection with ammonium hydroxide will yield around 80% active amine.

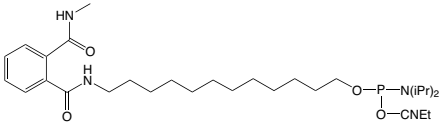
We are offering three PDA Amino-Modifiers:

- 5'-Amino-Modifier C6-PDA
- Hydrophobic 5'-Amino-Modifier C12-PDA
- Hydrophilic 5'-Amino-Modifier-TEG-PDA

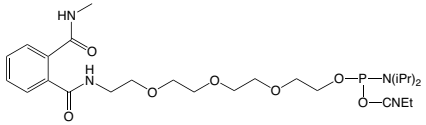
Item	Catalog No.	Pack
5'-Amino-Modifier C6-PDA	10-1947-90	100 µmole
	10-1947-02	0.25g
5'-Amino-Modifier C12-PDA	10-1948-90	100 µmole
	10-1948-02	0.25g
5'-Amino-Modifier-TEG-PDA	10-1949-90	100 µmole
	10-1949-02	0.25g



5'-Amino-Modifier C6-PDA



5'-Amino-Modifier C12-PDA



5'-Amino-Modifier-TEG-PDA

INTELLECTUAL PROPERTY

PDA amino-modifiers were eveloped by Stefan Pitsch and ReseaChem GmbH (S. Berger), Patent pending.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

TERMINUS MODIFIERS (CONT.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

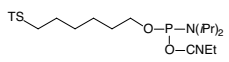
(Please inquire for availability of vials and columns for other instrument types.)

INTELLECTUAL PROPERTY

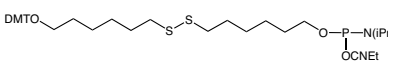
5′-Maleimide Modifier Phosphoramidite is protected by a patent application and is offered by Glen Research under a non-exclusive license agreement from the University of Barcelona.

The disulfide thiol modifier may be used for introducing 3′- or 5′-thiol linkages. Dithiol Serinol, produced from lipoic acid and our patented serinol backbone, allows easy connection of multiply dithiol-labeled oligos to gold surfaces. 5′-Carboxy-Modifier C10 is a unique linker designed to be added at the terminus of an oligonucleotide synthesis. It generates an activated carboxylic acid N-hydroxysuccinimide (NHS) ester suitable for immediate conjugation on the synthesis column with molecules containing a primary amine, resulting in a stable amide linkage. An alternative carboxylate protecting group is the 2-chlorotrityl group, which is simply removed using the standard deblock cycle to generate a free carboxyl group on an otherwise fully protected oligonucleotide. The 2-chlorotrityl group is also removed during oligo deprotection with ammonium hydroxide or AMA and is incompatible with RP purification techniques. PC Amino-Modifier is a photocleavable C6 amino-modifier, part of our line of photocleavable (PC) modifiers. 5′-AminoOxy-Modifier 11 is based on a tetraethylene glycol linkage for improved solubility and for reducing the potential negative impact on hybridization of the oligo. The oxime formed from the reaction of alkyloxyamines with aldehydes creates a stable covalent bond. In comparison, the imine formed by the conjugation of primary amines with aldehydes is not stable to acidic or basic conditions and requires subsequent reduction with borohydride to form stable amine conjugates. 5′-Maleimide Modifier Phosphoramidite, developed at the University of Barcelona, incorporates a maleimide cycloadduct that is stable to ammonium hydroxide at room temperature. This phosphoramidite can be incorporated into DNA and RNA with both phosphate and phosphorothioate linkages. A retro–Diels-Alder reaction deprotects the maleimide immediately prior to conjugation.

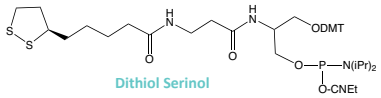
Item	Catalog No.	Pack
5′-Thiol-Modifier C6	10-1926-90 10-1926-02	100 µmole 0.25g
Thiol-Modifier C6 S-S	10-1936-90 10-1936-02	100 µmole 0.25g
Dithiol Serinol Phosphoramidite	10-1991-95 10-1991-90 10-1991-02	50 µmole 100 µmole 0.25g
PC Amino-Modifier Phosphoramidite	10-4906-90 10-4906-02	100 µmole 0.25g
5′-Carboxy-Modifier C10	10-1935-90 10-1935-02	100 µmole 0.25g
5′-Carboxy-Modifier C5	10-1945-90 10-1945-02	100 µmole 0.25g
5′-AminoOxy-Modifier 11	10-1919-95 10-1919-90 10-1919-02	50 µmole 100 µmole 0.25g
5′-Maleimide-Modifier Phosphoramidite	10-1938-90 10-1938-02	100 µmole 0.25g



5′-Thiol-Modifier C6



Thiol-Modifier C6 S-S



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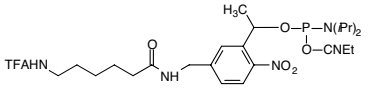
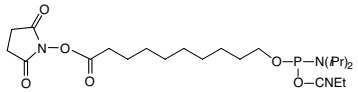
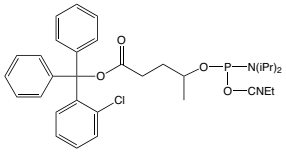


PC Amino-Modifier



5′-Carboxy-Modifier C10



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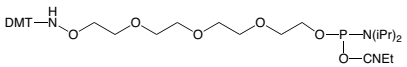
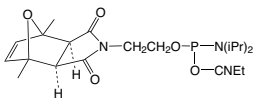


5′-AminoOxy-Modifier 11



5′-Maleimide-Modifier

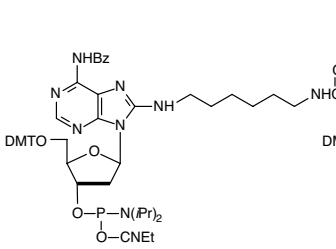
SEQUENCE MODIFIERS

Sequence Modifiers are designed for use in automated synthesis. The carboxy-dT is hydrolyzed during deprotection and can be coupled directly to a molecule containing a primary amino group by a standard peptide coupling or via the intermediate N-hydroxysuccinimide (NHS) ester. Amino-Modifier dA, Amino-Modifier dC, N2-Amino-Modifier dG and both Amino-Modifier dT products can be added in place of a dA, dC, dG and dT residue, respectively, during oligonucleotide synthesis. Corresponding Amino-Modifier supports can replace their respective deoxynucleoside supports. After deprotection, the primary amine on the C6 analogues is separated from the oligonucleotide by a spacer arm with a total of 7 -10 atoms and can be labeled or attached to an enzyme. The C2 analogue is more suitable for the attachment of molecules designed to react with the oligonucleotide.

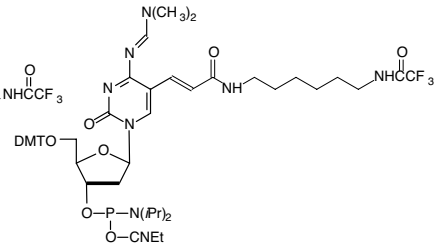
RELATED

Amino-Modifier supports..... 83

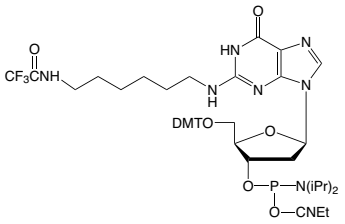
Item	Catalog No.	Pack
Amino-Modifier C6 dA	10-1089-90	100 µmole
	10-1089-02	0.25g
Amino-Modifier C6 dC	10-1019-90	100 µmole
	10-1019-02	0.25g
N2-Amino-Modifier C6 dG	10-1529-95	50 µmole
	10-1529-90	100 µmole
	10-1529-02	0.25g
Carboxy-dT	10-1035-90	100 µmole
	10-1035-02	0.25g
Amino-Modifier C2 dT	10-1037-90	100 µmole
	10-1037-02	0.25g
	10-1037-05	0.5g
Amino-Modifier C6 dT	10-1039-90	100 µmole
	10-1039-02	0.25g
	10-1039-05	0.5g



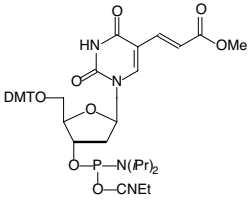
Amino-Modifier C6 dA



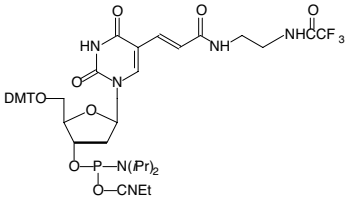
Amino-Modifier C6 dC



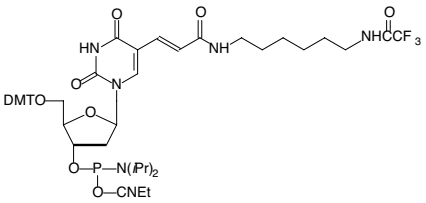
N2-Amino-Modifier C6 dG



Carboxy-dT



Amino-Modifier C2 dT



Amino-Modifier C6 dT

SEQUENCE MODIFIERS (CONT.)

RELATED

Carboxy-Modifiers.....80

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

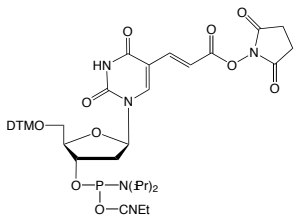
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

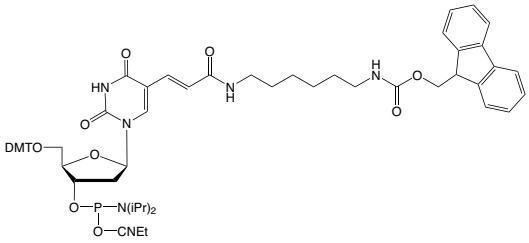
Our repertoire of NHS ester derivatives has been expanded to include the NHS-Carboxy-dT-CE Phosphoramidite. By making a dT analog of the Carboxy-Modifier C10, it is possible to label one or multiple sites within an oligonucleotide. This opens up the possibility to label any number of different dyes or molecules within an oligonucleotide when the phosphoramidite is unavailable. Doing so is straightforward and may be done manually off the synthesizer or even in a fully-automated manner on the DNA synthesizer.

We have never found conditions which allow the TFA group to be removed from an amino-modifier while the oligonucleotide remains attached to the support. We are able to solve this problem by using a 9-fluorenylmethoxycarbonyl (Fmoc) protecting group. The Fmoc group is removed using a two step procedure, the first to remove the cyanoethyl protection groups and flush the formed acrylonitrile from the synthesis column using 1% diisopropylamine in acetonitrile, and the second to remove the Fmoc group using 10% piperidine in DMF. The amino group so formed on the column can be reacted with a variety of activated esters. We offer Fmoc-Amino-Modifier C6 dT Phosphoramidite as a nucleosidic option and Amino-Modifier Serinol Phosphoramidite as a non-nucleosidic alternative. We also offer S-Bz-Thiol-Modifier C6-dT to join the ranks of thiol-modifiers for oligonucleotide synthesis. Thiol-Modifier C6-dT can be added as usual at the desired locations within a sequence.

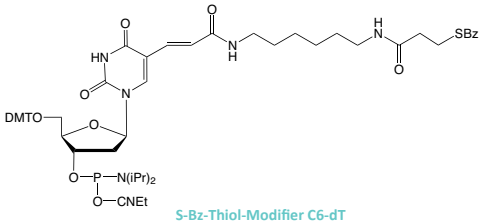
Item	Catalog No.	Pack
NHS-Carboxy-dT	10-1535-90	100 µmole
	10-1535-02	0.25g
Fmoc-Amino-Modifier C6 dT	10-1536-90	100 µmole
	10-1536-02	0.25g
S-Bz-Thiol-Modifier C6-dT	10-1538-95	50 µmole
	10-1538-90	100 µmole
	10-1538-02	0.25g
Amino-Modifier Serinol Phosphoramidite	10-1997-95	50 µmole
	10-1997-90	100 µmole
	10-1997-02	0.25g



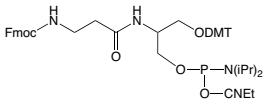
NHS-Carboxy-dT



Fmoc-Amino-Modifier C6 dT



S-Bz-Thiol-Modifier C6-dT

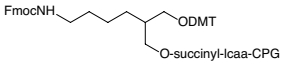


Amino-Modifier Serinol Phosphoramidite

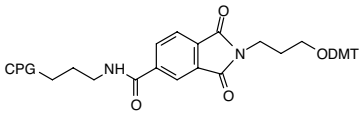
3’-MODIFIERS

3’-Amino-Modifier CPGs, containing amino groups protected with the base-labile Fmoc group, are designed to functionalize the 3’-terminus of the target oligonucleotide by the introduction of a primary amine. In an alternative approach, the nitrogen destined to become the 3’-amino group is included in a phthalimide (PT) group which is attached to the support through an amide group attached to the aromatic ring. This simple linkage is very stable to all conditions of oligonucleotide synthesis and contains no chiral center. Using an extended ammonium hydroxide treatment (55°C for 17 hours), the cleavage of the amine from the phthalimide is accomplished along with the deprotection of the oligonucleotide. ABI-style columns are supplied unless otherwise requested.

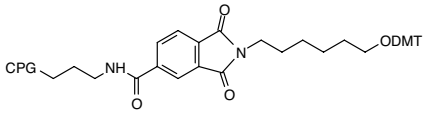
Item	Cat. No.	Pack
3’-Amino-Modifier C7 CPG 1000	20-2958-01	0.1g
	20-2958-10	1.0g
1 µmole columns	20-2958-41	Pack of 4
0.2 µmole columns	20-2958-42	Pack of 4
10 µmole column (ABI)	20-2958-13	Pack of 1
15 µmole column (Expedite)	20-2958-14	Pack of 1
3’-Amino-Modifier Serinol CPG	20-2997-01	0.1g
	20-2997-10	1.0g
0.2 µmole columns	20-2997-42	Pack of 4
1 µmole columns	20-2997-41	Pack of 4
10 µmole column (ABI)	20-2997-13	Pack of 1
15 µmole column (Expedite)	20-2997-14	Pack of 1
3’-PT-Amino-Modifier C3 CPG	20-2954-01	0.1g
	20-2954-10	1.0g
1 µmole columns	20-2954-41	Pack of 4
0.2 µmole columns	20-2954-42	Pack of 4
10 µmole column (ABI)	20-2954-13	Pack of 1
15 µmole column (Expedite)	20-2954-14	Pack of 1
3’-PT-Amino-Modifier C6 CPG	20-2956-01	0.1g
	20-2956-10	1.0g
1 µmole columns	20-2956-41	Pack of 4
0.2 µmole columns	20-2956-42	Pack of 4
10 µmole column (ABI)	20-2956-13	Pack of 1
15 µmole column (Expedite)	20-2956-14	Pack of 1
3'-PT-Amino-Modifier C6 PS	26-2956-01	0.1g
	26-2956-10	1.0g
200 nmole columns (ABI 3900)	26-2956-52	Pack of 10
40 nmole columns (ABI 3900)	26-2956-55	Pack of 10



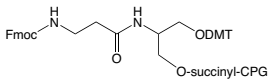
3’-Amino-Modifier C7 CPG



3’-PT Amino-Modifier C3 CPG



3’-PT Amino-Modifier C6 CPG



3’-Amino-Modifier Serinol CPG

3’-MODIFIERS (CONT.)

RELATED

Dithiol Serinol 80

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

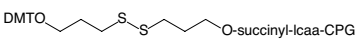
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

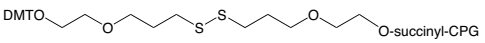
(Please inquire for availability of vials and columns for other instrument types.)

The 3’-Thiol-Modifier S-S CPG supports are used to introduce 3’-thiol linkages with three and six atom spacers into oligonucleotides. 3’-Dithiol Serinol CPG is used to introduce a dithiol group at the 3’-terminus. In conjunction with Dithiol Serinol Phosphoramidite, it is simple to produce oligonucleotides with multiple thiol groups at the 3’ terminus, which is ideal for conjugation to gold surfaces. With Glyceryl CPG the 3’-terminus of an oligonucleotide is readily oxidized by sodium periodate to form a 3’-phosphoglycaldehyde. The aldehyde may be further oxidized to the corresponding carboxylic acid. Either the aldehyde or the carboxylate may be used for subsequent conjugation to amine-containing products.

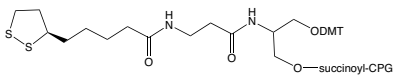
Item	Cat. No.	Pack
3’-Thiol-Modifier C3 S-S CPG	20-2933-01	0.1g
	20-2933-10	1.0g
0.2 µmole columns	20-2933-42	Pack of 4
1 µmole columns	20-2933-41	Pack of 4
10 µmole column (ABI)	20-2933-13	Pack of 1
15 µmole column (Expedite)	20-2933-14	Pack of 1
3’-Thiol-Modifier 6 S-S CPG	20-2938-01	0.1g
	20-2938-10	1.0g
0.2 µmole columns	20-2938-42	Pack of 4
1 µmole columns	20-2938-41	Pack of 4
10 µmole column (ABI)	20-2938-13	Pack of 1
15 µmole column (Expedite)	20-2938-14	Pack of 1
3’-Dithiol Serinol CPG	20-2991-01	0.1g
	20-2991-10	1.0g
0.2 µmole columns	20-2991-42	Pack of 4
1 µmole columns	20-2991-41	Pack of 4
10 µmole column (ABI)	20-2991-13	Pack of 1
15 µmole column (Expedite)	20-2991-14	Pack of 1
3’-Glyceryl CPG	20-2902-01	0.1g
	20-2902-10	1.0g
0.2 µmole columns	20-2902-42	Pack of 4
1 µmole columns	20-2902-41	Pack of 4
10 µmole column (ABI)	20-2902-13	Pack of 1
15 µmole column (Expedite)	20-2902-14	Pack of 1



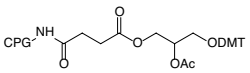
3’-Thiol-Modifier C3 S-S CPG



3’-Thiol-Modifier 6 S-S CPG



3’-Dithiol Serinol CPG

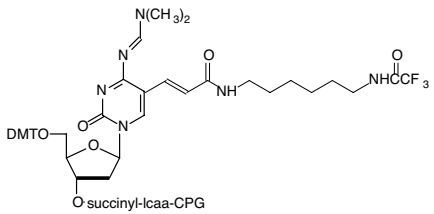


3’-Glyceryl CPG

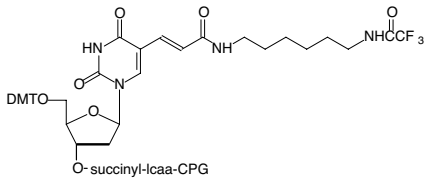
3’-MODIFIERS (CONT.)

3’-Amino-Modifier C6 dC CPG and 3’-Amino-Modifier C6 dT CPG replace a dC and T, respectively, at the 3’-terminus. These products allow convenient labeling at the 3’ without blocking the terminus from desired enzymatic activity.

Item	Cat. No.	Pack
3’-Amino-Modifier C6 dC CPG	20-2019-01	0.1g
	20-2019-10	1.0g
1 µmole columns	20-2019-41	Pack of 4
0.2 µmole columns	20-2019-42	Pack of 4
10 µmole column (ABI)	20-2019-13	Pack of 1
15 µmole column (Expedite)	20-2019-14	Pack of 1
3’-Amino-Modifier C6 dT CPG	20-2039-01	0.1g
	20-2039-10	1.0g
1 µmole columns	20-2039-41	Pack of 4
0.2 µmole columns	20-2039-42	Pack of 4
10 µmole column (ABI)	20-2039-13	Pack of 1
15 µmole column (Expedite)	20-2039-14	Pack of 1



Amino-Modifier C6 dC CPG



Amino-Modifier C6 dT CPG

CHEMICAL PHOSPHORYLATION

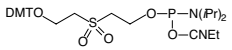
INTELLECTUAL PROPERTY

Solid Chemical Phosphorylation Reagent II and related supports are covered by European Patent: EP0816368.

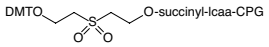
(1) A. Guzaev, H.Salo, A. Azhayev, and H. Lonnberg, ***Tetrahedron***, 1995, **51**, 9375-9384.

RELATED

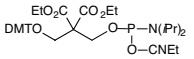
High load supports.....33



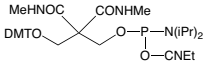
Chemical Phosphorylation Reagent



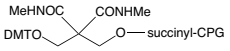
3'-Phosphate CPG



Chemical Phosphorylation Reagent II



Solid Chemical Phosphorylation Reagent II



3'-CPR II CPG

Chemical Phosphorylation Reagent is most commonly used to phosphorylate the 5'-terminus of an oligonucleotide. Although this product is also successful in 3'-phosphorylation, 3'-Phosphate CPG allows direct preparation of oligonucleotides with a 3'-phosphate group. Chemical Phosphorylation Reagent II contains a DMT group on a side chain which is stable to base cleavage and can be left on the oligonucleotide for use in RP purification. The DMT group is later removed with aqueous acid and the side chain is eliminated after brief treatment with aqueous ammonium hydroxide to yield the 5'-phosphate.[1] Solid CPR II is similar in performance to CPR II but it is easier to prepare aliquots since it is a powder. Many researchers treat synthesis supports with a hindered base (e.g., diethylamine, diisopropylethylamine, or DBU) post-synthesis to eliminate and remove the cyanoethyl phosphate groups. In this way, the acrylonitrile formed in situ is removed from the support and is not available to alkylate dT residues at the N3 position in the oligos. Since the sulfonylethyl group in 3'-Phosphate CPG is also susceptible to ß-elimination leading to oligo cleavage, this technique is not compatible with 3'-phosphate CPG. Using CPR II CPG, which is base labile but does not support ß-elimination, the cyanoethyl groups can be removed from the oligo prior to cleavage and base deprotection. ABI-style vials and columns are supplied unless otherwise requested.

Item	Cat. No.	Pack
Chemical Phosphorylation Reagent	10-1900-90	100 µmole
	10-1900-02	0.25g
3'-Phosphate CPG	20-2900-01	0.1g
	20-2900-10	1.0g
1 µmole columns	20-2900-41	Pack of 4
0.2 µmole columns	20-2900-42	Pack of 4
10 µmole column (ABI)	20-2900-13	Pack of 1
15 µmole column (Expedite)	20-2900-14	Pack of 1
3'-Phosphate PS	26-2900-01	0.1g
	26-2900-10	1.0g
200 nmole columns (ABI 3900)	26-2900-52	Pack of 10
40 nmole columns (ABI 3900)	26-2900-55	Pack of 10
3'-Phosphate CPG (High Load)	25-2900-01	0.1g
	25-2900-10	1.0g
2.5 µmole columns	25-2900-46	Pack of 4
Chemical Phosphorylation Reagent II (CPR II)	10-1901-90	100 µmole
	10-1901-02	0.25g
Solid Chemical Phosphorylation Reagent II (Solid CPR II)	10-1902-90	100 µmole
	10-1902-02	0.25g
3'-CPR II CPG	20-2903-01	0.1g
	20-2903-10	1.0g
0.2 µmole columns	20-2903-42	Pack of 4
1 µmole columns	20-2903-41	Pack of 4
10 µmole column (ABI)	20-2903-13	Pack of 1
15 µmole column (Expedite)	20-2903-14	Pack of 1

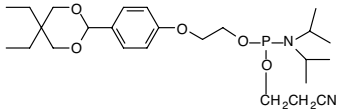
ALDEHYDE MODIFICATION

Aldehyde modifiers would be attractive electrophilic substitutions in oligonucleotides since they are able to react with amino groups to form a Schiff's base, with hydrazino groups to form hydrazones, and with semicarbazides to form semi-carbazones. The Schiff's base is unstable and must be reduced with sodium borohydride to form a stable linkage but hydrazones and semicarbazides are very stable linkages.

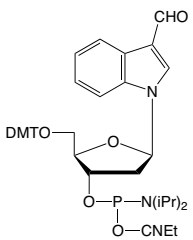
Our collaboration with ELITechGroup, formerly Epoch Biosciences, has allowed us to offer 5'-Aldehyde-Modifier C2 Phosphoramidite. The acetal protecting group is sufficiently hydrophobic for use in RP HPLC and cartridge purification and is readily removed after oligonucleotide synthesis under standard oligonucleotide detritylation conditions with 80% acetic acid / 20% water or 2% aqueous trifluoroacetic acid during cartridge purification.

A formylindole nucleoside analogue has been used to introduce aldehyde groups within an oligonucleotide or at the 5' terminus. This product has no protecting group on the aldehyde, which means that deprotection of the modified oligonucleotide can be done without changing preferred conditions.

Item	Cat. No.	Pack
5'-Aldehyde-Modifier C2 Phosphoramidite	10-1933-90 10-1933-02	100 µmole 0.25g
Formylindole CE Phosphoramidite	10-1934-90 10-1934-02	100 µmole 0.25g



5'-Aldehyde-Modifier C2



Formylindole

INTELLECTUAL PROPERTY

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A simple agreement must be signed before end-users and custom oligo services may purchase these products for use as defined above. https://www.glenresearch.com/media/productattach/import/technical_note/ELITechGroupProducts.pdf

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

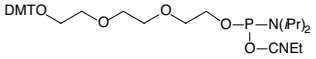
SPACER MODIFIERS

RELATED

PC Modifiers 90
Pyrrolidine 67

The spacer phosphoramidites C3, 9, C12 and 18 are used to insert a spacer arm in an oligonucleotide. The compounds may be added in multiple additions when a longer spacer is required. 3'-Spacer C3 CPG may also act as a blocker of exonuclease and polymerase activity at the 3'-terminus. dSpacer is used to introduce a stable abasic site within an oligonucleotide. PC Spacer is a photocleavable C3 spacer modifier, part of our line of photocleavable (PC) modifiers.

Item	Cat. No.	Pack
Spacer Phosphoramidite 9	10-1909-90	100 µmole
	10-1909-02	0.25g
Spacer Phosphoramidite C3	10-1913-90	100 µmole
	10-1913-02	0.25g
dSpacer CE Phosphoramidite	10-1914-90	100 µmole
	10-1914-02	0.25g
Spacer Phosphoramidite 18	10-1918-90	100 µmole
	10-1918-02	0.25g
Spacer C12 CE Phosphoramidite	10-1928-90	100 µmole
	10-1928-02	0.25g
3'-Spacer C3 CPG	20-2913-01	0.1g
	20-2913-10	1.0g
1 µmole columns	20-2913-41	Pack of 4
0.2 µmole columns	20-2913-42	Pack of 4
10 µmole column (ABI)	20-2913-13	Pack of 1
15 µmole column (Expedite)	20-2913-14	Pack of 1
PC Spacer Phosphoramidite	10-4913-90	100 µmole
	10-4913-02	0.25g



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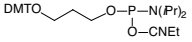

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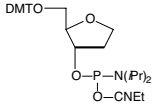

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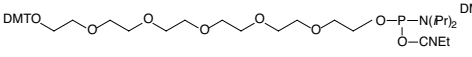

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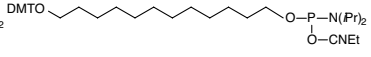

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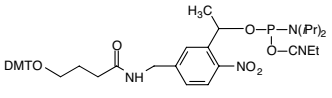


PC Spacer

DENDRIMERS

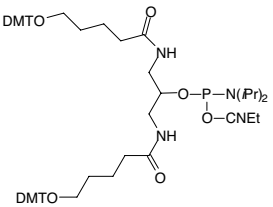
Dendrimers are discrete, highly branched, monodispersed polymers that possess patterns reminiscent of the branching of trees. Plain and mixed oligonucleotide dendrimers can be synthesized using novel doubling and trebling phosphoramidite synthons.[1,2] Dendrimers offer the following advantages. Incorporation of label using γ-32P-ATP and polynucleotide kinase increases in proportion to the number of 5'-ends. Fluorescent signal also increases in proportion to the number of 5'-ends, if spacers are incorporated between the labels and the ends of the branches. When using a dendrimeric oligonucleotide as a PCR primer, the strand bearing the dendrimer is resistant to degradation by T7 Gene 6 exonuclease making it easy to convert the double-stranded product of the PCR to a multiply labeled, single-stranded probe. Enhanced stability of DNA dendrimers makes them useful as building blocks for the 'bottom up' approach to nano-assembly. These features also suggest applications in DNA chip technology when higher temperatures are required, for example, to melt secondary structure in the target.

Item	Catalog No.	Pack
Symmetric Doubler Phosphoramidite	10-1920-90	100 µmole
	10-1920-02	0.25g
Asymmetric Doubler (LEV) Phosphoramidite	10-1981-90	100 µmole
	10-1981-02	0.25g
Trebler Phosphoramidite	10-1922-90	100 µmole
	10-1922-02	0.25g
Long Trebler Phosphoramidite	10-1925-90	100 µmole
	10-1925-02	0.25g

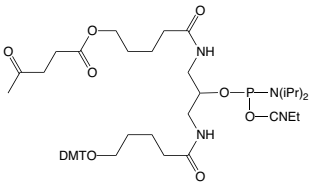
BRANCHING PHOSPHORAMIDITE

A branching monomer is required to construct comb-like oligonucleotide probes. The developers of the comb system from Chiron Corporation evaluated[3] several protecting groups for the branch point and chose levulinyl (LEV), which is specifically removed using a reagent containing hydrazine hydrate, acetic acid and pyridine.

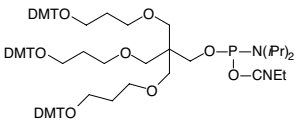
Item	Catalog No.	Pack
5-Me-dC Brancher Phosphoramidite	10-1018-90	100 µmole
	10-1018-02	0.25g



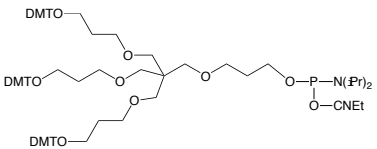
Symmetric Doubler



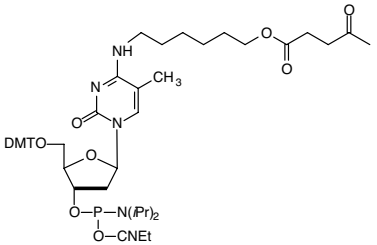
Asymmetric Doubler (LEV)



Trebler



Long Trebler



5-Me-dC Brancher

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

REFERENCES

(1) M.S. Shchepinov, I.A. Udalova, A.J. Bridgman, and E.M. Southern, ***Nucleic Acids Res***, 1997, **25**, 4447-4454.
(2) M.S. Shchepinov, K.U. Mir, J.K. Elder, M.D. Frank-Kamenetskii, and E.M. Southern, ***Nucleic Acids Res***, 1999, **27**, 3035-41.
(3) T. Horn, C.A. Chang, and M.S. Urdea, ***Nucleic Acids Res***, 1997, **25**, 4842-4849.

PHOTOCLEAVABLE MONOMERS

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

INTELLECTUAL PROPERTY

Glen Research offers PC Biotin, PC Amino-Modifier and PC Spacer products in association with AmberGen, Inc. and Link Technologies, Ltd. For a commercial application license, please contact AmberGen, Inc., +617-923-9990, (sales@ambergen.com), https://www.ambergen.com

PC Linker phosphoramidite is available from Glen Research in association with Link Technologies Ltd (Scotland).

RELATED

5'-Biotin 103

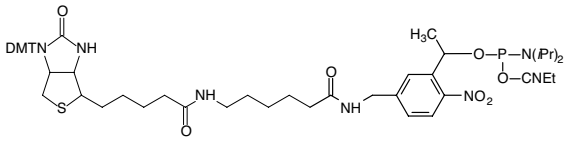
REFERENCES

(1) P. Ordoukhanian and J-S. Taylor, ***J. Am. Chem. Soc.***, **117**, 9570-9571, 1995.
(2a) F. Hausch and A. Jäschke, Nucleic Acids Research, 2000, **28**, e35.
(2b) F. Hausch and A. Jäschke, ***Tetrahedron***, 2001, **57**, 1261-1268.
(3) T. Wenzel, T. Elssner, K. Fahr, J. Bimmler, S. Richter, I. Thomas, and M. Kostrzewa, ***Nucleosides, Nucleotides & Nucleic Acids***, 2003, **22**, 1579-1581.

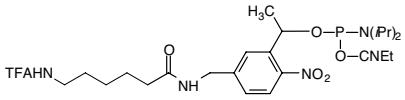
PC Biotin Phosphoramidite can be used to prepare 5'-biotinylated oligonucleotides suitable for capture by streptavidin in a mode similar to our popular 5' Biotin Phosphoramidite. Amino- and thiol-modified oligonucleotides have proven to be very useful for the attachment of a variety of haptens and fluorophores, as well as for the tethering of the oligonucleotides to a diversity of beads and surfaces. PC Amino-Modifier Phosphoramidite is used to prepare 5'-amino-modified oligonucleotides suitable for subsequent photocleavage. PC Spacer Phosphoramidite can be used as an intermediary to attach any modification reagent, available as a phosphoramidite, to the terminus of oligonucleotides. After photocleavage, a 5'-phosphate is generated on the DNA, rendering it suitable for further biological transformations, such as gene construction and cloning after ligation.

A versatile photocleavable DNA building block has been described by researchers in Washington University, Missouri and used in phototriggered hybridization.[1] This reagent has also been used in the design of multifunctional DNA and RNA conjugates[2] for the *in vitro* selection of new molecules catalyzing biomolecular reactions. Researchers at Bruker Daltonik in Germany have also developed genoSNIP, a method for single-nucleotide polymorphism (SNP) genotyping by MALDI-TOF mass spectrometry.[3] This method uses size reduction of primer extension products by incorporation of the photocleavable linker for phototriggering strand breaks near to the 3' end of the extension primer. PC Linker can be incorporated into oligonucleotides at any position by standard automated DNA synthesis methodology. PC Linker Phosphoramidite has the added advantage in that photocleavage results in monophosphate fragments at both the 3'- and 5'-termini of the oligonucleotide fragments.

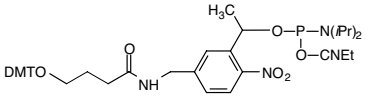
Item	Catalog No.	Pack
PC Biotin Phosphoramidite	10-4950-95	50 µmole
	10-4950-90	100 µmole
	10-4950-02	0.25g
PC Amino-Modifier Phosphoramidite	10-4906-90	100 µmole
	10-4906-02	0.25g
PC Spacer Phosphoramidite	10-4913-90	100 µmole
	10-4913-02	0.25g
PC Linker Phosphoramidite	10-4920-90	100 µmole
	10-4920-02	0.25g



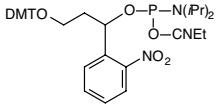
PC Biotin



PC Amino-Modifier



PC Spacer



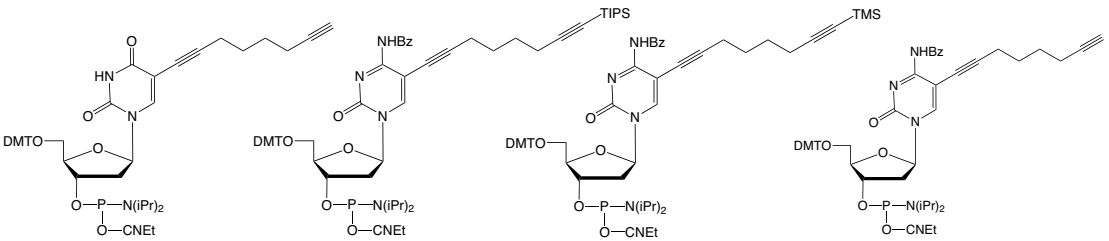
PC Linker

CONJUGATION USING CLICK CHEMISTRY

The copper(I)-catalyzed azide-alkyne cycloaddition (CuAAC) reaction between azides and alkynes to form 1,2,3-triazoles, as reported[1] by Sharpless, was found to be so exquisitely regioselective and efficient at even the most mild conditions that Sharpless coined the term 'Click Chemistry' to describe it. The use of this method for DNA modification has been somewhat delayed by the fact that copper ions damage DNA, typically yielding strand breaks.[2] As these problems have now been overcome by the use of copper(I)-stabilizing ligands (e.g., tris(benzyltriazolylmethyl)amine, TBTA[3]), Carell et al. and Seela et al. discovered that the CuAAC reaction can be used to functionalize alkyne-modified DNA nucleobases with extremely high efficiency.[4]

Oligonucleotides bearing a single nucleosidic alkyne group can be prepared using a C8-Alkyne-dC or dT-CE Phosphoramidite. Purified oligonucleotides are usually modified with 2-5 equivalents of the corresponding marker-azide (e.g., fluorescent-dye azides). After the addition of precomplexed Cu(I), complete conversion to the labeled oligo is observed in a time span between 30 min and 4 hours. After a simple precipitation step, labeled oligonucleotides can be recovered in near quantitative yields. Using a combination of C8-Alkyne, C8-TIPS-Alkyne and C8-TMS-Alkyne, it is possible to label oligonucleotides in up to three separate click reactions. The alkyne groups on the last two monomers are protected, respectively, with triisopropylsilyl (TIPS) and trimethylsilyl (TMS) protecting groups.[5,6] The first click reaction on solid phase on a C8-Alkyne yields the singly modified oligonucleotide with full retention of the TIPS and/or TMS protecting group. For double click, a C8-TIPS-Alkyne is used as the second nucleoside and the TIPS protecting group is cleaved with tetrabutylammonium fluoride (TBAF) without causing any damage to the DNA. The second click reaction in solution yields the doubly modified oligonucleotide in excellent yield. For the introduction of three different labels, all three nucleosides are introduced into oligonucleotides. The first click reaction is performed directly on the resin. The singly modified oligonucleotide is subsequently cleaved from the support with concomitant cleavage of the TMS group and retention of the TIPS protecting group. The second click reaction is performed in solution. Precipitation of the doubly modified oligonucleotide, cleavage of the TIPS group with TBAF, and a subsequent third click reaction in solution furnishes the desired triply modified oligonucleotide in excellent overall yield.

Item	Catalog No.	Pack
C8-Alkyne-dT-CE Phosphoramidite	10-1540-95	50 µmole
	10-1540-90	100 µmole
	10-1540-02	0.25g
C8-TIPS-Alkyne-dC-CE Phosphoramidite	10-1541	Discontinued
C8-TMS-Alkyne-dC-CE Phosphoramidite	10-1542	Discontinued
C8-Alkyne-dC-CE Phosphoramidite	10-1543-95	50 µmole
	10-1543-90	100 µmole
	10-1543-02	0.25g



REFERENCES

[1] C.W. Tornoe, C. Christensen, M. Meldal, *J. Org. Chem.* 2002, **67**, 3057-3064; V. V. Rostovtsev, L. G. Green, V. V. Fokin, K. B. Sharpless, *Angew. Chem.* 2002, **114**, 2708-2711; *Angew. Chem. Int. Ed.* 2002, **41**, 2596-2599.

[2] C. J. Burrows, J. G. Muller, *Chem. Rev.* 1998, **98**, 1109 – 1151.

[3] T. R. Chan, R. Hilgraf, K. B. Sharpless, V. V. Fokin, *Org. Lett.* 2004, **6**, 2853 – 2855.

[4] J. Gierlich, G. A. Burley, P. M. E. Gramlich, D. M. Hammond, T. Carell, *Org. Lett.* 2006, **8**, 3639-3642. F. Seela, V. R. Sirivolu, *Chem. Biodiversity* 2006, **3**, 509-514.

[5] P. M. E. Gramlich, S. Warncke, J. Gierlich, T. Carell, *Angew. Chem.* 2008, **120**, 3491–3493; *Angew. Chem. Int. Ed.* 2008, **47**, 3442–3444.

[6] P. M. E. Gramlich, C. T. Wirges, A. Manetto, T. Carell, *Angew. Chem. Int. Ed.* 2008, **47**, 8350-8358.

INTELLECTUAL PROPERTY

baseclick GmbH has been granted the following patents (1-3) besides its further patent applications (4-5).

1. WO 2006/117161 (New labeling strategies for the sensitive detection of analytes)
2. WO 2008/952775 (Click chemistry for the production of reporter molecules)
3. WO 2010/115957 (Click Chemistry on heterogeneous catalysts)
4. PCT/EP 2013/064610 (Anandamide-modified nucleic molecules)
5. PCT/EP 2015/056007 (Self-assembly of DNA Origami: a diagnostic tool)

baseclick GmbH holds a worldwide exclusive license for granted patent application WO 03/101972 (Copper-catalysed ligation of azides and acetylenes for the nucleic acid field) in the area of diagnostics and research.

As Glen Research and baseclick are partners, Glen Research is now able to help in sublicensing this outstanding technology.

CONJUGATION USING CLICK CHEMISTRY (CONT.)

RELATED

3'-Propargyl-5-Me-dC CPG.....68

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

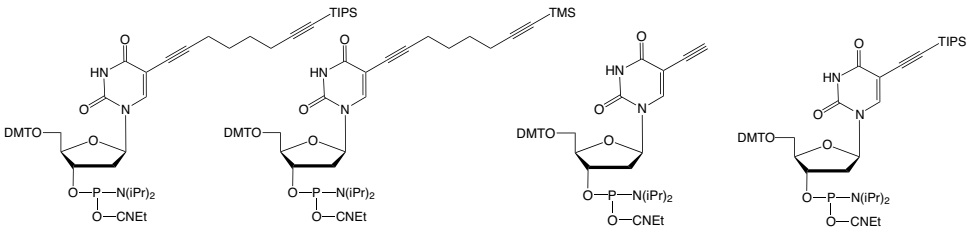
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

5-Ethynyl-dU offers convenient click conjugation with an azide to generate a label rigidly attached to one of the oligonucleotide bases. 5-Ethynyl-dU is subject to base-catalyzed hydration during cleavage and deprotection, especially when using a strong base or heat. Hydration of an ethynyl group forms a methyl ketone which subsequently blocks potential click reactions. Mild deprotection conditions are necessary when using 5-Ethynyl-dU-CE Phosphoramidite to prevent this side reaction. TIPS-5-Ethynyl-dU-CE Phosphoramidite, containing a protected alkyne, offers broader compatibility with oligonucleotide synthesis and deprotection. Protecting the 5-ethynyl group with a triisopropylsilyl (TIPS) protecting group prevents acid or base catalyzed hydration during oligonucleotide synthesis and workup. A quick treatment with TBAF removes the TIPS protecting group.

Item	Catalog No.	Pack
C8-TIPS-Alkyne-dT-CE Phosphoramidite	10-1544	Discontinued
C8-TMS-Alkyne-dT-CE Phosphoramidite	10-1545	Discontinued
5-Ethynyl-dU-CE Phosphoramidite	10-1554-95	50 µmole
	10-1554-90	100 µmole
	10-1554-02	0.25g
TIPS-5-Ethynyl-dU-CE Phosphoramidite	10-1555-95	50 µmole
	10-1555-90	100 µmole
	10-1555-02	0.25g
THPTA Ligand	50-1004-92	25 µmole
(Water soluble)	50-1004-90	100 µmole
Click-Solution (DMSO/t-BuOH)	50-1002-11	10 x 1.0mL



C8-TIPS-Alkyne-dT | C8-TMS-Alkyne-dT | 5-Ethynyl-dU | TIPS-5-Ethynyl-dU

CONJUGATION USING CLICK CHEMISTRY (CONT.)

Oligonucleotides prepared using 5'-Hexynyl Phosphoramidite are stable to standard deprotection conditions and exhibit a slightly increased retention time on RP HPLC. Azides are not compatible with oligonucleotide synthesis using phosphoramidites so a post-synthesis reaction is required. Azidobutyrate NHS Ester is used[1] for azido-modification of amines at either the 3'-end or the 5'-end of an oligo and it can even be used for internal modification on an Amino-Modifier-C6 dX residue within the sequence. Specific to the 5'-terminus, 5'-Bromohexyl Phosphoramidite is added in the last cycle. This modifier can then be easily transformed into a 5'-azido group by displacement of bromide using sodium azide.[2] Alkyne NHS ester allows the functionalization of an amino moiety in a variety of molecules, including DNA and RNA oligonucleotides as well as peptides or proteins. We also offer two products for use in Click Chemistry based upon our 1,3-diol product portfolio with the serinol backbone - a phosphoramidite for adding an alkyne group at the 5' terminus or within the sequence, and a synthesis support for labeling the 3' terminus of oligonucleotides with an alkyne group.

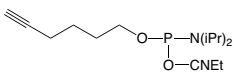
REFERENCES

(1) R. Kumar, et al., *Journal of the American Chemical Society*, 2007, **129**, 6859-6864.
(2) J. Lietard, A. Meyer, J.J. Vasseur, and F. Morvan, *Tetrahedron Letters*, 2007, **48**, 8795-8798.

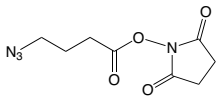
RELATED

Serinol Products 98

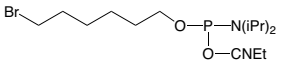
Item	Catalog No.	Pack
5'-Hexynyl Phosphoramidite	10-1908-90	100 µmole
	10-1908-02	0.25g
Azidobutyrate NHS Ester	50-1904-23	2.3mg
(Dissolve 2.3mg in 60µL of DMSO)	50-1904-24	23mg
5'-Bromohexyl Phosphoramidite	10-1946-90	100 µmole
	10-1946-02	0.25g
Alkyne-NHS Ester	50-1905-23	2.3mg
(Dissolve 2.3mg in 60µL of DMSO)	50-1905-24	23mg
Alkyne-Modifier Serinol Phosphoramidite	10-1992-95	50 µmole
	10-1992-90	100 µmole
	10-1992-02	0.25g
3'-Alkyne-Modifier Serinol CPG	20-2992-01	0.1g
	20-2992-10	1.0g
0.2 µmole columns	20-2992-42	Pack of 4
1 µmole columns	20-2992-41	Pack of 4
10 µmole column (ABI)	20-2992-13	Pack of 1
15 µmole column (Expedite)	20-2992-14	Pack of 1



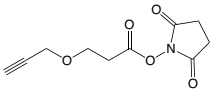
5'-Hexynyl Phosphoramidite



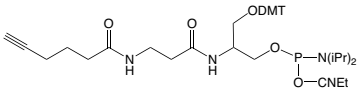
Azidobutyrate NHS Ester



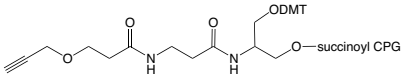
5'-Bromohexyl Phosphoramidite



Alkyne-NHS Ester



Alkyne-Modifier Serinol Phosphoramidite



3'-Alkyne-Modifier Serinol CPG

CONJUGATION USING CLICK CHEMISTRY (CONT.)

RELATED

dSpacer 88

STABILITY NOTES

Oligonucleotides containing a 5′-iodo group are prepared conventionally with the exception that deprotection is carried out in ammonium hydroxide at room temperature for 24 hours. Under these conditions, degradation of the iodo group was less than 2%.

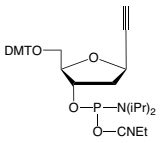
1-Ethynyl-dSpacer CE Phosphoramidite can be used in any position within an oligonucleotide while still retaining the high efficiency of click chemistry. The modifier is efficiently incorporated into oligonucleotides using standard phosphoramidite chemistry, is stable to common deprotection conditions, and is compatible with Glen-Pak™ purification. 1-Ethynyl-dSpacer generates a substituted 1,2,3-triazole pseudo-nucleobase after click chemistry conjugation with an azide. The 1-ethynyl-dSpacer modification exhibits similar duplex stability to the standard dSpacer (10-1914) and destabilizes the duplex when internally incorporated. Upon cycloaddition, the duplex stability is moderated by the resulting structure of the modification. Simple 1,2,3-triazoles were destabilizing, as were modifications that incorporated TEG linkers (6-FAM-TEG and Amino-TEG). Modifications that incorporated aromatic functional groups restored duplex stability to varying degrees with coumarin and psoralen significantly restoring stability. A 5′-iodo-modified oligonucleotide (prepared using 5′-Iodo-dT) can be quantitatively converted to the corresponding 5′-azide.

Item	Catalog No.	Pack
1-Ethynyl-dSpacer CE Phosphoramidite	10-1910-95	50 µmole
	10-1910-90	100 µmole
	10-1910-02	0.25g
5′-I-dT-CE Phosphoramidite	10-1931-90	100 µmole
	10-1931-02	0.25g

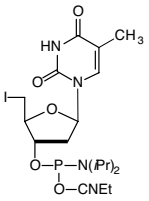
OLIGO-CLICK KITS

Oligo-Click Kits has been discontinued. Please contact technical support.

Item	Catalog No.	Pack
baseclick Oligo-Click-M-Reload	50-2100	Discontinued
baseclick Oligo-Click-M-Biotin	50-2101	Discontinued
baseclick Oligo-Click-M-Fluorescein	50-2102	Discontinued
baseclick Oligo-Click-M-TAMRA	50-2103	Discontinued



1-Ethynyl-dSpacer



5′-I-dT

COPPER-FREE CLICK CHEMISTRY

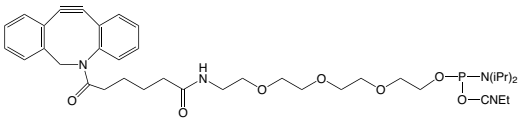
At Glen Research, our goal was to offer a copper-free click phosphoramidite reagent with the following properties:

- Simple to use
- Stable in solution on the synthesizer
- Stable to ammonium hydroxide and AMA
- Excellent click performance in 17 hours or less at room temperature

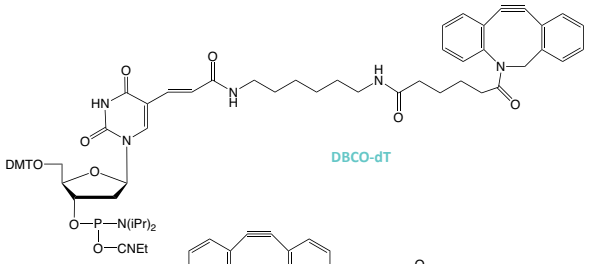
From the variety of cyclooctyne-based copper-free click reagents so far described, we have chosen to offer compounds based on a dibenzo-cyclooctyne (DBCO) structure. We are offering 5'-DBCO-TEG Phosphoramidite for preparing oligos with a 5'-DBCO modification and DBCO-dT-CE Phosphoramidite for inserting a DBCO group at any position within the oligonucleotide. In addition, we offer a further DBCO phosphoramidite – DBCO-Serinol Phosphoramidite. Using our proprietary serinol backbone as a non-nucleosidic spacer allows the DBCO group to be placed at any location within a sequence with multiple additions clearly possible. DBCO-sulfo-NHS Ester is also offered for post-synthesis conjugation reactions. DBCO-modified oligos may be conjugated with azides in organic solvents, such as DMSO, or aqueous buffers. Depending on the azide used, the reaction will go to completion in 4-17 hours at room temperature. Simple desalting on a Glen Gel-Pak™ leads to a product with virtually quantitative conjugation efficiency.

Note: We now recommend that synthesis of oligos containing DBCO-dT be completed using 0.5 M CSO in anhydrous acetonitrile (40-4632-xx). Acceptable results can be achieved with iodine oxidation if DBCO-dT is subjected to no more than 8-10 cycles.

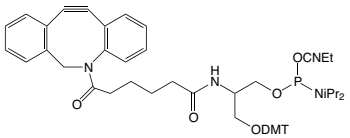
Item	Catalog No.	Pack
5'-DBCO-TEG Phosphoramidite	10-1941-95	50 µmole
	10-1941-90	100 µmole
	10-1941-02	0.25g
DBCO-dT-CE Phosphoramidite	10-1539-95	50 µmole
	10-1539-90	100 µmole
	10-1539-02	0.25g
DBCO-sulfo-NHS Ester	50-1941-23	5.2mg
(Dissolve 5.2mg in 60µL water or DMSO)	50-1941-24	52mg
DBCO-Serinol Phosphoramidite	10-1998-95	50 µmole
	10-1998-90	100 µmole
	10-1998-02	0.25g



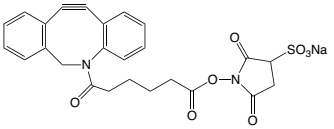
5'-DBCO-TEG



DBCO-dT



DBCO-Serinol



DBCO-sulfo-NHS Ester

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

RELATED

0.5M CSO 36
Serinol Products 98

CONJUGATION USING CLICK CHEMISTRY (CONT.)

REFERENCE

(1) J. Gierlich, G.A. Burley, P.M. Gramlich, D.M. Hammond, and T. Carell, ***Org Lett,*** 2006, **8**, 3639-42.

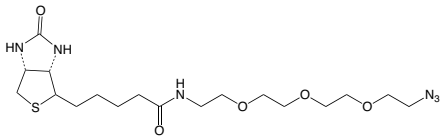
Glen Research is offering first our most popular labels for general interest and, subsequently, we will add azide products that are not compatible with phosphoramidite chemistry.

Biotin is still our most commonly used label and biotinTEG, with its hydrophilic triethylene glycol spacer, is the most popular biotin product. Desthiobiotin is a biotin analogue that is well captured by streptavidin but the captured product can be easily released by applying a biotin solution to the streptavidin beads. 6-FAM is our most popular fluorescein derivative and we offer azides of both 6-FAM and pivaloyl-protected 6-FAM for situations where subsequent reactions require the 6-FAM to be protected. In both 6-FAM products, the hydrophilic TEG spacer is again used. The azides are offered in 25 and 100 µmole packs for convenient oligonucleotide labeling.

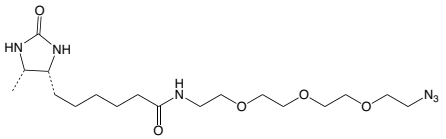
7-Hydroxycoumarin, also known as umbelliferone, is a highly fluorescent, pH-sensitive fluorophore that emits in the blue region of the spectrum. However, its fluorescence is strongly quenched if the hydroxyl is alkylated or phosphorylated, making it useful in high-throughput screening for phosphatases and lipases. Interestingly, it was found that the 3-azido derivative is also highly quenched but, upon reaction with an alkyne in the presence of copper to form the triazole, the fluorescence is restored.[1] The clicked coumarin emits at a lambda max of 480 nm and absorbs at 358 nm.

HEX and TET are two of our most popular fluorescein-based dyes for labeling oligonucleotides. We are happy to offer 6-HEX and 6-TET Azides for use in click conjugations.

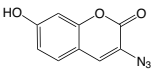
Item	Catalog No.	Pack
BiotinTEG Azide	50-2000-92	25 µmole
	50-2000-90	100 µmole
DesthiobiotinTEG Azide	50-2001-92	25 µmole
	50-2001-90	100 µmole
Dipivaloyl 6-FAM-TEG Azide	50-2002-92	25 µmole
	50-2002-90	100 µmole
6-FAM-TEG Azide	50-2003-92	25 µmole
	50-2003-90	100 µmole
Coumarin Azide	50-2004-92	25 µmole
	50-2004-90	100 µmole
6-HEX Azide	50-2005-92	25 µmole
	50-2005-90	100 µmole
6-TET Azide	50-2006-92	25 µmole
	50-2006-90	100 µmole



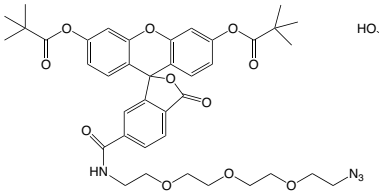
BiotinTEG Azide



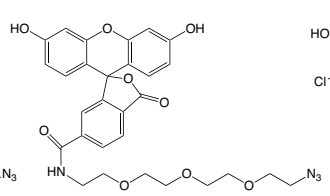
DesthiobiotinTEG Azide



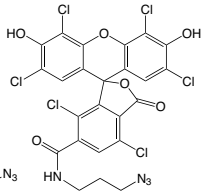
Coumarin Azide



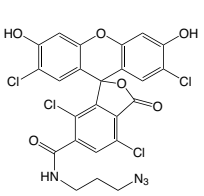
Dipivaloyl 6-FAM-TEG Azide



6-FAM-TEG Azide



6-HEX Azide



6-TET Azide

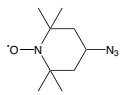
CONJUGATION USING CLICK CHEMISTRY (CONT.)

Two nitroxide spin labels, TEMPO Azide and TEMPO-TEG Azide, for site directed spin labeling (SDSL) are now offered.

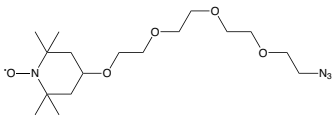
Click Chemistry with psoralen azide and one of our many nucleosidic and non-nucleosidic alkyne derivatives has the potential to generate a variety of practical cross-linkers. The well known reversible cross-linking behavior of psoralen with an adjacent thymidine residue could be very useful.

To better address applications in near-infrared (NIR) imaging, Glen Research is offering a water soluble Disulfo-Cyanine 7 azide that can be easily conjugated to DNA and RNA through standard click chemistry. This long wavelength dye offers the benefits of improved solubility, reduced aggregation, and improved stability in the near-infrared spectrum along with the convenience of click chemistry.

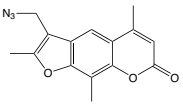
Item	Catalog No.	Pack
TEMPO Azide	50-2007-92	25 µmole
	50-2007-90	100 µmole
TEMPO-TEG Azide	50-2008-92	25 µmole
	50-2008-90	100 µmole
Psoralen Azide	50-2009-92	25 µmole
	50-2009-90	100 µmole
Disulfo-Cyanine 7 Azide	50-2010	Discontinued



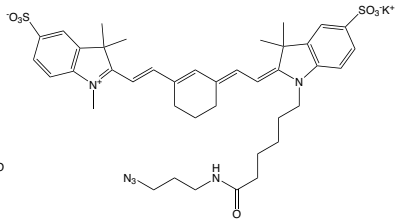
TEMPO Azide



TEMPO-TEG Azide



Psoralen Azide



Disulfo-Cyanine 7 Azide

SERINOL REAGENTS FOR MODIFICATION AND LABELING

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

INTELLECTUAL PROPERTY

Serinol Reagents for Modification and Labeling are covered by US Patent No.: 8,394,948.

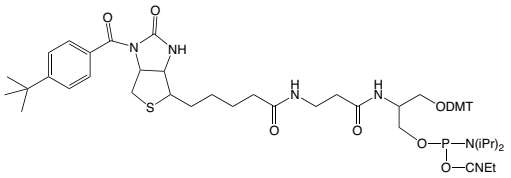
Most popular non-nucleosidic phosphoramidites for modification and labeling are based on two structural types: 1,2-diols and 1,3-diols. Products based on a 1,2-diol backbone were first described to allow amino-modification and biotin labeling. Technically, the 1,2-diol backbone has some drawbacks relative to the 1,3-diol backbone. The 1,2-diol backbone can participate in a dephosphorylation reaction since the 1,2-diol can form a favored 5-membered cyclic phosphate intermediate. This reaction is competitive with simple hydrolysis of the protecting groups and leads to some loss of label. However, the degree of loss at the 3' terminus can be limited by the removal of the cyanoethyl protecting group using DBU or diethylamine prior to the cleavage and deprotection steps. Similarly, loss at the 5' terminus can be eliminated by retaining the DMT group until the oligo is fully deprotected. Fortunately, the elimination reaction is virtually non-existent in the 1,3-diol backbone since the cyclic intermediate would be a 6-membered ring which is not favored for a cyclic phosphate intermediate.

IVD customers have requested a new backbone based on a 1,3-diol that would overcome any technical or IP issues surrounding our current products. We now offer a line of products based on the serinol backbone, which have been developed in close collaboration between Glen Research and Nelson Biotechnologies. Protected Biotin Serinol Phosphoramidite and CPG are protected with a *t*-butylbenzoyl group on the biotin ring. This group is designed to stop any phosphoramidite reactions at this active position in biotin. This protection avoids branching when using nucleophilic activators like DCI. The protecting group is easily removed during oligonucleotide cleavage and deprotection. The BiotinLC versions are similarly protected and should be useful for the synthesis of highly sensitive biotinylated probes. 6-Fluorescein Serinol Phosphoramidite and CPG are designed to prepare oligonucleotides containing one or several 6-Fluorescein (6-FAM) residues. Amino-Modifier Serinol Phosphoramidite and CPG are used to add amino groups into one or several positions in oligonucleotides. The amino group is protected with Fmoc, which may be removed on the synthesis column prior to solid-phase conjugation to the amino groups, or which may be removed during deprotection for subsequent solution phase conjugation to the amino groups.

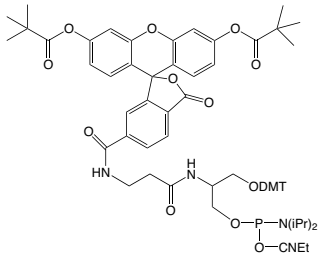
Combining lipoic acid and our patented serinol backbone, we now offer Dithiol Serinol Phosphoramidite and the related 3'-Dithiol Serinol CPG. This unique architecture moves the bulky dithiol away from the phosphate backbone, making it suitable for conjugation to gold surfaces. The long spacer arm of Dithiol Serinol also allows multiple consecutive incorporations of the modifier without the need for intermediate spacer phosphoramidite additions to achieve optimal stepwise coupling efficiency.

We offer three products for use in Click Chemistry based upon our 1,3-diol product portfolio with the serinol backbone - a phosphoramidite for adding an alkyne group at the 5' terminus or within the sequence, a synthesis support for labeling the 3' terminus of oligonucleotides with an alkyne group, and DBCO-Serinol phosphoramidite as a copper-free click reagent.

Item	Catalog No.	Pack
Protected Biotin Serinol Phosphoramidite	10-1993-95	50 µmole
	10-1993-90	100 µmole
	10-1993-02	0.25g
6-Fluorescein Serinol Phosphoramidite	10-1994-95	50 µmole
	10-1994-90	100 µmole
	10-1994-02	0.25g



Protected Biotin Serinol Phosphoramidite



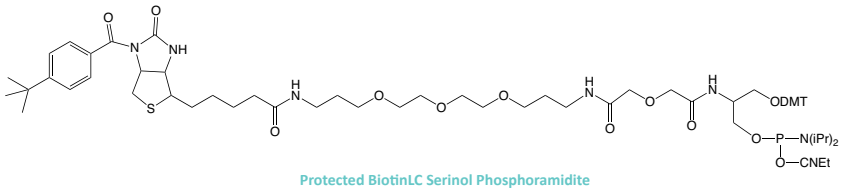
6-Fluorescein Serinol Phosphoramidite

SERINOL REAGENTS FOR MODIFICATION AND LABELING (CONT.)

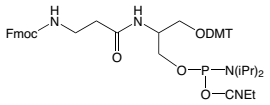
Item	Catalog No.	Pack
Protected BiotinLC Serinol Phosphoramidite	10-1995-95	50 µmole
	10-1995-90	100 µmole
	10-1995-02	0.25g
Amino-Modifier Serinol Phosphoramidite	10-1997-95	50 µmole
	10-1997-90	100 µmole
	10-1997-02	0.25g
Dithiol Serinol Phosphoramidite	10-1991-95	50 µmole
	10-1991-90	100 µmole
	10-1991-02	0.25g
Alkyne-Modifier Serinol Phosphoramidite	10-1992-95	50 µmole
	10-1992-90	100 µmole
	10-1992-02	0.25g
DBCO-Serinol Phosphoramidite	10-1998-95	50 µmole
	10-1998-90	100 µmole
	10-1998-02	0.25g

RELATED

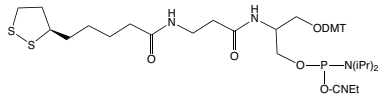
DBCO.....95



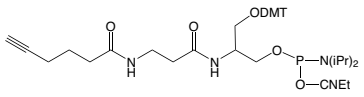
Protected BiotinLC Serinol Phosphoramidite



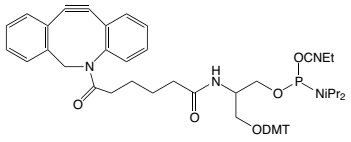
Amino-Modifier Serinol Phosphoramidite



Dithiol Serinol



Alkyne-Modifier Serinol Phosphoramidite



DBCO-Serinol

SERINOL REAGENTS FOR MODIFICATION AND LABELING (CONT.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

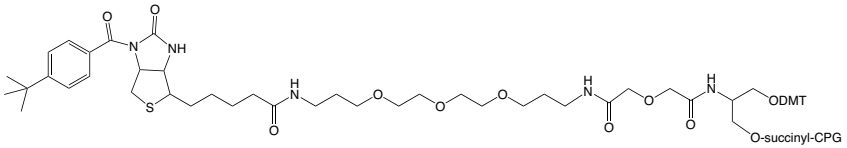
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

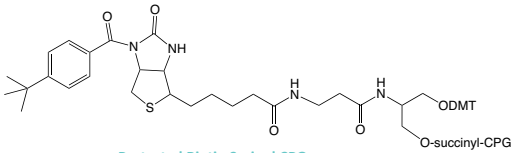
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

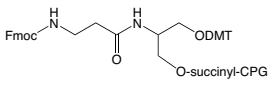
Item	Catalog No.	Pack
3'-Protected Biotin Serinol CPG	20-2993-01	0.1g
	20-2993-10	1.0g
0.2 µmole columns	20-2993-42	Pack of 4
1 µmole columns	20-2993-41	Pack of 4
10 µmole column (ABI)	20-2993-13	Pack of 1
15 µmole column (Expedite)	20-2993-14	Pack of 1
3'-6-Fluorescein Serinol CPG	20-2994-01	0.1g
	20-2994-10	1.0g
0.2 µmole columns	20-2994-42	Pack of 4
1 µmole columns	20-2994-41	Pack of 4
10 µmole column (ABI)	20-2994-13	Pack of 1
15 µmole column (Expedite)	20-2994-14	Pack of 1
3'-Protected BiotinLC Serinol CPG	20-2995-01	0.1g
	20-2995-10	1.0g
0.2 µmole columns	20-2995-42	Pack of 4
1 µmole columns	20-2995-41	Pack of 4
10 µmole column (ABI)	20-2995-13	Pack of 1
15 µmole column (Expedite)	20-2995-14	Pack of 1
3'-Amino-Modifier Serinol CPG	20-2997-01	0.1g
	20-2997-10	1.0g
0.2 µmole columns	20-2997-42	Pack of 4
1 µmole columns	20-2997-41	Pack of 4
10 µmole column (ABI)	20-2997-13	Pack of 1
15 µmole column (Expedite)	20-2997-14	Pack of 1



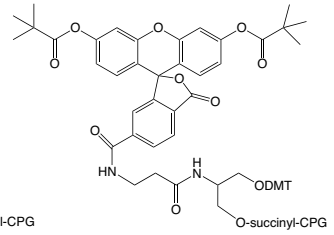
Protected BiotinLC Serinol CPG



Protected Biotin Serinol CPG



Amino-Modifier Serinol CPG



6-Fluorescein Serinol CPG

SERINOL REAGENTS FOR MODIFICATION AND LABELING (CONT.)

Item	Catalog No.	Pack
3'-Dithiol Serinol CPG	20-2991-01	0.1g
	20-2991-10	1.0g
0.2 µmole columns	20-2991-42	Pack of 4
1 µmole columns	20-2991-41	Pack of 4
10 µmole column (ABI)	20-2991-13	Pack of 1
15 µmole column (Expedite)	20-2991-14	Pack of 1
3'-Alkyne-Modifier Serinol CPG	20-2992-01	0.1g
	20-2992-10	1.0g
0.2 µmole columns	20-2992-42	Pack of 4
1 µmole columns	20-2992-41	Pack of 4
10 µmole column (ABI)	20-2992-13	Pack of 1
15 µmole column (Expedite)	20-2992-14	Pack of 1

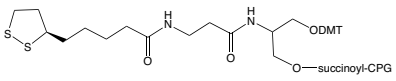
INTELLECTUAL PROPERTY

This product is covered under US Patent 8,945,515 B2.

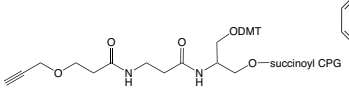
COT SERINOL PHOSPHORAMIDITE

COT Serinol Phosphoramidites has been discontinued. Please contact technical support.

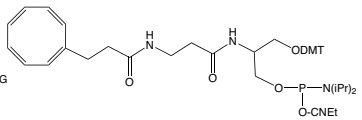
Item	Catalog No.	Pack
COT Serinol Phosphoramidite	10-1996	Discontinued



3'-Dithiol Serinol CPG



3'-Alkyne-Modifier Serinol CPG



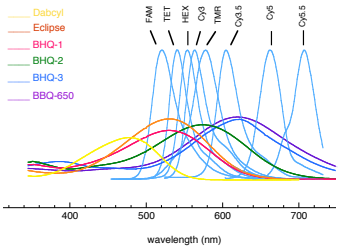
COT Serinol

DABCYL LABELING

REFERENCE

(1) S. Tyagi and F.R. Kramer, ***Nature Biotechnology***, 1996, **4**, 303-308.

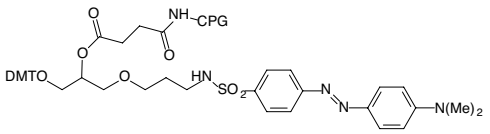
DYE QUENCHER PLOT



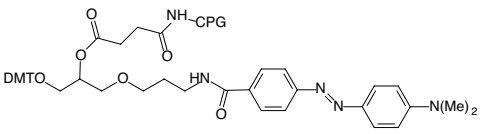
https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

A molecular beacon probe[1] has its natural fluorescence quenched in solution unless it is hybridized to the target sequence. Consequently, the design of a molecular beacon requires a fluorophore to be in one part of the sequence and the quencher molecule to be in another, with both molecules being separated from the oligonucleotide by a hydrocarbon spacer. The Dabcyl group has been found to be a universal quencher. 3'-Dabsyl CPG and 3'-Dabcyl CPG are used to prepare probes with the quencher blocking the 3'-terminus. 5'-Dabcyl Phosphoramidite locates the quencher at the 5'-terminus and Dabcyl-dT places it within the sequence, leaving the 3'-terminus available for polymerase extension.

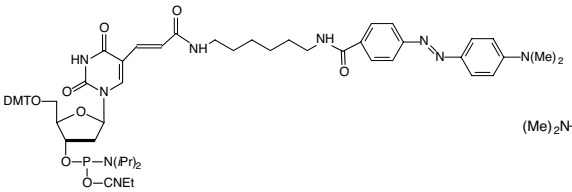
Item	Catalog No.	Pack
3'-Dabsyl CPG	20-5911-01	0.1g
	20-5911-10	1.0g
1 µmole columns	20-5911-41	Pack of 4
0.2 µmole columns	20-5911-42	Pack of 4
10 µmole column (ABI)	20-5911-13	Pack of 1
15 µmole column (Expedite)	20-5911-14	Pack of 1
3'-Dabcyl CPG	20-5912-01	0.1g
	20-5912-10	1.0g
1 µmole columns	20-5912-41	Pack of 4
0.2 µmole columns	20-5912-42	Pack of 4
10 µmole column (ABI)	20-5912-13	Pack of 1
15 µmole column (Expedite)	20-5912-14	Pack of 1
3'-Dabcyl PS	26-5912-01	0.1g
	26-5912-10	1.0g
200 nmole columns (ABI 3900)	26-5912-52	Pack of 10
40 nmole columns (ABI 3900)	26-5912-55	Pack of 10
Dabcyl-dT	10-1058-95	50 µmole
	10-1058-90	100 µmole
	10-1058-02	0.25g
5'-Dabcyl Phosphoramidite	10-5912-95	50 µmole
	10-5912-90	100 µmole
	10-5912-02	0.25g



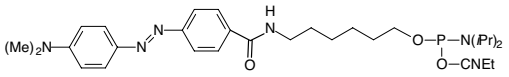
Dabsyl CPG



Dabcyl CPG



Dabcyl-dT



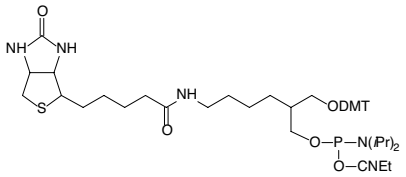
5'-Dabcyl Phosphoramidite

BIOTIN LABELING

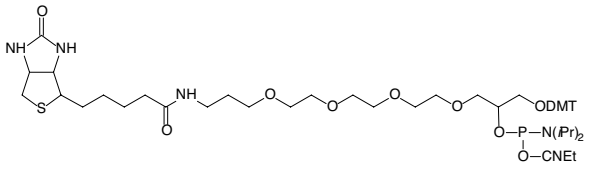
Glen Research biotin phosphoramidites for direct labeling of synthetic oligonucleotides exhibit the following features:

1. All are soluble in acetonitrile at concentrations useful for DNA synthesis.
2. All include a DMT group for cartridge purifications which is essential for the preparation of biotinylated PCR primers because of the potential for cross contamination in HPLC purifications.
3. For the development of diagnostic probes, biotin phosphoramidite is capable of branching to allow multiple biotins to be introduced at the 3'- or 5'-terminus. BiotinTEG Phosphoramidite contains a 15 atom mixed polarity spacer arm based on a triethylene glycol.
4. Protected Biotin Serinol Phosphoramidite and CPG are protected with a ***t***-butylbenzoyl group on the biotin ring. This group is designed to stop any phosphoramidite reactions at this active position in biotin. This protection avoids branching when using nucleophilic activators like DCI. The protecting group is easily removed during oligonucleotide cleavage and deprotection. The BiotinLC versions are similarly protected and should be useful for the synthesis of highly sensitive biotinylated probes.

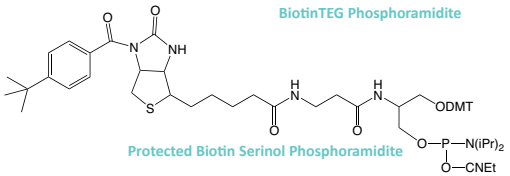
Item	Catalog No.	Pack
Biotin Phosphoramidite	10-1953-95	50 µmole
	10-1953-90	100 µmole
	10-1953-02	0.25g
BiotinTEG Phosphoramidite	10-1955-95	50 µmole
	10-1955-90	100 µmole
	10-1955-02	0.25g
Protected Biotin Serinol Phosphoramidite	10-1993-95	50 µmole
	10-1993-90	100 µmole
	10-1993-02	0.25g
Protected BiotinLC Serinol Phosphoramidite	10-1995-95	50 µmole
	10-1995-90	100 µmole
	10-1995-02	0.25g



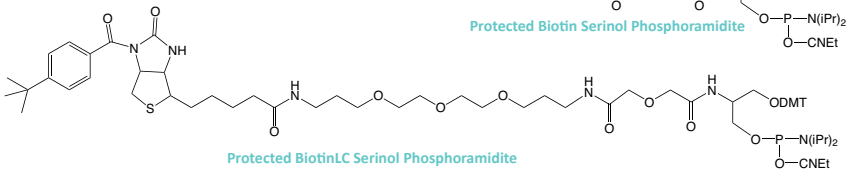
Biotin Phosphoramidite



BiotinTEG Phosphoramidite



Protected Biotin Serinol Phosphoramidite



Protected BiotinLC Serinol Phosphoramidite

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

BIOTIN LABELING (CONT.)

RELATED

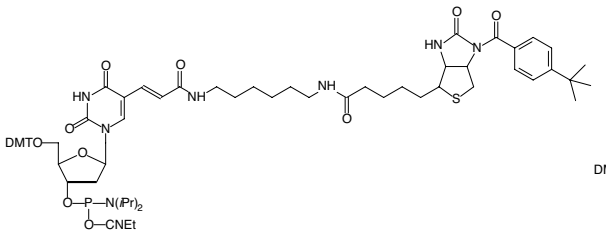
PC Biotin 90

Biotin-dT can replace dT residues within the oligonucleotide sequence. 5'-Biotin phosphoramidite can be added ONLY ONCE to the 5'-terminus of an oligonucleotide. However, the DMT group on the biotin can be used in RP cartridge and HPLC purification techniques. PC Biotin is a photocleavable 5'-biotin phosphoramidite. BiotinTEG CPG and Protected BiotinLC Serinol CPG are designed for the direct synthesis of oligonucleotides containing biotin at the 3' terminus.

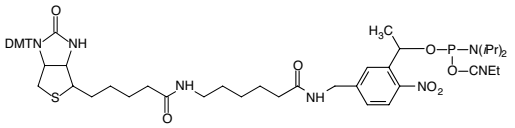
Desthiobiotin is a biotin analogue that exhibits lower binding to biotin-binding proteins such as streptavidin. This biotin analogue is lacking the sulfur group from the molecule and has a dissociation constant (Kd) several orders of magnitude less than biotin/streptavidin. As a result, biomolecules containing desthiobiotin are dissociated from streptavidin simply in the presence of buffered solutions of biotin. We offer desthiobiotinTEG phosphoramidite and the corresponding CPG.

ABI-style vials and columns are supplied unless otherwise requested (see note box).

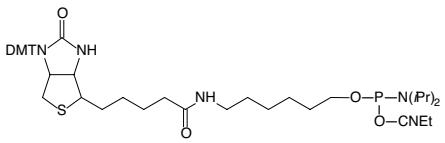
IItem	Catalog No.	Pack
5'-Biotin Phosphoramidite	10-5950-95	50 µmole
	10-5950-90	100 µmole
	10-5950-02	0.25g
Biotin-dT	10-1038-95	50 µmole
	10-1038-90	100 µmole
	10-1038-02	0.25g
PC Biotin Phosphoramidite	10-4950-95	50 µmole
	10-4950-90	100 µmole
	10-4950-02	0.25g
DesthiobiotinTEG Phosphoramidite	10-1952-95	50 µmole
	10-1952-90	100 µmole
	10-1952-02	0.25g



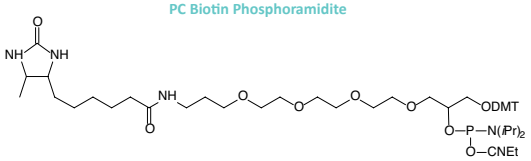
Biotin-dT



PC Biotin Phosphoramidite



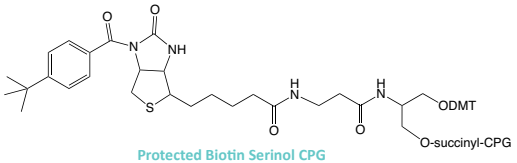
5'-Biotin Phosphoramidite



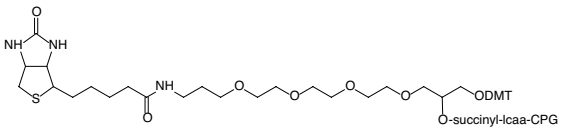
DesthiobiotinTEG Phosphoramidite

BIOTIN LABELING (CONT.)

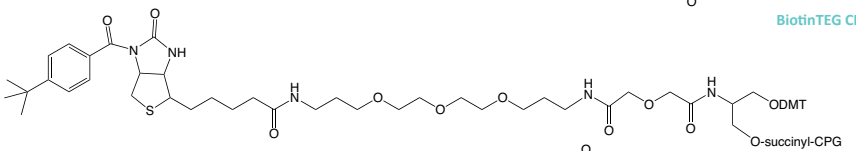
Item	Catalog No.	Pack
3'-BiotinTEG CPG	20-2955-01	0.1g
	20-2955-10	1.0g
0.2 µmole columns	20-2955-42	Pack of 4
1 µmole columns	20-2955-41	Pack of 4
10 µmole column (ABI)	20-2955-13	Pack of 1
15 µmole column (Expedite)	20-2955-14	Pack of 1
3'-BiotinTEG PS	26-2955-01	0.1g
	26-2955-10	1.0g
200 nmole columns (ABI 3900)	26-2955-52	Pack of 10
40 nmole columns (ABI 3900)	26-2955-55	Pack of 10
3'-Protected Biotin Serinol CPG	20-2993-01	0.1g
	20-2993-10	1.0g
0.2 µmole columns	20-2993-42	Pack of 4
1 µmole columns	20-2993-41	Pack of 4
10 µmole column (ABI)	20-2993-13	Pack of 1
15 µmole column (Expedite)	20-2993-14	Pack of 1
3'-Protected BiotinLC Serinol CPG	20-2995-01	0.1g
	20-2995-10	1.0g
0.2 µmole columns	20-2995-42	Pack of 4
1 µmole columns	20-2995-41	Pack of 4
10 µmole column (ABI)	20-2995-13	Pack of 1
15 µmole column (Expedite)	20-2995-14	Pack of 1
DesthiobiotinTEG CPG	20-2952-01	0.1g
	20-2952-10	1.0g
0.2 µmole columns	20-2952-42	Pack of 4
1 µmole columns	20-2952-41	Pack of 4
10 µmole column (ABI)	20-2952-13	Pack of 1
15 µmole column (Expedite)	20-2952-14	Pack of 1



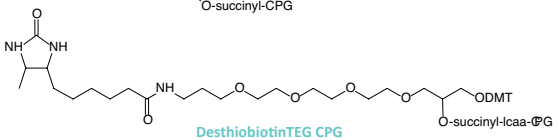
Protected Biotin Serinol CPG



BiotinTEG CPG



Protected BiotinLC Serinol CPG



DesthiobiotinTEG CPG

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

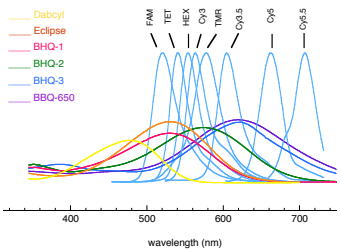
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

FLUORESCEIN LABELING

DYE QUENCHER PLOT



https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

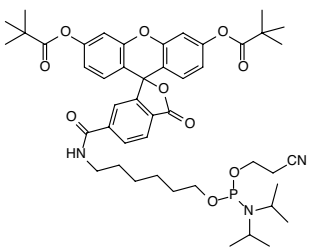
5'-Fluorescein phosphoramidite contains no 4,4'-dimethoxytrityl (DMT) group and can be added only once at the 5'-terminus, thereby terminating synthesis. This product is prepared using the 6-carboxyfluorescein derivative. The tetrachloro-, hexachloro-and dichloro-dimethoxy-fluorescein (TET, HEX and JOE, respectively) phosphoramidites are designed to take advantage of the multicolor detection capability of modern DNA sequencers and genetic analyzers. Fluorescein phosphoramidite is designed to produce the same fluorescein-type structure as had been previously prepared using fluorescein isothiocyanate (FITC). Our fluorescein phosphoramidite also contains a DMT group to allow quantification of coupling. The analogous structure, 6-Fluorescein Phosphoramidite, prepared using 6-FAM, is also available, along with 6-Fluorescein Serinol Phosphoramidite. Fluorescein-dT can be inserted into the desired sequence as a replacement for a dT residue.

We offer five fluorescein supports. Fluorescein CPG has traditionally been used to add the fluorescein label at the 3'-terminus. The analogous structure, 3'-(6-Fluorescein) CPG, prepared using 6-FAM, is now also available, along with 6-Fluorescein Serinol CPG. We also offer 3'-(6-FAM) CPG and Fluorescein-dT CPG, both derivatives of 6-carboxyfluorescein (6-FAM). Both are single isomers and use an amide linkage which is stable during cleavage and deprotection and does not allow isomer formation. 3'-(6-FAM) CPG allows effective blockage of the 3'-terminus from polymerase extension as well as exonuclease digestion. Fluorescein-dT CPG allows both of these enzymatic activities to proceed. Normal cleavage and deprotection with ammonium hydroxide readily generates the fluorescein labeled oligos.

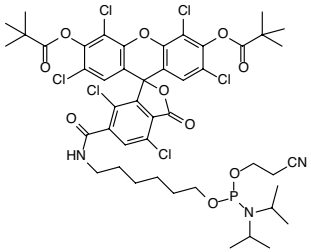
The NHS ester provides the option for post-deprotection labeling. When paired with a 5'-amino-modifier C6 (10-1906, 10-1907, 10-1916 or 10-1947), the resulting product would be identical to that generated with 5'-Fluorescein Phosphoramidite (10-5901).

The spectral characteristics of these dyes are detailed on the following page.

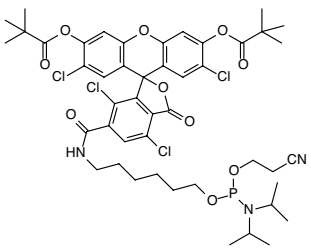
Item	Cat. No.	Pack
5'-Fluorescein Phosphoramidite (6-FAM)	10-5901-95 10-5901-90 10-5901-02	50 µmole 100 µmole 0.25g
5'-Hexachloro-Fluorescein Phosphoramidite (HEX)	10-5902-95 10-5902-90 10-5902-02	50 µmole 100 µmole 0.25g
5'-Tetrachloro-Fluorescein Phosphoramidite (TET)	10-5903-95 10-5903-90 10-5903-02	50 µmole 100 µmole 0.25g



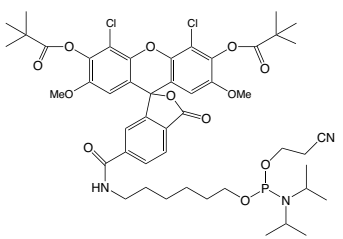
5'-Fluorescein Phosphoramidite



5'-Hexachloro-Fluorescein Phosphoramidite



5'-Tetrachloro-Fluorescein Phosphoramidite



5'-Dichloro-dimethoxy-Fluorescein Phosphoramidite II

FLUORESCEIN LABELING (CONT.)

Item	Cat. No.	Pack
5′-Dichloro-dimethoxy-Fluorescein Phosphoramidite II (JOE)	10-5906-95	50 µmole
	10-5906-90	100 µmole
	10-5906-02	0.25g
Fluorescein Phosphoramidite	10-1963-95	50 µmole
	10-1963-90	100 µmole
	10-1963-02	0.25g
6-Fluorescein Phosphoramidite	10-1964-95	50 µmole
	10-1964-90	100 µmole
	10-1964-02	0.25g
6-Fluorescein Serinol Phosphoramidite	10-1994-95	50 µmole
	10-1994-90	100 µmole
	10-1994-02	0.25g
Fluorescein-dT Phosphoramidite	10-1056-95	50 µmole
	10-1056-90	100 µmole
	10-1056-02	0.25g
Fluorescein NHS ester	50-5901-22	2.4mg
	50-5901-25	9.5mg

FLUORESCENT DYES

	Absorbance Maximum	Emission Maximum	Color
Fluorescein	494nm	525nm	Green
Tetrachloro-Fluorescein	521nm	536nm	Orange
Hexachloro-Fluorescein	535nm	556nm	Pink
SIMA (HEX)	538nm	551nm	Pink
Dichloro-dimethoxy-Fluorescein	525nm	548nm	Orange/ Pink
TAMRA	565nm	580nm	Rose
Cy3	546nm	563nm	Red
Cy3.5	588nm	604nm	Purple
Cy5	646nm	662nm	Violet
Cy5.5	683nm	707nm	Dark Blue
Yakima Yellow	530nm	549nm	Yellow
Redmond Red	579nm	595nm	Red

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

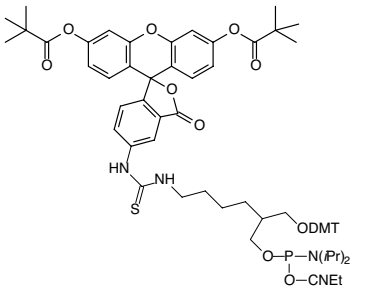
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

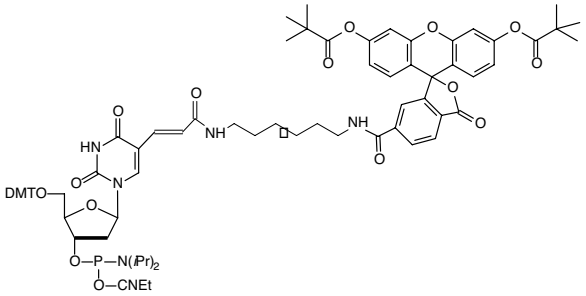
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

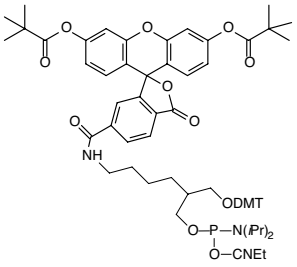
(Please inquire for availability of vials and columns for other instrument types.)



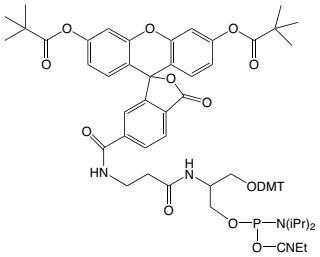
Fluorescein Phosphoramidite



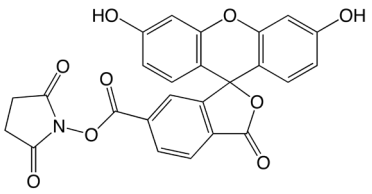
Fluorescein dT



6-Fluorescein Phosphoramidite



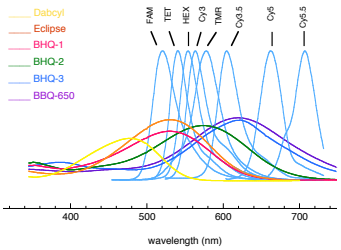
6-Fluorescein Serinol Phosphoramidite



Fluorescein NHS ester

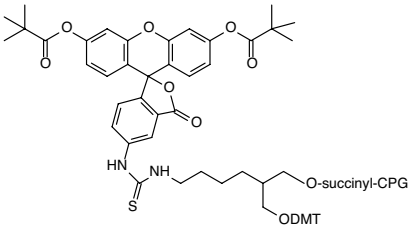
FLUORESCEIN LABELING (CONT.)

DYE QUENCHER PLOT

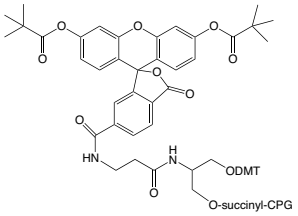


https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

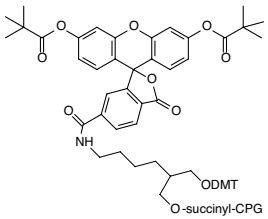
Item	Cat. No.	Pack
3′-Fluorescein CPG	20-2963-01	0.1g
	20-2963-10	1.0g
1 µmole columns	20-2963-41	Pack of 4
0.2 µmole columns	20-2963-42	Pack of 4
10 µmole column (ABI)	20-2963-13	Pack of 1
15 µmole column (Expedite)	20-2963-14	Pack of 1
3′-(6-Fluorescein) CPG	20-2964-01	0.1g
	20-2964-10	1.0g
1 µmole columns	20-2964-41	Pack of 4
0.2 µmole columns	20-2964-42	Pack of 4
10 µmole column (ABI)	20-2964-13	Pack of 1
15 µmole column (Expedite)	20-2964-14	Pack of 1
3′-(6-FAM) CPG	20-2961-01	0.1g
	20-2961-10	1.0g
1 µmole columns	20-2961-41	Pack of 4
0.2 µmole columns	20-2961-42	Pack of 4
10 µmole column (ABI)	20-2961-13	Pack of 1
15 µmole column (Expedite)	20-2961-14	Pack of 1
3′-(6-FAM) PS	26-2961-01	0.1g
	26-2961-10	1.0g
200 nmole columns (ABI 3900)	26-2961-52	Pack of 10
40 nmole columns (ABI 3900)	26-2961-55	Pack of 10
3′-6-Fluorescein Serinol CPG	20-2994-01	0.1g
	20-2994-10	1.0g
0.2 µmole columns	20-2994-42	Pack of 4
1 µmole columns	20-2994-41	Pack of 4
10 µmole column (ABI)	20-2994-13	Pack of 1
15 µmole column (Expedite)	20-2994-14	Pack of 1



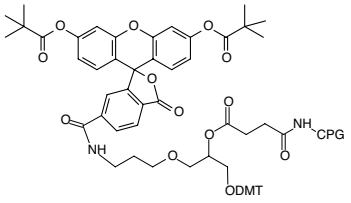
3′-Fluorescein CPG



3′-6-Fluorescein Serinol CPG



3′-(6-Fluorescein) CPG



3′-(6-FAM) CPG

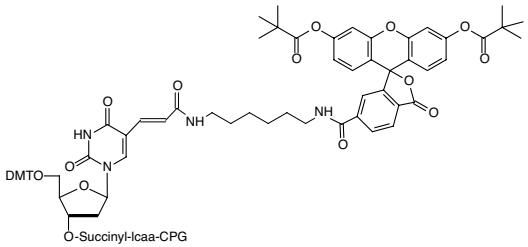
FLUORESCEIN LABELING (CONT.)

Item	Cat. No.	Pack
3'-Fluorescein-dT CPG	20-2056-01	0.1g
	20-2056-10	1.0g
1 µmole columns	20-2056-41	Pack of 4
0.2 µmole columns	20-2056-42	Pack of 4
10 µmole column (ABI)	20-2056-13	Pack of 1
15 µmole column (Expedite)	20-2056-14	Pack of 1

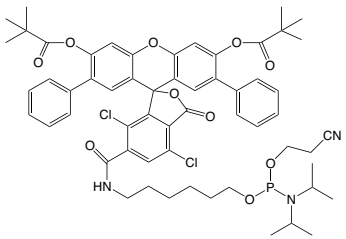
FLUORESCEIN LABELING (SIMA)

Dichloro-diphenyl-fluorescein, SIMA (HEX) exhibits virtually identical absorbance and emission spectra to HEX. SIMA (HEX) is much more stable to basic deprotection conditions than HEX and oligonucleotides can be deprotected using ammonium hydroxide at elevated temperatures and even ammonium hydroxide/methylamine (AMA) at room temperature or 65°C for 10 minutes. SIMA absorption maximum was 3 nm blue-shifted compared to HEX at pH 7. The absorbance is broader, so the extinction coefficient is smaller than that of HEX, but when exciting at 500 nm where the absorbance was normalized, the emission was still 90% of HEX and the emission was red-shifted by 5 nm. A second SIMA (HEX) product, SIMA (HEX)-dT, can be used to introduce SIMA (HEX) in the synthetic oligonucleotide sequence, usually as a replacement for the native dT linkage. Again, this product is fully compatible with deprotection schemes using ammonium hydroxide at elevated temperatures or AMA at room temperature and 65°C.

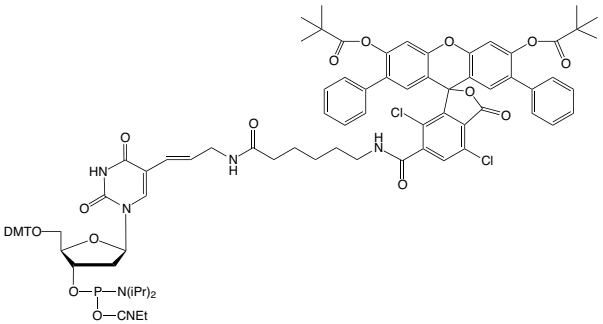
Item	Cat. No.	Pack
SIMA (HEX) Phosphoramidite	10-5905-95	50 µmole
	10-5905-90	100 µmole
	10-5905-02	0.25g
SIMA (HEX)-dT Phosphoramidite	10-5945-95	50 µmole
	10-5945-90	100 µmole
	10-5945-02	0.25g



3'-Fluorescein-dT CPG



SIMA (HEX) Phosphoramidite



SIMA (HEX)-dT Phosphoramidite

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

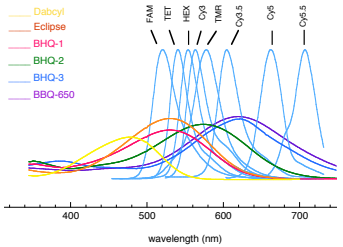
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

DYE QUENCHER PLOT



https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

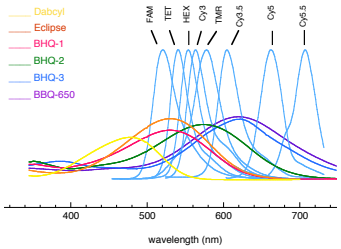
CYANINE LABELING

SPECTRAL DATA FOR CYANINE DYES

	Absorbance Maximum	Emission Maximum	Color
Cyanine 3	546nm	563nm	Red
Cyanine 3.5	588nm	604nm	Purple
Cyanine 5	646nm	662nm	Violet
Cyanine 5.5	683nm	707nm	Dark Blue
Cyanine 7	750nm	773nm	Dark Green

(Measured in an oligo in 0.1M TEAA buffer, pH7.)

DYE QUENCHER PLOT



https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

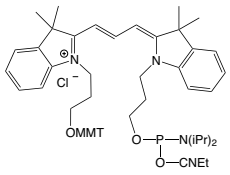
Two cyanine derivatives, Cyanine 3 and Cyanine 5, which differ in structure simply by the number of carbons in the conjugated polyene linkage, are joined by the closely related analogues, Cyanine 3.5 and Cyanine 5.5, and are available as phosphoramidites. Cyanine dyes are normally added once at the 5'-terminus and the MMT group should be removed on the synthesizer. The absorbance of the MMT cation (yellow) is noticeably different from the DMT cation (orange), and so, absorbance-based trityl monitors will detect it incorrectly as a low coupling. On the other hand, conductivity detectors will interpret the release more correctly. Cyanine dye phosphoramidites have also been used successfully adjacent to the 3'-terminus. Cyanine 3 and Cyanine 5 supports are also offered to allow simpler production of 3' cyanine dye-labeled oligonucleotides.

Deprotection of oligos containing Cyanine dyes may be carried out with ammonium hydroxide at room temperature, regardless of the base protecting groups on the monomers used. If there is a need to use ammonium hydroxide at elevated temperature, Cyanine 3 and Cyanine 3.5 are more stable than Cyanine 5 and Cyanine 5.5. However, it is always prudent to use monomers with base labile protecting groups to limit the exposure time to 2 hours or less at 65°C during deprotection.

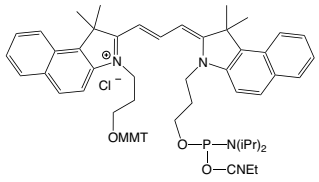
To better address applications in near-infrared (NIR) imaging, Glen Research is offering a water soluble Disulfo-Cyanine 7 azide that can be easily conjugated to DNA and RNA through standard click chemistry. This long wavelength dye offers the benefits of improved solubility, reduced aggregation, and improved stability in the near-infrared spectrum along with the convenience of click chemistry.

This NHS ester versions allows for post-deprotection labeling, and unlike the phosphoramidite versions, contains 2 sulfonate substitutions directly on the indocyanine nuclei. The sulfonates make the Cyanine 3 and 5 less susceptible to aggregation and do not significantly change the fluorescent properties of the dyes.

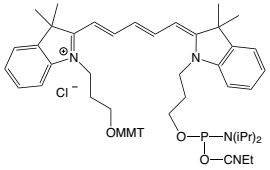
Item	Cat. No.	Pack
Cyanine 3 Phosphoramidite	10-5913-95	50 µmole
	10-5913-90	100 µmole
	10-5913-02	0.25g
Cyanine 3.5 Phosphoramidite	10-5914-95	50 µmole
	10-5914-90	100 µmole
	10-5914-02	0.25g
Cyanine 5 Phosphoramidite	10-5915-95	50 µmole
	10-5915-90	100 µmole
	10-5915-02	0.25g
Cyanine 5.5 Phosphoramidite	10-5916-95	50 µmole
	10-5916-90	100 µmole
	10-5916-02	0.25g



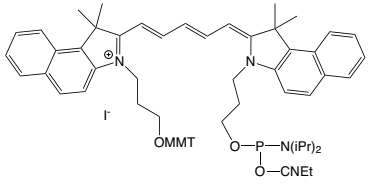
Cyanine 3 Phosphoramidite



Cyanine 3.5 Phosphoramidite



Cyanine 5 Phosphoramidite



Cyanine 5.5 Phosphoramidite

CYANINE LABELING (CONT.)

Item	Cat. No.	Pack
Cyanine 3 CPG	20-5913-01	0.1g
	20-5913-10	1.0g
1 µmole columns (TWIST format only)	20-5913-41	Pack of 4
0.2 µmole columns	20-5913-42	Pack of 4
Cyanine 5 CPG	20-5915-01	0.1g
	20-5915-10	1.0g
1 µmole columns (TWIST format only)	20-5915-41	Pack of 4
0.2 µmole columns	20-5915-42	Pack of 4
Disulfo-Cyanine 7 Azide	50-2010-92	25 µmole
	50-2010-90	100 µmole
sulfoCyanine 3 NHS Ester	50-5913-22	3.8mg
sulfoCyanine 5 NHS Ester	50-5915-22	3.9mg

OTHER INSTRUMENT TYPES

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Monomers

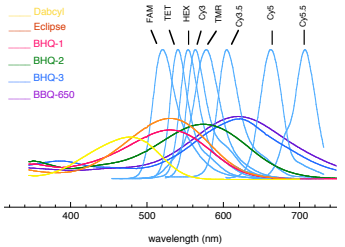
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

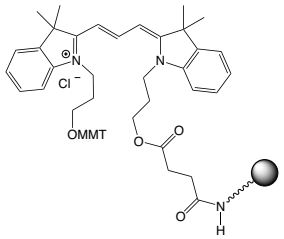
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

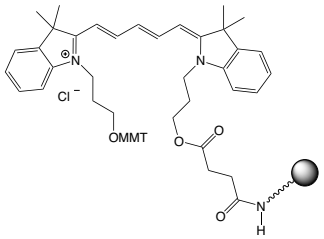
DYE QUENCHER PLOT



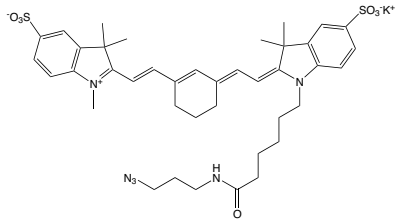
https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes



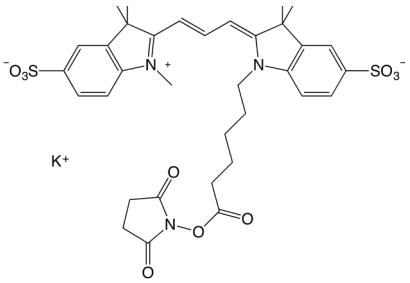
Cyanine 3 CPG



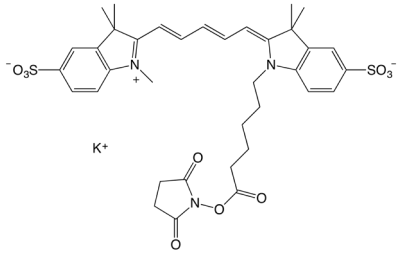
Cyanine 5 CPG



Disulfo-Cyanine 7 Azide



sulfoCyanine 3 NHS Ester



sulfoCyanine 5 NHS Ester

ELITECHGROUP DYES AND QUENCHER

FLUORESCENT DYES

	Absorbance Maximum	Emission Maximum	Color
Yakima Yellow	530nm	549nm	Yellow
Redmond Red	579nm	595nm	Red
AquaPhluor 593	593nm	613nm	Red

INTELLECTUAL PROPERTY

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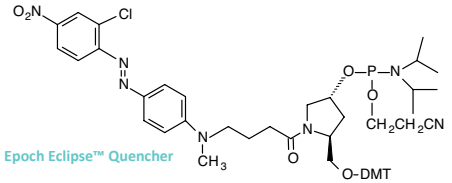
A simple agreement must be signed before end-users and custom oligo services may purchase these products for use as defined above. https://www.glenresearch.com/media/productattach/import/technical_note/ELITechGroupProducts.pdf

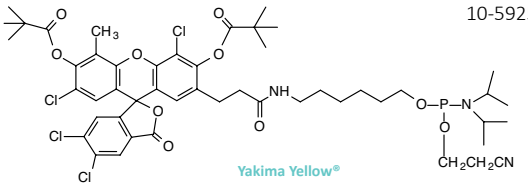
AquaPhluor®, Yakima Yellow®, Redmond Red® and Eclipse®, are registered Trademarks of ELITechGroup.

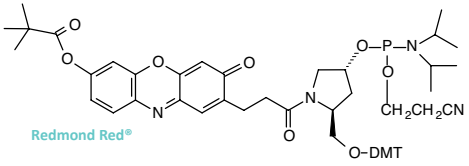
Glen Research's agreement with ELITechGroup, formerly Epoch Biosciences, allows us to offer several of their proprietary products designed for the synthesis of novel DNA probes. We are pleased to offer products based on ELITechGroup's Redmond Red®, Yakima Yellow® and AquaPhluor® 593 fluorophores and Eclipse® non-fluorescent quencher. Under our agreement we also supply PPG, a modified nucleoside, and 5'-Aldehyde-Modifier C2 Phosphoramidite. The fluorescent dyes, Yakima Yellow, Redmond Red and AquaPhluor 593, are available as phosphoramidites and supports. Yakima Yellow has an absorbance maximum at 530 nm and emission maximum at 549 nm, Redmond Red's absorbance and emission maxima are at 579 nm and 595 nm, respectively, and AquaPhluor 593 has an absorbance maximum at 593 nm and emission maximum at 613 nm.

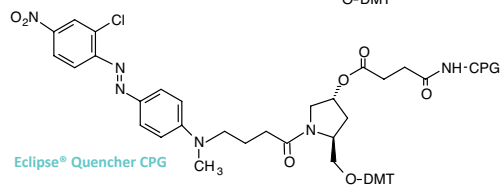
The Eclipse quencher from ELITechGroup solves most of the problems inherent in the synthesis of molecular beacon and FRET probes. The Eclipse molecule is highly stable and can be used safely in all common oligo deprotection schemes. The absorbance maximum for Eclipse Quencher is at 522 nm, compared to 479 nm for dabcyl. In addition, the structure of the Eclipse Quencher is substantially more electron deficient than that of dabcyl and this leads to better quenching over a wider range of dyes, especially those with emission maxima at longer wavelengths (red shifted) such as Redmond Red and Cyanine 5. In addition, with an absorption range from 390 nm to 625 nm, the Eclipse Quencher is capable of effective performance in a wide range of colored FRET probes.

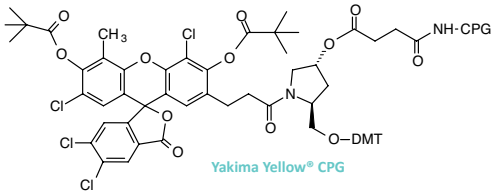
Item	Cat. No.	Pack
Redmond Red® Phosphoramidite	10-5920-95	50 µmole
	10-5920-90	100 µmole
	10-5920-02	0.25g
Yakima Yellow® Phosphoramidite	10-5921-95	50 µmole
	10-5921-90	100 µmole
	10-5921-02	0.25g
5'-AquaPhluor® 593 Phosphoramidite	10-5923-95	50 µmole
	10-5923-90	100 µmole
	10-5923-02	0.25g
5'-AquaPhluor® 639 Phosphoramidite	10-5926-95	50 µmole
	10-5926-90	100 µmole
	10-5926-02	0.25g
Eclipse® Quencher Phosphoramidite	10-5925-95	50 µmole
	10-5925-90	100 µmole
	10-5925-02	0.25g

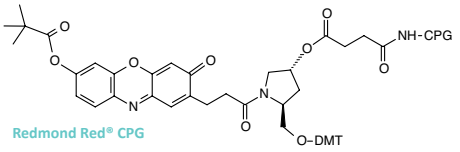












ELITECHGROUP DYES AND QUENCHER (CONT.)

Item	Cat. No.	Pack
Redmond Red® CPG	20-5920-01	0.1g
	20-5920-10	1.0g
1 µmole columns	20-5920-41	Pack of 4
0.2 µmole columns	20-5920-42	Pack of 4
10 µmole column (ABI)	20-5920-13	Pack of 1
15 µmole column (Expedite)	20-5920-14	Pack of 1
Yakima Yellow® CPG	20-5921-01	0.1g
	20-5921-10	1.0g
1 µmole columns	20-5921-41	Pack of 4
0.2 µmole columns	20-5921-42	Pack of 4
10 µmole column (ABI)	20-5921-13	Pack of 1
15 µmole column (Expedite)	20-5921-14	Pack of 1
AquaPhluor® 593 CPG	20-5923-01	0.1g
	20-5923-10	1.0g
1 µmole columns	20-5923-41	Pack of 4
0.2 µmole columns	20-5923-42	Pack of 4
10 µmole column (ABI)	20-5923-13	Pack of 1
15 µmole column (Expedite)	20-5923-14	Pack of 1
AquaPhluor® 639 CPG	20-5926-01	0.1g
	20-5926-10	1.0g
1 µmole columns	20-5926-41	Pack of 4
0.2 µmole columns	20-5926-42	Pack of 4
10 µmole column (ABI)	20-5926-13	Pack of 1
15 µmole column (Expedite)	20-5926-14	Pack of 1
Eclipse® Quencher CPG	20-5925-01	0.1g
	20-5925-10	1.0g
1 µmole columns	20-5925-41	Pack of 4
0.2 µmole columns	20-5925-42	Pack of 4
10 µmole column (ABI)	20-5925-13	Pack of 1
15 µmole column (Expedite)	20-5925-14	Pack of 1

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

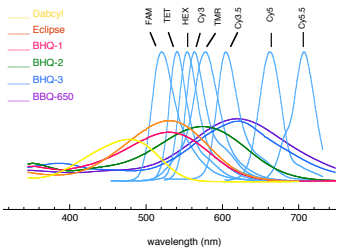
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

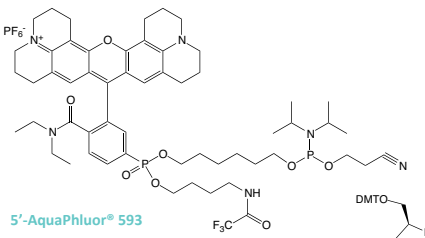
DYE QUENCHER PLOT



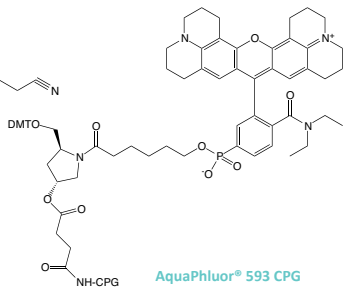
https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes

RELATED

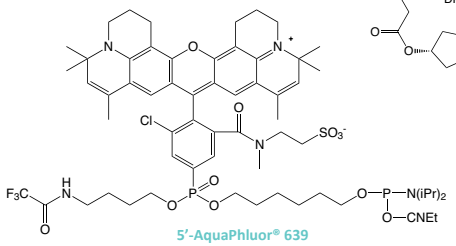
PPG.....61
5'-Aldehyde-Modifier C2.....87



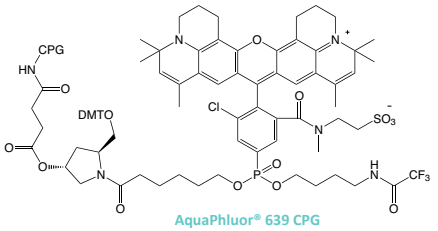
5'-AquaPhluor® 593



AquaPhluor® 593 CPG



5'-AquaPhluor® 639



AquaPhluor® 639 CPG

BLACK HOLE QUENCHER DYES

TABLE 1: BLACK HOLE QUENCHERS

Quencher	λmax (nm)	E260 (L/mol.cm)	Emax (L/mol.cm)
BHQ-1	534	8,000	34,000
BHQ-2	579	8,000	38,000
BHQ-3	672	13,000	42,700

REFERENCES

(1) S.A.E. Marras, F.R. Kramer, and S. Tyagi, ***Nucleic Acids Res.***, 2002, **30**, E122.

(2) M.K. Johansson, H. Fidder, D. Dick, and R.M. Cook, ***J Am Chem Soc***, 2002, **124**, 6950-6956.

RELATED

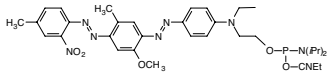
Dabcyl 102
Eclipse™ 112
BBQ-650® 116

INTELLECTUAL PROPERTY

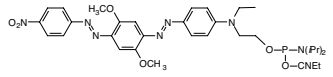
"Black Hole Quencher", "BHQ-0", "BHQ-1", "BHQ-2" and "BHQ-3" are trademarks of Biosearch Technologies, Inc., Novato, CA. The BHQ dye technology is the subject of pending patents and is licensed and sold under agreement with Biosearch Technologies, Inc.. Products incorporating the BHQ dye moiety are sold exclusively for R&D use by the end-user. They may not be used for clinical or diagnostic purposes and they may not be re-sold, distributed or re-packaged.

With the growing popularity of red and near-infrared dyes, we are offering the Black Hole Quencher™ dyes (BHQs), whose physical properties are detailed in Table 1. BHQ dyes are robust dark quenchers that very nicely complement our existing product line. They are compatible with ammonium hydroxide deprotection, exhibit excellent coupling efficiencies, have large extinction coefficients and are completely non-fluorescent. Their absorbances are well-tuned to quench a variety of popular fluorophores – even those far into the red, such as Cy3 and Cy5. The dark quencher most typically used in a Molecular Beacon is Dabcyl. Because the quenching does not involve FRET, there is little, if any, dependence upon donor-acceptor spectral overlap. In a comprehensive paper by Marras, Kramer and Tyagi,[1] the ability of BHQ-1 and BHQ-2 to quench 22 different fluorophores was evaluated. For shorter wavelength fluorophores such as fluorescein, the quenching efficiency was roughly the same as Dabcyl (91% – 93%). However, for dyes emitting in the far red, such as Cy5, the BHQ dyes were far superior – quenching the Cy5 with 96% efficiency, compared to 84% with Dabcyl. This may reflect the BHQ's ability to form stable, non-fluorescent complexes which can be a plus even in FRET probes. Indeed, recent work suggests that these non-fluorescent complexes will form even in the absence of a hairpin stem structure used by Molecular Beacons.[2]

Item	Cat. No.	Pack
5'-BHQ-1 Phosphoramidite	10-5931-95	50 µmole
	10-5931-90	100 µmole
	10-5931-02	0.25g
5'-BHQ-2 Phosphoramidite	10-5932-95	50 µmole
	10-5932-90	100 µmole
	10-5932-02	0.25g
BHQ-1-dT	10-5941-95	50 µmole
	10-5941-90	100 µmole
	10-5941-02	0.25g
BHQ-2-dT	10-5942-95	50 µmole
	10-5942-90	100 µmole
	10-5942-02	0.25g



5'-BHQ-1



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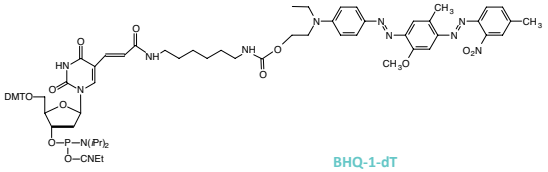

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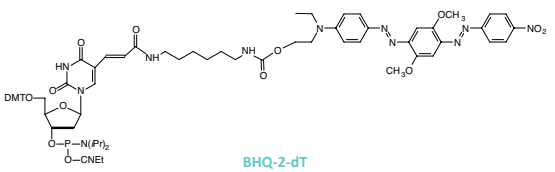

BHQ-2-dT

BLACK HOLE QUENCHER DYES (CONT.)

Item	Cat. No.	Pack
3'-BHQ-1 CPG	20-5931-01	0.1g
	20-5931-10	1.0g
1 µmole columns	20-5931-41	Pack of 4
0.2 µmole columns	20-5931-42	Pack of 4
10 µmole column (ABI)	20-5931-13	Pack of 1
15 µmole column (Expedite)	20-5931-14	Pack of 1
3'-BHQ-2 CPG	20-5932-01	0.1g
	20-5932-10	1.0g
1 µmole columns	20-5932-41	Pack of 4
0.2 µmole columns	20-5932-42	Pack of 4
10 µmole column (ABI)	20-5932-13	Pack of 1
15 µmole column (Expedite)	20-5932-14	Pack of 1
3'-BHQ-3 CPG	20-5933-01	0.1g
	20-5933-10	1.0g
1 µmole columns	20-5933-41	Pack of 4
0.2 µmole columns	20-5933-42	Pack of 4
10 µmole column (ABI)	20-5933-13	Pack of 1
15 µmole column (Expedite)	20-5933-14	Pack of 1

OTHER INSTRUMENT TYPES

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Monomers

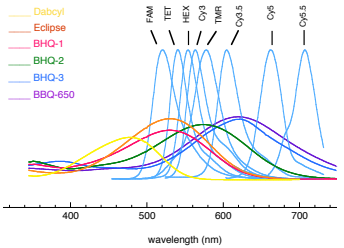
For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

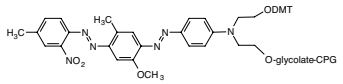
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

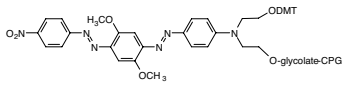
DYE QUENCHER PLOT



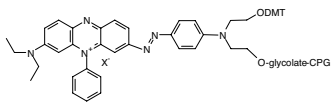
https://www.glenresearch.com/spectral-characteristics-of-fluorescent-dyes



3'-BHQ-1 CPG



3'-BHQ-2 CPG



3'-BHQ-3 CPG

BLACKBERRY® QUENCHER (BBQ-650®)

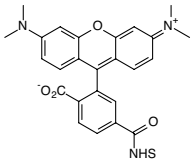
INTELLECTUAL PROPERTY

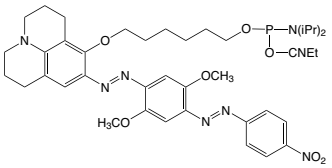
BlackBerry® Quencher technology: US Patent 7,879,986. The purchase of BlackBerry® Quencher reagents includes a limited license to use these reagents exclusively for research and development purposes. They may not be used for clinical or diagnostic purposes and they may not be re-sold, distributed, or re-packaged without prior agreement and consent of Berry & Associates, Inc. Subsequent sale of products that are derived from BlackBerry® Quencher reagents is permitted so long as the following written disclaimer is included in written and electronic catalogs, in commercial advertisement, and in packages with containers of such derivative products: *"BlackBerry is a trademark of Berry & Associates, Inc. Products derived from BlackBerry® Quencher reagents are sold exclusively for research and development use by the purchaser. They may not be used for clinical or diagnostic purposes without prior agreement and consent of Berry & Associates, Inc."*

We are happy to offer several products containing the BlackBerry® Quencher (BBQ-650®), which exhibits a broad absorption profile from 550 nm to 750 nm, centered at 650 nm. This range offers more effective quenching of some of our popular long wavelength dyes like TAMRA, Redmond Red, Cy dyes and DyLight dyes. We offer BBQ-650 products for the 3' and 5' termini, as well as BBQ-650-dT for inclusion within the oligonucleotide sequence, with the following properties:

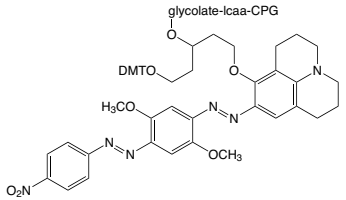
- Quenches the fluorescence of long wavelength dyes
- Quenches in FRET and contact mode
- Absorbance maximum at ~650 nm
- Quenching range – 550-750 nm
- Compatible with standard oligo synthesis chemistry
- Compatible with regular deprotection but requires mild deprotection with AMA at room temperature
- Available for 3', 5', and internal substitution
- More stable than BHQ-3

Item	Cat. No.	Pack
5'-BBQ-650® Phosphoramidite	10-5934-95	50 µmole
	10-5934-90	100 µmole
	10-5934-02	0.25g
BBQ-650®-dT	10-5944-95	50 µmole
	10-5944-90	100 µmole
	10-5944-02	0.25g
3'-BBQ-650® CPG	20-5934-01	0.1g
	20-5934-10	1.0g
1 µmole columns	20-5934-41	Pack of 4
0.2 µmole columns	20-5934-42	Pack of 4
10 µmole column (ABI)	20-5934-13	Pack of 1
15 µmole column (Expedite)	20-5934-14	Pack of 1

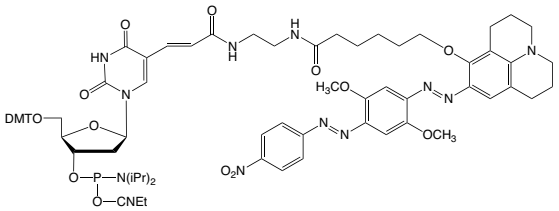




5'-BBQ-650™



3'-BBQ™-650™ CPG



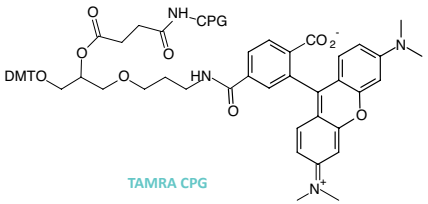
BBQ-650™-dT

RHODAMINE (TAMRA) LABELING

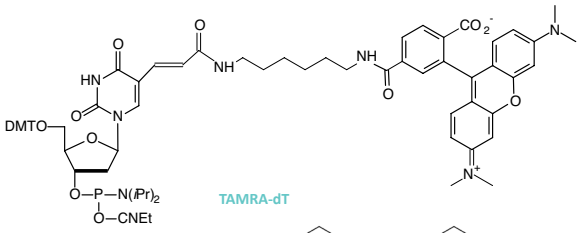
Rhodamine derivatives are not sufficiently stable to survive conventional deprotection and these must be attached to amino-modified oligonucleotides using post-synthesis labeling techniques. Because Tetramethyl Rhodamine (TAMRA) is not base stable, the procedure to cleave and deprotect the labeled oligonucleotide must be carefully considered. Using the UltraMILD monomers and deprotection with potassium carbonate in methanol, TAMRA oligonucleotides can be fairly conveniently isolated. To streamline the preparation of TAMRA oligos, we offer 3'-TAMRA CPG for 3' labeling and TAMRA-dT for labeling within the sequence. We also offer TAMRA NHS ester for labeling amino-modified oligonucleotides.

ROX is a rhodamine dye that has played a significant role in dideoxy Sanger sequencing alongside FAM, JOE and TAMRA. The dye itself is also commonly used for qPCR applications as a passive reference dye. ROX is not available as a phosphoramidite, and as such, the use of this NHS ester is the standard method of incorporating ROX into oligonucleotides. This NHS ester is offered as the 6-isomer.

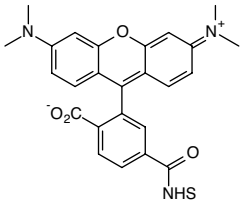
Item	Cat. No.	Pack
3'-TAMRA CPG	20-5910-01	0.1g
	20-5910-10	1.0g
1 µmole columns	20-5910-41	Pack of 4
0.2 µmole columns	20-5910-42	Pack of 4
3'-TAMRA PS	26-5910-01	0.1g
	26-5910-10	1.0g
200 nmole columns (ABI 3900)	26-5910-52	Pack of 10
40 nmole columns (ABI 3900)	26-5910-55	Pack of 10
TAMRA-dT	10-1057-95	50 µmole
	10-1057-90	100 µmole
	10-1057-02	0.25g
TAMRA NHS Ester (Solution in anhydrous DMSO)	50-5910-66	60 µL
ROX NHS Ester	50-5911-22	3.2mg



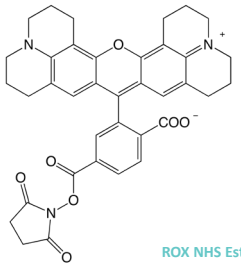
TAMRA CPG



TAMRA-dT



TAMRA NHS Ester



ROX NHS Ester

RELATED

UltraMILD monomers..... 27

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

ACRIDINE LABELING

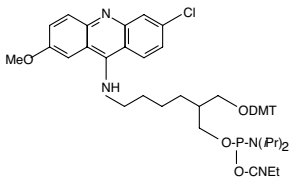
Acridine phosphoramidite is designed to produce an oligonucleotide containing acridine at any position in the molecule. Acridine CPG is used to label the 3'-terminus. Acridine is an effective intercalating agent.

Item	Cat. No.	Pack
Acridine Phosphoramidite	10-1973-95	50 µmole
	10-1973-90	100 µmole
	10-1973-02	0.25g
3'-Acridine CPG	20-2973-01	0.1g
	20-2973-10	1.0g
1 µmole columns	20-2973-41	Pack of 4
0.2 µmole columns	20-2973-42	Pack of 4
10 µmole column (ABI)	20-2973-13	Pack of 1
15 µmole cloumn (Expedite)	20-2973-14	Pack of 1

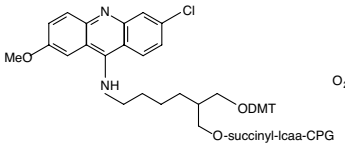
DNP LABELING

An analytical test based on detection of 2,4-dinitrophenyl (DNP) labeled oligonucleotides with anti-DNP antibodies has been proposed. We have chosen the branched triethylene glycol (TEG) spacer in our version of DNP phosphoramidite since it can be added once or several times to the 3' or 5' terminus.

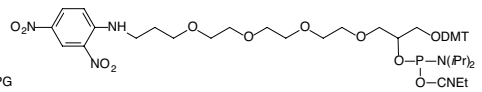
Item	Catalog No.	Pack
DNP-TEG Phosphoramidite	10-1985-95	50 µmole
	10-1985-90	100 µmole
	10-1985-02	0.25g



Acridine



Acridine CPG



DNP-TEG

CHOLESTEROL LABELING

Potential therapeutic oligonucleotides must permeate the cell membrane for optimal activity. The addition of lipophilic groups to an oligonucleotide would be expected to enhance cellular uptake/membrane permeation. The use of cholesteryl oligos and the consequent improvement in activity has been described. We have designed our Cholesteryl products with triethyleneglycol (TEG) spacers for maximum solubility.

RELATED

Spermine 52

Item	Catalog No.	Pack
Cholesteryl-TEG Phosphoramidite	10-1975-95	50 µmole
	10-1975-90	100 µmole
	10-1975-02	0.25g
5'-Cholesteryl-TEG Phosphoramidite	10-1976-95	50 µmole
	10-1976-90	100 µmole
	10-1976-02	0.25g
3'-Cholesteryl-TEG CPG	20-2975-01	0.1g
	20-2975-10	1.0g
1 µmole columns	20-2975-41	Pack of 4
0.2 µmole columns	20-2975-42	Pack of 4
10 µmole column (ABI)	20-2975-13	Pack of 1
15 µmole column (Expedite)	20-2975-14	Pack of 1

TOCOPHEROL LABELING

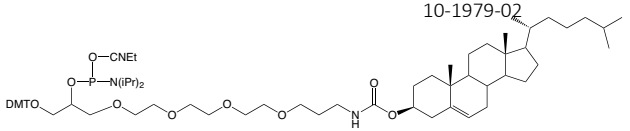
Vitamin E is both lipophilic and non-toxic even at high doses so would be an excellent candidate as a lipophilic carrier for oligonucleotides. Therefore, as an addition to our cholesteryl product line, we offer simple α-tocopheryl (vitamin E) labeling. Totally synthetic α-tocopherol is racemic at its three chiral centers and is used to prepare this product.

Item	Catalog No.	Pack
α-Tocopherol-TEG Phosphoramidite	10-1977-95	50 µmole
	10-1977-90	100 µmole
	10-1977-02	0.25g

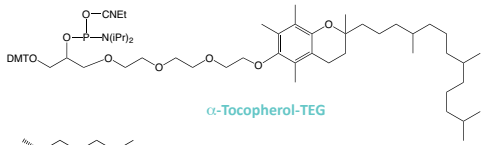
STEARYL LABELING

We now offer a simple C18 lipid as an economical and effective carrier molecule. We envisage that the 5'-stearyl group will become a favored lipophilic carrier for experimentation with synthetic oligonucleotides.

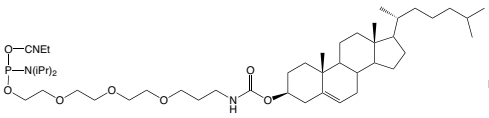
Item	Catalog No.	Pack
5'- Stearyl Phosphoramidite	10-1979-90	100 µmole
	10-1979-02	0.25g



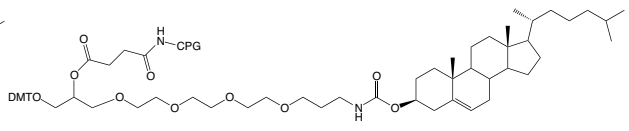
Cholesteryl-TEG



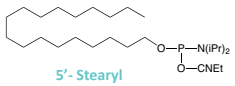
α-Tocopherol-TEG



5'-Cholesteryl-TEG



3'-Cholesteryl-TEG CPG



5'- Stearyl

N-ACETYLGALACTOSAMINE (GalNAc) LABELING

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

INTELLECTUAL PROPERTY

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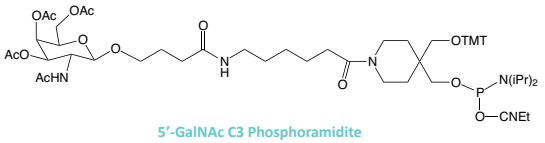
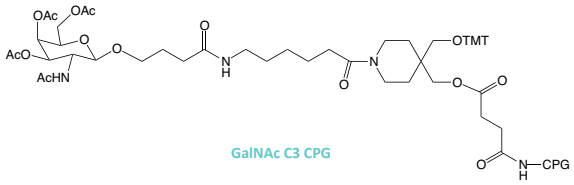
A directed approach to the delivery of therapeutic oligonucleotides specifically to the liver has been to target the asialoglycoprotein receptor (ASGPR) using a suitable glycoconjugate. Indeed, ASGPR is the ideal target for delivery of therapeutic oligonucleotides to the liver since it combines tissue specificity, high expression levels and rapid internalization and turnover. The use of oligonucleotide glycoconjugates has led to significant advances in therapeutic delivery as evidenced by the work of Alnylam Pharmaceuticals and Ionis Pharmaceuticals using multivalent N-acetylgalactosamine (GalNAc) oligonucleotide conjugates.

Glen Research is delighted to introduce a GalNAc modification strategy using a monomeric GalNAc support and the equivalent GalNAc phosphoramidite. Our experimental work has shown that these products are fully compatible with regular oligonucleotide synthesis and deprotection. Oligonucleotides containing GalNAc can be deprotected using standard procedures during which the acetyl protecting groups on GalNAc are removed. We have demonstrated that 5'-GalNAc C3 phosphoramidite can be used to prepare oligonucleotides with multiple consecutive GalNAc additions at the 5' terminus.

Item	Catalog No.	Pack
5'-GalNAc C3 Phosphoramidite	10-1974-95	50 µmole
	10-1974-90	100 µmole
	10-1974-02	0.25g
GalNAc C3 CPG	20-2974-01	0.1g
	20-2974-10	1.0g
1 µmole columns	20-2974-41	Pack of 4
0.2 µmole columns	20-2974-42	Pack of 4
10 µmole column (ABI)	20-2974-13	Pack of 1
15 µmole column (Expedite)	20-2974-14	Pack of 1



5'-GalNAc C3 Phosphoramidite



GalNAc C3 CPG

CDPI$_3$ MGB™ LABELING

The tripeptide of dihydropyrroloindole-carboxylate (CDPI$_3$) is a minor groove binding (MGB) moiety derived from the natural product CC-1065 with strong DNA binding properties. Synthetic oligonucleotides with covalently-attached CDPI$_3$ have enhanced DNA affinity and have improved the hybridization properties of sequence-specific DNA probes. Short CDPI$_3$-oligonucleotides hybridize with single-stranded DNA to give more stable DNA duplexes than unmodified ODNs of similar length. CDPI$_3$ MGB-oligonucleotide conjugates have been found to be useful in the following applications:

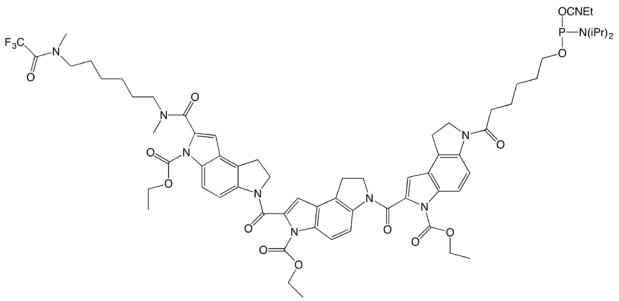
- Arrest of primer extension and PCR blockers
- Short and fluorogenic PCR primers
- Real-time PCR probes
- miRNA Inhibitors

The simplest approach to MGB probe design is to use an MGB support, add a quencher molecule as the first addition and complete the synthesis with a 5'-fluorophore. Alternatively, a fluorophore support could be used with the 5' terminus containing a quencher molecule followed by a final MGB addition at the 5' terminus. Glen Research offers 5'-CDPI$_3$ MGB™ Phosphoramidite and 3'-CDPI$_3$ MGB™ CPG.

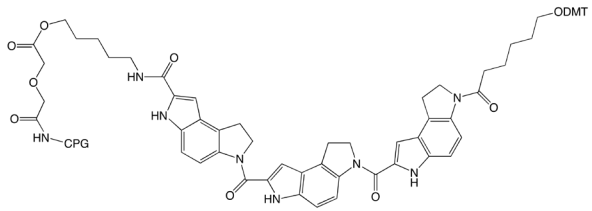
5'-CDPI$_3$ MGB phosphoramidite was found to be hydrophobic enough that it required 10% THF in ACN to go completely into solution at a 0.1 M concentration and required a 3 minute coupling time. Deprotection can be carried out in EtOH/NH4OH 1:3 (v/v) 17 hr at 55 °C and CDPI$_3$ MGB is compatible with GlenPak™ purification.

With the CDPI$_3$ MGB CPG, optimal results are obtained if UltraMild monomers and Cap A are used during synthesis along with 0.5 M CSO oxidizer. However, the use of standard monomers with iodine oxidation followed by deprotection with EtOH/NH4OH 1:3 (v/v) for 17 hr at 55 °C will give acceptable results.

Item	Catalog No.	Pack
5'-CDPI$_3$ MGB™ Phosphoramidite	10-5924-95	50 µmole
	10-5924-90	100 µmole
	10-5924-02	0.25g
CDPI$_3$ MGB™ CPG	20-5924-01	0.1g
	20-5924-10	1.0g
1 µmole columns	20-5924-41	Pack of 4
0.2 µmole columns	20-5924-42	Pack of 4
10 µmole column (ABI)	20-5924-13	Pack of 1
15 µmole column (Expedite)	20-5924-14	Pack of 1



5'-CDPI$_3$ MGB™ Phosphoramidite



CDPI$_3$ MGB™ CPG

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MGB ECLIPSE® CPG

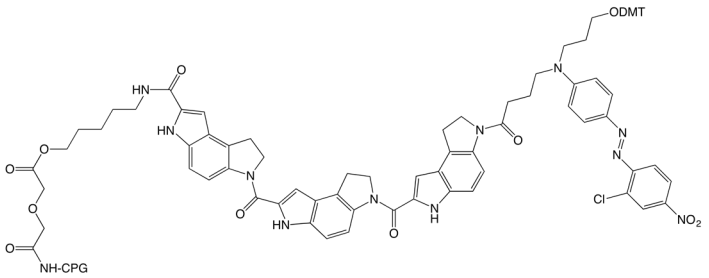
MGB Eclipse® pairs a minor groove binding (MGB) tripeptide with a dark quencher. The MGB significantly enhances hybridization while the Eclipse® has a broad absorption range that quenches many of the most common fluorophores including FAM, HEX, TET and Yakima Yellow®. Together, MGB Eclipse® is an attractive group for the synthesis of hydrolysis probes, the most common probe detection method for qPCR.

Item	Catalog No.	Pack
MGB Eclipse® CPG	20-5957-01	0.1g
	20-5957-10	1.0g
1 µmole columns	20-5957-41	Pack of 4
0.2 µmole columns	20-5957-42	Pack of 4
10 µmole column (ABI)	20-5957-13	Pack of 1
15 µmole column (Expedite)	20-5957-14	Pack of 1

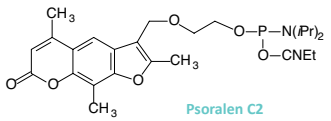
PSORALEN LABELING

Psoralen C2 at the 5'-terminus of an oligonucleotide serves effectively as a cross-linking reagent in double-stranded oligonucleotides. The 6 atom spacer arm of Psoralen C6 allows cross-linking with a triplex oligonucleotide strand. Click Chemistry with psoralen azide and one of our many nucleosidic and non-nucleosidic alkyne derivatives has the potential to generate a variety of practical cross-linkers. The well known reversible cross-linking behavior of psoralen with an adjacent thymidine residue could be very useful.

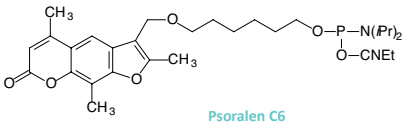
Item	Cat. No.	Pack
Psoralen C2 Phosphoramidite	10-1982-90	100 µmole
	10-1982-02	0.25g
Psoralen C6 Phosphoramidite	10-1983-90	100 µmole
	10-1983-02	0.25g
Psoralen Azide	50-2009-92	25 µmole
	50-2009-90	100 µmole



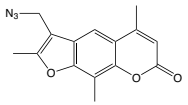
MGB Eclipse® CPG



Psoralen C2



Psoralen C6



Psoralen Azide

EDTA LABELING

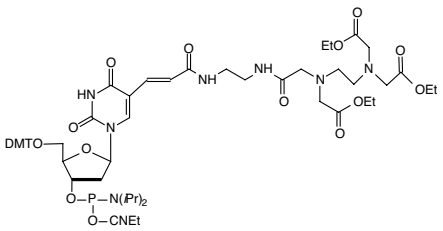
EDTA-C2-dT phosphoramidite contains the triethyl ester of EDTA which allows sequence-specific cleavage of single- and double-stranded DNA and RNA. The cleavage reaction is only initiated once Fe(II) and dithiothreitol are added and so is readily controlled. Coupling of EDTA-dT is normal but cleavage and deprotection should be carried out with sodium hydroxide in aqueous methanol (0.4M NaOH in methanol/water 4:1) overnight at room temperature.

Item	Cat. No.	Pack
EDTA-C2-dT-CE Phosphoramidite	10-1059-95	50 µmole
	10-1059-90	100 µmole
	10-1059-02	0.25g

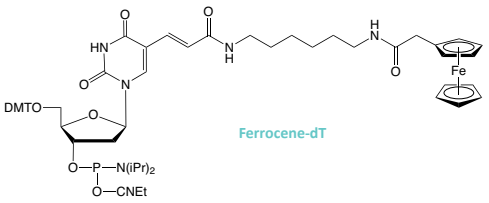
FERROCENE LABELING

With an excellent stability profile, ferrocene has always attracted considerable interest for DNA labeling to generate probes for electrochemical detection. Based on our Amino-Modifier C6-dT structure, Ferrocene-dT is easily added to oligonucleotides with no disruption of regular hybridization behavior. Multiple incorporations into an oligonucleotide probe are also simply achieved. Oligonucleotides are deprotected using standard techniques. Ferrocene oligonucleotides should be stored under Argon and aqueous solutions should be degassed immediately.

Item	Cat. No.	Pack
Ferrocene-dT-CE Phosphoramidite	10-1576-95	50 µmole
	10-1576-90	100 µmole
	10-1576-02	0.25g



EDTA-C2-dT



Ferrocene-dT

INTELLECTUAL PROPERTY

Methylene Blue II is covered under European patent EP2820003 and US patent US9540405 and is sold under license from the University of Lyon.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

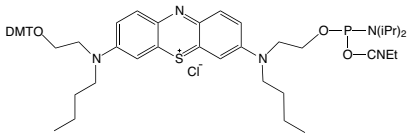
(Please inquire for availability of vials and columns for other instrument types.)

METHYLENE BLUE LABELING

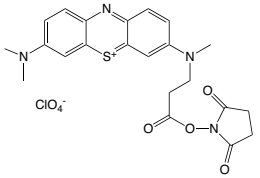
Methylene Blue, which belongs to the phenothiazine family of dyes, is a unique dye with a variety of useful properties. Despite its high extinction coefficient in the visible region (81,000 L/mol•cm), it is weakly fluorescent due to its high rate of intersystem crossing from the S_1 excited state to the T_1 triplet state. This property makes it an excellent photosensitizer, and it has been used extensively to produce highly reactive singlet oxygen. Methylene blue has the ability to both intercalate in duplex DNA, preferring G:C over T:A base pairs, and can act as an electrochemical redox probe. Methylene blue has also been shown to be unmatched in performance as a redox-active reporter for electrochemical biosensors.

Earlier, we introduced Methylene Blue C3 Phosphoramidite but this product proved to have quite limited stability and has been discontinued. As an alternative option, we introduced Methylene Blue NHS Ester to allow researchers to label amino-modified oligonucleotides with this interesting dye. With the encouragement and technical expertise of Carole Chaix and her colleagues at the University of Lyon, we decided to prepare an alternative structure that seemed to have a much superior stability profile - Methylene Blue II Phosphoramidite. Fortunately, this structure did indeed prove more stable and we are now able to offer again a Methylene Blue Phosphoramidite.

Item	Cat. No.	Pack
Methylene Blue NHS Ester (Dissolve 5.4mg in 60µL of DMSO)	50-1960-23	5.4mg
Methylene Blue II Phosphoramidite	10-5961-95 10-5961-90 10-5961-02	50 µmole 100 µmole 0.25g



Methylene Blue II

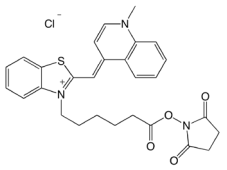


Methylene Blue NHS Ester

LABELING WITH THIAZOLE ORANGE

Thiazole orange is an asymmetric cyanine dye whose fluorescence can be quite dependent on its local environment. When an oligonucleotide labeled with thiazole orange is hybridized to its complementary sequence, the thiazole orange acts as an intercalator. In addition to providing enhanced thermal stability, the dye adopts a mostly planar configuration resulting in significantly enhanced fluorescence. This "light up" effect can be as high as 34-fold depending on the sequence and how the dye is attached. This NHS ester will allow simple functionalization of internally located amino modifications such as those generated with amino-modifier C6 dT (10-1039).

Item	Cat. No.	Pack
Thiazole Orange NHS Ester	50-1970-23	5.4mg



Thiazole Orange NHS Ester

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

FLUORESCENT DYES

	Absorbance Maximum	Emission Maximum	Excimer
Pyrene-dU	402nm	472nm	486nm
Perylene-dU	473nm	490nm	Not Determined

LABELING WITH POLYAROMATIC HYDROCARBONS

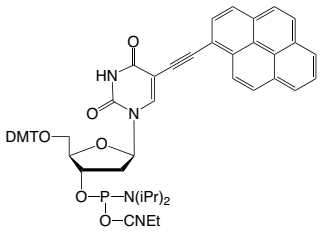
Pyrene and perylene are fluorescent polycyclic aromatic hydrocarbons that have the ability to form 'excited state dimers' known as excimers. This unstructured, long-wavelength emission arises from the formation of a charge-transfer complex between the excited state and the ground state of two fluorescent molecules. In Pyrene-dU and perylene-dU, the hydrocarbon is attached at the 5 position of deoxyuridine through a triple bond and is electronically coupled to the deoxyuridine base. This electronic coupling of the base and the hydrocarbon makes the fluorescence sensitive to the base pairing of the dU portion of the molecule, allowing the discrimination between perfect and one base mismatched targets.

Item	Cat. No.	Pack
Pyrene-dU-CE Phosphoramidite	10-1590-95	50 µmole
	10-1590-90	100 µmole
	10-1590-02	0.25g
Perylene-dU-CE Phosphoramidite	10-1591-95	50 µmole
	10-1591-90	100 µmole
	10-1591-02	0.25g

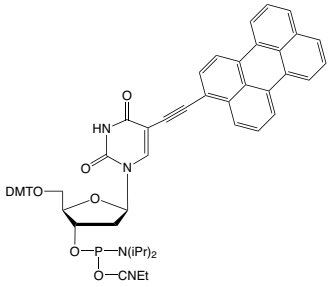
PUROMYCIN CPG

One of the most challenging requirements associated with combinatorial chemistry is the recovery of sequence information of the oligonucleotide or peptide selected by the screening assay. A method[1] has been developed to generate a fusion product between mRNA and the polypeptide it encodes using *in vitro* translation of synthetic RNAs 3'-labeled with puromycin, an antibiotic that mimics transfer RNA. Puromycin binds in the ribosome's A site, forms a peptide bond with the growing peptide chain, and blocks further peptide elongation. By linking puromycin to mRNA, a peptide-RNA fusion product results from the translation of the message linking the encoding mRNA with its peptide product.

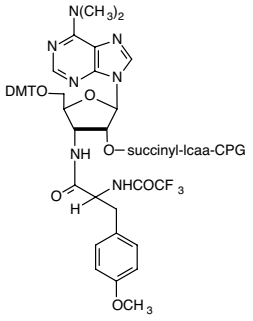
Item	Catalog No.	Pack
Puromycin CPG	20-4040-01	0.1g
	20-4040-10	1.0g
1 µmole columns	20-4140-41	Pack of 4
0.2 µmole columns	20-4140-42	Pack of 4
10 µmole column (ABI)	20-4140-13	Pack of 1
15 µmole columns (Expedite)	20-4140-14	Pack of 1



Pyrene-dU



Perylene-dU



Puromycin CPG

REFERENCES

(1) R.W. Roberts and J.W. Szostak, *Proc. Natl. Acad. Sci. USA*, 1997, **94**, 12297-302.
(2) S. Sando and E.T. Kool, *J Amer Chem Soc*, 2002, **124**, 2096-2097.

RELATED

3'-Phosphate CPG 86
Sulfurizing Reagent 39
Fluorescein-dT 107

LABELING WITH METAL CHELATES

2,2'-Dipicolylamine Phosphoramidite has been discontinued. This product was manufactured and developed by Syntrix Biosystems Inc. For further information, please contact:

Dean Y. Maeda, Ph.D., M.B.A.
Director, Chemistry and Preclinical Development
Syntrix Biosystems
215 Clay St NW Ste B5
Auburn, WA 98001
tel: 253-833-8009 ext. 23
fax: 253-833-8127
Dmaeda@syntrixbio.com

LABELING FOR PHOTO-REGULATION OF OLIGONUCLEOTIDES

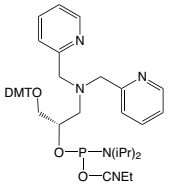
Photo-control, the use of ultraviolet or visible light to control a reaction, has a number of advantages over other external stimuli:

- Light does not introduce contaminants into the reaction system,
- Excitation wavelength can be controlled through the design of the photo-responsive molecule, and
- It is now straightforward to control irradiation time and/or local excitation.

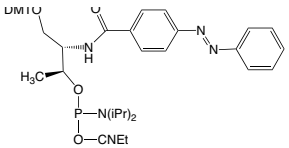
When a photo-responsive molecule is directly attached to DNA as a receptor, photo-regulation of the bioprocess regulated by that DNA molecule could, in principle, be achieved. Such photo-responsive DNA could also be used as a switch in a DNA-based nano-machine. Professor Hiroyuki Asanuma and his group at the department of Molecular Design and Engineering of the Graduate School of Engineering of the Nagoya University (Japan) have developed an efficient method to achieve this goal. They have attached azobenzene to DNA and made it photo-responsive[1,2]. Azobenzene is a typical photo-responsive molecule that isomerizes from its planar *trans*-form to the non-planar ***cis***-form after UV-light irradiation with a wavelength between 300 nm and 400 nm (λ_{max} is around 330 nm). Interestingly, the system reverts from the *cis*-form to the *trans*-form after further irradiation with visible light (wavelength over 400 nm). This process is completely reversible, and the azobenzene group does not decompose or induce undesirable side reactions even on repeated *trans-cis* isomerization. By introducing azobenzenes into DNA through D-threoninol as a linker, Asanuma and co-workers succeeded in achieving photo-regulation of:

- Formation and dissociation of a DNA duplex[3,4] and
- Transcription by T7-RNA polymerase reaction[5,6,7]

Item	Catalog No.	Pack
Azobenzene Phosphoramidite	10-5800-95	50 µmole
	10-5800-90	100 µmole
	10-5800-02	0.25g



2,2'-Dipicolylamine



Azobenzene Phosphoramidite

REFERENCES

(1) H. Asanuma, et al., ***Angew Chem Int Ed***, 2001, **40**, 2671-2673.
(2) T. Takarada, et al., ***Chem Lett.***, 2001, **30**, 732.
(3) H. Asanuma, X.G. Liang, T. Yoshida, and M. Komiyama, ***Chembiochem***, 2001, **2**, 39-44.
(4) H. Asanuma, D. Matsunaga, and M. Komiyama, ***NUCLEIC ACIDS SYMP SER (OXF)***, 2005, **49**, 35.
(5) H. Asanuma, et al., ***Chembiochem***, 2002, **3**, 786.
(6) M. Liu, H. Asanuma, and M. Komiyama, ***J. Amer. Chem. Soc.***, 2006 , **128**, 1009.
(7) H. Asanuma, et al., ***Nature Protocols***, 2007, **2**, 203-212.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

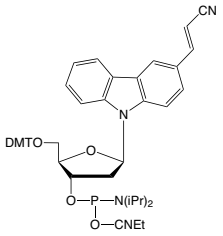
QUENCHED AUTOLIGATION (QUAL) PROBES

REFERENCES

(1) Y. Yoshimura, and K. Fujimoto, ***Org Lett,*** 2008, **10**, 3227-30.
(2) K. Fujimoto, K. Konishi-Hiratsuka, T. Sakamoto, and Y. Yoshimura, ***ChemBioChem,*** 2010, **11**, 1661-4.
(3) Y. Yoshimura, T. Ohtake, H. Okada, and K. Fujimoto, ***ChemBioChem,*** 2009, **10**, 1473-6.

QUAL probes[2] consist of two oligonucleotides, the first containing a nucleophilic group at the 3'-terminus, while the second has an electrophilic group at the 5'-terminus. When the probe pair finds the target, the oligos line up with the 3'-terminus of the first directly adjacent to the 5'-terminus of the second. An autoligation reaction then takes place to combine the two oligos into a single probe. As usual, the 3' nucleophilic group is the 3-thiophosphate, easily prepared using 3'-phosphate CPG with a sulfurizing step in the first cycle. In this case, the electrophilic group is a 5'-dabsyl group, which is an excellent leaving group as well as a fine quencher of fluorescence. The second oligo, therefore, contains a fluorophore which is quenched by the dabsyl group. A popular choice for fluorophore is fluorescein-dT but it is easy to imagine that a variety of fluorophores could be attached to any of the commercially available amino-modified nucleoside phosphoramidites.

Item	Catalog No.	Pack
5'-Dabsyl-dT-CE Phosphoramidite	10-1532-90	100 µmole
	10-1532-02	0.25g



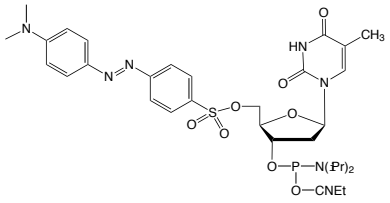
3-Cyanovinylcarbazole

LABELING WITH ULTRAFAST PHOTO CROSS-LINKER

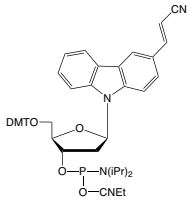
When 3-cyanovinylcarbazole nucleoside (^{CNV}K) is incorporated into an oligonucleotide, very rapid photo cross-linking to the complementary strand can be induced at one wavelength and rapid reversal of the cross-link is possible at a second wavelength. Neither wavelength has the potential to cause significant DNA damage. Irradiation of a duplex containing a single incorporation of ^{CNV}K at 366 nm led to 100% cross-linking to thymine base in 1 second, although complete cross-linking to cytosine takes 25 seconds.[1] A 30 second irradiation time should cover all situations. In addition, it was demonstrated that the purine bases were unreactive to cross-linking, allowing differentiation between pyrimidines and purines at the target site. The authors also determined the effect of sequence contexts around the ^{CNV}K site and demonstrated that the identity of bases on either side of the cross-linking site has little effect on the reaction. Once cross-linked, the UV melting temperature of the duplex was raised by around 30 °C relative to the duplex before irradiation. Complete reversal of the cross-link takes place at 312 nm in 3 minutes. This facile reversal reaction is, therefore, accomplished with no damage to normal DNA.

In a later publication, a further application of this cross-linking technique was investigated.[2] When ^{CNV}K was cross-linked with a dC residue in duplex DNA, heating at 90° C for 3.5 hours led to deamination of the cytosine base to form uracil in the complementary strand. Reversal of the cross-link at 312 nm led to a DNA strand in which dC had been converted to dU. The authors showed that this transformation is specific for the dC residue opposite the ^{CNV}K and any further adjacent dC residues are unaffected. Similarly, the authors have shown that ^{CNV}K can be cross-linked to an adjacent RNA strand.[3]

Item	Cat. No.	Pack
3-Cyanovinylcarbazole Phosphoramidite (^{CNV}K)	10-4960-95	50 µmole
	10-4960-90	100 µmole
	10-4960-02	0.25g



5'-Dabsyl-dT



3-Cyanovinylcarbazole Phosphoramidite (^{CNV}K)

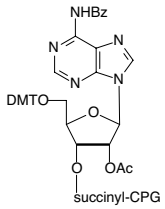
RNA SUPPORTS FOR 3’ MODIFICATION

Glen Research offers RNA supports in which protected ribonucleosides are attached to CPG. With 5’-DMT protection, and all other protecting groups base-labile, the use of these supports is identical to DNA supports. These supports are suitable for use in producing oligodeoxynucleotides modified at the 3’-terminus or oligoribonucleotides. ABI-style columns are supplied unless otherwise requested (see note box).

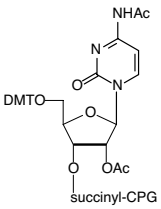
ABBREVIATIONS

Ac = Acetyl
Bz = Benzoyl
CNEt = Cyanoethyl
CPG = Controlled Pore Glass
DMT = 4,4’-Dimethoxytrityl

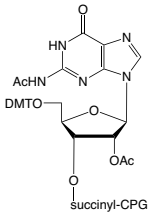
Item	Catalog No.	Pack
Bz-A-RNA-CPG	20-3303-01	0.1g
	20-3303-02	0.25g
	20-3303-10	1.0g
1 µmole columns	20-3403-41	Pack of 4
0.2 µmole columns	20-3403-42	Pack of 4
10 µmole columns (ABI)	20-3403-13	Pack of 1
15 µmole column (Expedite)	20-3403-14	Pack of 1
Ac-C-RNA-CPG	20-3315-01	0.1g
	20-3315-02	0.25g
	20-3315-10	1.0g
1 µmole columns	20-3415-41	Pack of 4
0.2 µmole columns	20-3415-42	Pack of 4
10 µmole column (ABI)	20-3415-13	Pack of 1
15 µmole column (Expedite)	20-3415-14	Pack of 1
Ac-G-RNA-CPG	20-3324-01	0.1g
	20-3324-02	0.25g
	20-3324-10	1.0g
1 µmole columns	20-3424-41	Pack of 4
0.2 µmole columns	20-3424-42	Pack of 4
10 µmole column (ABI)	20-3424-13	Pack of 1
15 µmole column (Expedite)	20-3424-14	Pack of 1
U-RNA-CPG	20-3330-01	0.1g
	20-3330-02	0.25g
	20-3330-10	1.0g
1 µmole columns	20-3430-41	Pack of 4
0.2 µmole columns	20-3430-42	Pack of 4
10 µmole column (ABI)	20-3430-13	Pack of 1
15 µmole column (Expedite)	20-3430-14	Pack of 1



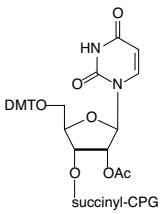
Bz-A-CPG



Ac-C-CPG



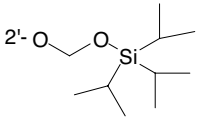
Ac-G-CPG



U-CPG

TOM-PROTECTED RNA PHOSPHORAMIDITES

INTELLECTUAL PROPERTY



TOM-Protecting-Group™

TOM-Protecting-Group is a trademark of QIAGEN.

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

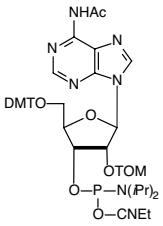
(Please inquire for availability of vials and columns for other instrument types.)

RNA synthesis using monomers containing the 2'-O-TriisopropylsilylOxyMethyl (TOM) group (TOM-Protecting-Group™) is characterized by very high coupling efficiency along with fast, simple deprotection. High coupling efficiency is achieved because the TOM-Protecting-Group exhibits lower steric hindrance than the 2'-O-t-butyldimethylsilyl (TBDMS) group used in our alternative RNA monomers. Fast and reliable deprotection is achieved using methylamine in ethanol/water at room temperature. A further feature of the TOM-Protecting-Group is that during basic steps it can not undergo 2' to 3' migration. This migration under basic conditions leads to non-biologically active 2'-5' linkages when using the TBDMS group. These features allow the TOM-Protected monomers to produce longer oligonucleotides. TOM-Protected RNA monomers are also fully compatible with minor bases with 2'-O-TBDMS protection.

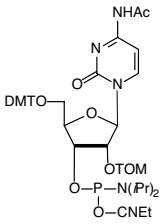
Item	Catalog No.	Pack
A-TOM-CE Phosphoramidite	10-3004-02	0.25g
	10-3004-05	0.5g
	10-3004-10	1.0g
C-TOM-CE Phosphoramidite	10-3014-02	0.25g
	10-3014-05	0.5g
	10-3014-10	1.0g
G-TOM-CE Phosphoramidite	10-3024-02	0.25g
	10-3024-05	0.5g
	10-3024-10	1.0g
U-TOM-CE Phosphoramidite	10-3034-02	0.25g
	10-3034-05	0.5g
	10-3034-10	1.0g

RNA SUPPORTS FOR TOM RNA SYNTHESIS

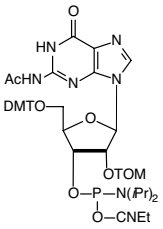
Item	Catalog No.	Pack
Ac-A-RNA-CPG	20-3304-01	0.1g
	20-3304-02	0.25g
	20-3304-10	1.0g
1 µmole columns	20-3404-41	Pack of 4
0.2 µmole columns	20-3404-42	Pack of 4
10 µmole column (ABI)	20-3404-13	Pack of 1
15 µmole column (Expedite)	20-3404-14	Pack of 1



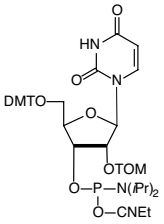
A-TOM



C-TOM



G-TOM



U-TOM

RNA SUPPORTS FOR TOM RNA SYNTHESIS (CONT.)

Item	Catalog No.	Pack
Ac-C-RNA-CPG	20-3315-01	0.1g
	20-3315-02	0.25g
	20-3315-10	1.0g
1 µmole columns	20-3415-41	Pack of 4
0.2 µmole columns	20-3415-42	Pack of 4
10 µmole column (ABI)	20-3415-13	Pack of 1
15 µmole column (Expedite)	20-3415-14	Pack of 1
Ac-G-RNA-CPG	20-3324-01	0.1g
	20-3324-02	0.25g
	20-3324-10	1.0g
1 µmole columns	20-3424-41	Pack of 4
0.2 µmole columns	20-3424-42	Pack of 4
10 µmole column (ABI)	20-3424-13	Pack of 1
15 µmole column (Expedite)	20-3424-14	Pack of 1
U-RNA-CPG	20-3330-01	0.1g
	20-3330-02	0.25g
	20-3330-10	1.0g
1 µmole columns	20-3430-41	Pack of 4
0.2 µmole columns	20-3430-42	Pack of 4
10 µmole column (ABI)	20-3430-13	Pack of 1
15 µmole column (Expedite)	20-3430-14	Pack of 1

TBDMS-PROTECTED RNA PHOSPHORAMIDITES

ABBREVIATIONS

Bz = Benzoyl
CNEt = Cyanoethyl
CPG = Controlled Pore Glass
dmf = Dimethylformamidine
DMT = 4,4'-Dimethoxytrityl
iPr = Isopropyl
lcaa = long chain alkylamino
Pac = Phenoxyacetyl
PhOAc = Phenoxyacetyl
TBDMS = t-Butyl-dimethylsilyl

INSTRUMENT TYPES

Glen Research packages these monomers in a variety of industry-standard vials and bottles. Please provide the exact specification of the bottle required prior to receiving a quotation.

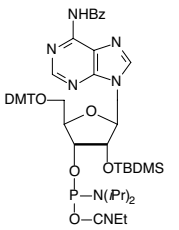
Glen Research CE (ß-cyanoethyl) Phosphoramidites for RNA synthesis are produced and packaged to ensure the highest performance on commercial synthesizers. Every batch is accompanied by a Certificate of Analysis and an HPLC trace, showing the results of our QC testing. RNA Phosphoramidites are synthesis-tested with a minimum coupling efficiency of 97%. Glen Research RNA monomers are packaged in industry standard vials which are specially cleaned to eliminate particulate contamination. These monomers are available in a variety of packs, including high throughput (HT) and low cost (LC). An UltraMild set is also available for situations where sensitive bases are in use. Dmf-G (10-3029) has been discontinued and may be substituted with Ac-G (10-3025).

Item	Catalog No.	Pack
Bz-A-CE Phosphoramidite	10-3003-02	0.25g
	10-3003-05	0.5g
	10-3003-10	1.0g
Ac-C-CE Phosphoramidite	10-3015-02	0.25g
	10-3015-05	0.5g
	10-3015-10	1.0g
Ac-G-CE Phosphoramidite	10-3025-02	0.25g
	10-3025-05	0.5g
	10-3025-10	1.0g
U-CE Phosphoramidite	10-3030-02	0.25g
	10-3030-05	0.5g
	10-3030-10	1.0g

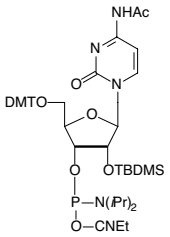
RNA PHOSPHORAMIDITES - SPECIAL PACKAGING

We offer our high quality DNA phosphoramidites specifically packaged for high throughput and large-scale synthesis customers. These customers normally require high quality materials produced under the guidelines of a validated quality management system while still being priced aggressively. These products include the usual Glen Research certification and guarantees and they are available in larger packs or in bulk. The core catalog numbers for regular DNA phosphoramidites are shown below. For these products, please request a quote.

Item	Catalog No.
Bz-A-CE Phosphoramidite	10-3003-SP
Ac-C-CE Phosphoramidite	10-3015-SP
Ac-G-CE Phosphoramidite	10-3025-SP
U-CE Phosphoramidite	10-3030-SP



Bz-A-CE Phosphoramidite



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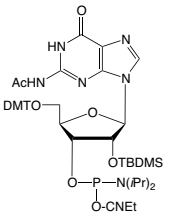
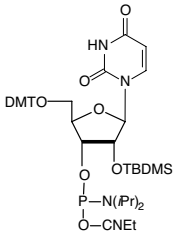


Ac-G-CE Phosphoramidite



U-CE Phosphoramidite

ULTRAMILD TBDMS RNA PHOSPHORAMIDITES

Item	Catalog No.	Pack
Pac-A-CE Phosphoramidite	10-3000-02	0.25g
	10-3000-05	0.5g
	10-3000-10	1.0g
Ac-C-CE Phosphoramidite	10-3015-02	0.25g
	10-3015-05	0.5g
	10-3015-10	1.0g
iPr-Pac-G-CE Phosphoramidite	10-3021-02	0.25g
	10-3021-05	0.5g
	10-3021-10	1.0g
U-CE Phosphoramidite	10-3030-02	0.25g
	10-3030-05	0.5g
	10-3030-10	1.0g

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

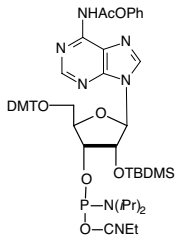
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

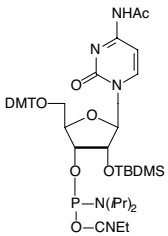
TBDMS RNA SUPPORTS

ABI-style columns are supplied for 1 µmole and 0.2 µmole scales unless otherwise requested (see note box).

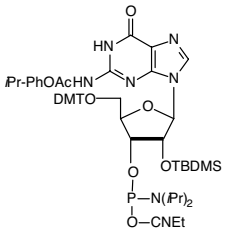
Item	Catalog No.	Pack
Pac-A-RNA-CPG	20-3300-01	0.1g
	20-3300-02	0.25g
	20-3300-10	1.0g
1 µmole columns	20-3400-41	Pack of 4
0.2 µmole columns	20-3400-42	Pack of 4
10 µmole column (ABI)	20-3400-13	Pack of 1
15 µmole column (Expedite)	20-3400-14	Pack of 1
Bz-A-RNA-CPG	20-3303-01	0.1g
	20-3303-02	0.25g
	20-3303-10	1.0g
1 µmole columns	20-3403-41	Pack of 4
0.2 µmole columns	20-3403-42	Pack of 4
10 µmole column (ABI)	20-3403-13	Pack of 1
15 µmole column (Expedite)	20-3403-14	Pack of 1



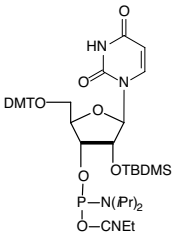
Pac-A-CE Phosphoramidite



Ac-C-CE Phosphoramidite



iPr-Pac-G-CE Phosphoramidite



U-CE Phosphoramidite

TBDMS RNA SUPPORTS (CONT.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

Item	Catalog No.	Pack
Ac-C-RNA-CPG	20-3315-01	0.1g
	20-3315-02	0.25g
	20-3315-10	1.0g
1 µmole columns	20-3415-41	Pack of 4
0.2 µmole columns	20-3415-42	Pack of 4
10 µmole column (ABI)	20-3415-13	Pack of 1
15 µmole column (Expedite)	20-3415-14	Pack of 1
iPr-Pac-G-RNA-CPG	20-3321-01	0.1g
	20-3321-02	0.25g
	20-3321-10	1.0g
1 µmole columns	20-3421-41	Pack of 4
0.2 µmole columns	20-3421-42	Pack of 4
10 µmole column (ABI)	20-3421-13	Pack of 1
15 µmole column (Expedite)	20-3421-14	Pack of 1
Ac-G-RNA-CPG	20-3324-01	0.1g
	20-3324-02	0.25g
	20-3324-10	1.0g
1 µmole columns	20-3424-41	Pack of 4
0.2 µmole columns	20-3424-42	Pack of 4
10 µmole column (ABI)	20-3424-13	Pack of 1
15 µmole column (Expedite)	20-3424-14	Pack of 1
U-RNA-CPG	20-3330-01	0.1g
	20-3330-02	0.25g
	20-3330-10	1.0g
1 µmole columns	20-3430-41	Pack of 4
0.2 µmole columns	20-3430-42	Pack of 4
10 µmole column (ABI)	20-3430-13	Pack of 1
15 µmole column (Expedite)	20-3430-14	Pack of 1

ULTRAMILD SOLVENTS/REAGENTS

Item	Catalog No.	Pack
Cap Mix A		
THF/Pyridine/Pac_2O	40-4210-52	200mL
(Applied Biosystems)	40-4210-57	450mL
THF/Pac_2O	40-4212-52	200mL
(Expedite)	40-4212-57	450mL
Deprotection Solution		
0.05M Potassium Carbonate in Methanol	60-4600-30	30mL
	60-4600-52	200mL
	60-4600-57	450mL

MINOR RNA PHOSPHORAMIDITES (TOM PROTECTED)

RELATED

Minor TBDMS monomers 137
Pyrrolo-CTP 140
rSpacer TBDMS 138

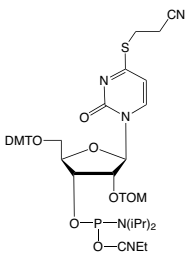
Glen Research offers minor RNA phosphoramidites with either TOM or TBDMS protecting groups. 4-Thio-U, 5-Methyl-Cytidine, and 2-Amino-Adenosine are useful for analyzing RNA structure and activity relationships, for example, in ribozyme studies.

Pyrrolo-C is a fluorescent nucleoside whose fluorescence is sensitive to its environment and is ideal for probing RNA structure. It base-pairs as a normal C nucleotide. It is highly fluorescent and its excitation and emission are well suited to the red of most fluorescent nucleotide analogs, which eliminates or reduces background fluorescence from proteins. Pyrrolo-CTP has potential uses in biological assay development.

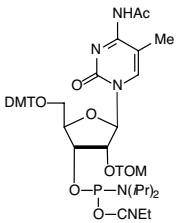
rSpacer is used to introduce an abasic site to an RNA sequence. The TOM protected version has been discontinued and is replaced with the TBDMS version.

The protecting scheme for 2,6-Diaminopurine has been changed and the original product (10-3084) has been replaced with the optimized product (10-3085) below.

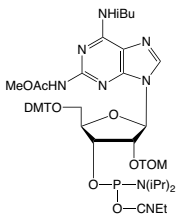
Item	Catalog No.	Pack
4-Thio-U-TOM-CE Phosphoramidite	10-3052-95	50 µmole
	10-3052-90	100 µmole
	10-3052-02	0.25g
5-Me-C-TOM-CE Phosphoramidite	10-3064-95	50 µmole
	10-3064-90	100 µmole
	10-3064-02	0.25g
2,6-Diaminopurine-TOM-CE Phosphoramidite (2-amino-A)	10-3085-95	50 µmole
	10-3085-90	100 µmole
	10-3085-02	0.25g



4-Thio-U-TOM



5-Me-C-TOM



2,6-diaminopurine-TOM

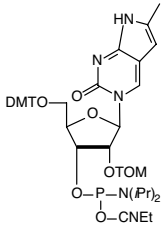
MINOR RNA PHOSPHORAMIDITES (TOM PROTECTED) (CONT.)

Item	Catalog No.	Pack
Pyrrolo-C-TOM-CE Phosphoramidite	10-3017-95	50 µmole
	10-3017-90	100 µmole
	10-3017-02	0.25g

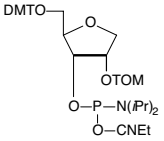
RNA SEQUENCE MODIFIER (TOM PROTECTED)

Amino-Modifier C6-U has been added to the growing family of sequence modifiers and we envisage applications in RNA structural studies as well as for labeling siRNA to probe uptake and cellular distribution.

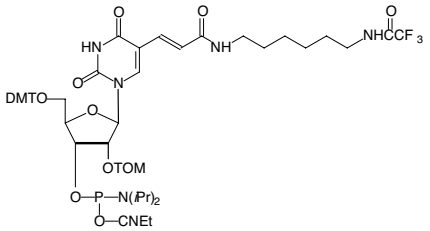
Item	Catalog No.	Pack
Amino-Modifier C6-U Phosphoramidite	10-3039-95	50 µmole
	10-3039-90	100 µmole
	10-3039-02	0.25g



Pyrrolo-C-TOM



rSpacer



Amino-Modifier C6-U

RELATED

Pyrrolo-dC.....72
Pyrrolo-CTP.....140

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

MINOR RNA PHOSPHORAMIDITES (TBDMS PROTECTED)

Inosine and 5-Methyl-Uridine are useful for analyzing RNA structure and activity relationships. 5-Bromo-Uridine and 5-Iodo-Uridine have been used for crystallography studies and cross-linking experiments. 6-Thioguanosine (6-thio-G) has applications in ribozyme and siRNA research, as well as in RNA-protein interactions. The removal of the silyl protecting group without interfering with the sulfur is critical. This is removed[1] cleanly by triethylamine trihydrofluoride in DMSO but t-butylammonium fluoride (TBAF) leads to degradation of the thio-nucleotide analogue and should not be used. 2-Aminopurine riboside is useful for analyzing RNA structure and activity relationships, for example, in ribozyme studies.

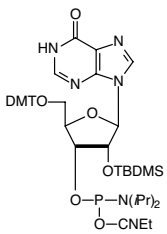
Item	Catalog No.	Pack
I-CE Phosphoramidite	10-3040-95	50 µmole
	10-3040-90	100 µmole
	10-3040-02	0.25g
5-Me-U-CE Phosphoramidite (T)	10-3050-95	50 µmole
	10-3050-90	100 µmole
	10-3050-02	0.25g
Br-U-CE Phosphoramidite	10-3090-95	50 µmole
	10-3090-90	100 µmole
	10-3090-02	0.25g
I-U-CE Phosphoramidite	10-3091-95	50 µmole
	10-3091-90	100 µmole
	10-3091-02	0.25g
6-Thio-G-CE Phosphoramidite	10-3072-95	50 µmole
	10-3072-90	100 µmole
	10-3072-02	0.25g
2-Aminopurine-CE Phosphoramidite	10-3070-95	50 µmole
	10-3070-90	100 µmole
	10-3070-02	0.25g

RELATED

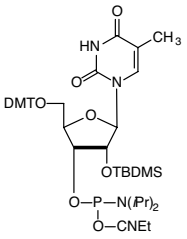
Minor TOM monomers 135

REFERENCES

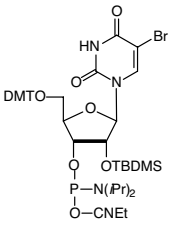
(1) C.J. Adams, J.B. Murray, M.A. Farrow, J.R.P. Arnold, and P.G. Stockley, *Tetrahedron Lett.*, 1995, **36**, 5421-5424.
(2) D.A. Berry, et al., *Tetrahedron Lett*, 2004, **45**, 2457-2461.



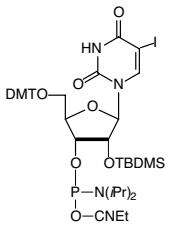
Inosine



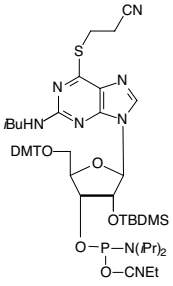
5-Me-U



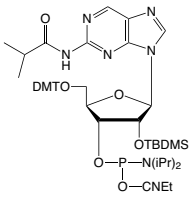
Br-U



I-U



6-Thio-G



2-Aminopurine

MINOR RNA (TBDMS PROTECTED) (CONT.)

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

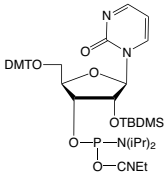
8-Aza-7-deaza-Adenosine is an isomer of Adenosine with virtually identical electron density. The N7 nitrogen is not available for hydrogen bonding.

Ribozyme activity is substantially affected by the substitution of modified pyrimidine bases. Zebularine (pyrimidin-2-one ribonucleoside) may be regarded as a Cytidine derivative lacking the exocyclic amino group. Zebularine and Pyridin-2-one Ribonucleoside, the 3-deaza analogue of Zebularine, are prime candidates for use in evaluating ribozyme activity and function. It should be noted that Zebularine is mildly fluorescent, absorbing at 298 nm and emitting at 367 nm.

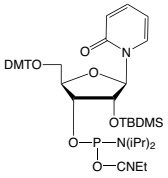
PseudoUridine is one of the most common modified nucleosides found in RNA. The availability of a phosphoramidite will allow detailed research into the effects of this modified base on RNA structure and activity.

rSpacer is used to introduce an abasic site to an RNA sequence.

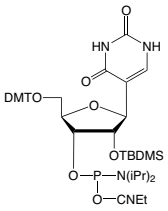
Item	Catalog No.	Pack
Zebularine-CE Phosphoramidite	10-3011-95	50 µmole
	10-3011-90	100 µmole
	10-3011-02	0.25g
Pyridin-2-one-CE Phosphoramidite	10-3012	Discontinued
PseudoUridine-CE Phosphoramidite	10-3055-95	50 µmole
	10-3055-90	100 µmole
	10-3055-02	0.25g
8-Aza-7-deaza-A-CE Phosphoramidite	10-3083	Discontinued
rSpacer TBDMS CE Phosphoramidite	10-3915-95	50 µmole
	10-3915-90	100 µmole
	10-3915-02	0.25g



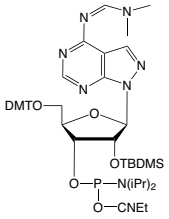
Zebularine



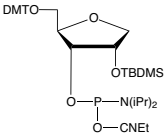
Pyridin-2-one



PseudoUridine



8-Aza-7-deaza-A



rSpacer TBDMS

MINOR RNA (TBDMS PROTECTED) (CONT.)

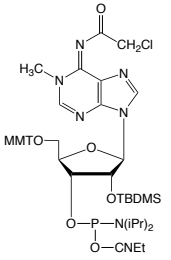
Methylation of adenosine at position 1 produces a drastic functional change in the nucleobase. 1-Methyladenosine (pK_a 8.25) is a much stronger base than adenosine (pK_a 3.5). N-1 methylation excludes participation of the adenine base in canonical Watson–Crick base pairing and provides a positive charge to the nucleobase. This modification also alters the hydrophobicity of the base, the stacking properties, the ordering of water molecules and the chelation properties. The base may become involved in non-canonical hydrogen bonding, in electrostatic interactions and, in general, it may contribute to the conformational dynamics of the tRNA.

In the central dogma of molecular biology, genetic information flows from DNA to RNA and then to protein. Reversible epigenetic modifications on genomic DNA and histone have been known to substantially regulate gene expression. On the other hand, there exists more than 100 naturally occurring chemical modifications in RNA; however, the functions of these RNA modifications are largely unknown. Whether some of these modifications in RNA can be reversed and could impact gene expression in the central dogma was unknown until the recent discovery of N6-methyladenosine (N6-Me-A) as the first example of reversible RNA methylation.[1] We offer the N6-Me-A RNA monomer with a phenoxyacetyl protecting group to minimize potential branching. We have shown N6-Me-A-CE Phosphoramidite to be completely compatible with all popular RNA synthesis and deprotection methods, from UltraMild to the most popular procedure using AMA for deprotection.

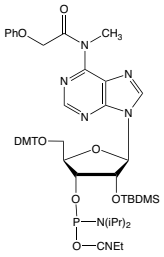
Item	Catalog No.	Pack
1-Me-A-CE Phosphoramidite	10-3501-95	50 µmole
	10-3501-90	100 µmole
	10-3501-02	0.25g
N6-Me-A-CE Phosphoramidite	10-3005-95	50 µmole
	10-3005-90	100 µmole
	10-3005-02	0.25g

RNA methylation occurs in a large selection of RNA nucleosides and this post transcriptional modification of RNA, carried out by a variety of RNA methyltransferases, appears in a wide variety of RNA species - including tRNA, mRNA, miRNA and RNA viruses. Over 90 methylated nucleosides have been found in tRNA and these play many significant roles in tRNA structure. In addition, methylation appears to mark the tRNA as mature, preventing its degradation as well as directing localization within the cell. mRNA, modified with 1-methylpseudouridine (1-Me-**Ψ**) alone or in combination with 5-methylcytidine (5-Me-C), significantly increases protein expression in cells and mouse models. 1-Me-**Ψ** is also a modified nucleobase that can greatly enhance the properties of mRNA by reducing immunogenicity and increasing stability.

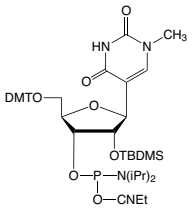
Item	Catalog No.	Pack
1-Me-Pseudouridine Phosphoramidite	10-3056-95	50 µmole
	10-3056-90	100 µmole
	10-3056-02	0.25g



1-Me-A



N6-Me-A



1-Me-Pseudouridine

REFERENCE

(1) Y. Fu, D. Dominissini, G. Rechavi, and C. He, *Nat Rev Genet*, 2014, **15**, 293-306.

RELATED

5-Me-C 135
Pseudouridine 138

MINOR RNA (TBDMS PROTECTED) (CONT.)

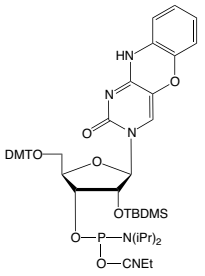
The bright fluorescent tricyclic cytosine analogues tC and tC^{O} stand out among fluorescent bases due to their virtually unquenched fluorescence inside single- or double-stranded DNA. Until recently, this family of tricyclic cytosines had only been studied and used in DNA contexts and, importantly, introduced as possible donors of the first DNA base analogue FRET-pair with tC$_{nitro}$. Fluorescent base analogues for RNA are limited in number compared to their DNA counterparts. To facilitate the application of such analogues, characterization of their structural and dynamics behavior in RNA compared to the corresponding natural nucleoside is important. We now introduce the tC^{O} ribonucleoside, which has been incorprated into a range of RNA sequences, where it was shown to be a very potent and useful fluorophore in this context.[1] Glen Research offers this useful fluorescent ribonucleoside analogue in cooperation with ModyBase HB.

Item	Catalog No.	Pack
Ribo-tCO-CE Phosphoramidite	10-3517-95	50 µmole
	10-3517-90	100 µmole
	10-3517-02	0.25g

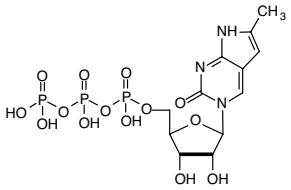
MINOR RNA TRIPHOSPHATES

Pyrrolo-dC is a fluorescent nucleoside that codes as dC and base pairs efficiently with dG. Preliminary evidence indicates that pyrrolo-dC triphosphate is an excellent substrate for Taq, Pfu and Vent polymerases and is incorporated specifically opposite dG. Pyrrolo-dCTP has been available for some time and is in use in biological assays. Pyrrolo-CTP is a fluorescent ribonucleotide with fluorescence exquisitely sensitive to its environment and is of great interest for RNA structural research. The pyrrolo-C project is a joint development by Berry and Associates, Inc. and Glen Research Corporation.

Item	Catalog No.	Pack
Pyrrolo-CTP 10mM	81-3017-01	Discontinued



Ribo-tC°



Pyrrolo-CTP

REFERENCE

(1) Füchtbauer, A.F., Preus, S., Börjesson, K., McPhee, S.A., Lilley D.M.J., Wilhelmsson, L.M., *Sci. Rep.*, 2017, **7**, 2393.

INTELLECTUAL PROPERTY

These products are offered in collaboration with ModyBase HB.

RELATED

tC^{O} 74
Pyrrolo-dC 72
Pyrrolo-C 136

2’-OME-RNA PHOSPHORAMIDITES

Glen Research 2’-OMe-RNA CE (ß-cyanoethyl) Phosphoramidites are designed to produce synthetic oligonucleotides containing nuclease resistant 2’-O-methyl ribonucleotide linkages. Deprotection, isolation and handling of 2’-O-methyl oligonucleotides are identical to the procedures for oligodeoxynucleotides.

Item	Catalog No.	Pack
2’-OMe-A-CE Phosphoramidite	10-3100-90	100 µmole
	10-3100-02	0.25g
	10-3100-05	0.5g
	10-3100-10	1.0g
2’-OMe-Ac-C-CE Phosphoramidite	10-3115-90	100 µmole
	10-3115-02	0.25g
	10-3115-05	0.5g
	10-3115-10	1.0g
2’-OMe-iBu-G-CE Phosphoramidite	10-3120-90	100 µmole
	10-3120-02	0.25g
	10-3120-05	0.5g
	10-3120-10	1.0g
2’-OMe-G-CE Phosphoramidite	10-3121-90	100 µmole
	10-3121-02	0.25g
	10-3121-05	0.5g
	10-3121-10	1.0g
2’-OMe-U-CE Phosphoramidite	10-3130-90	100 µmole
	10-3130-02	0.25g
	10-3130-05	0.5g
	10-3130-10	1.0g

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

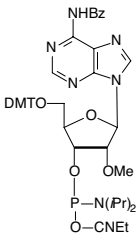
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

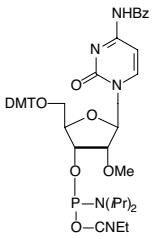
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



2’-OMe-A



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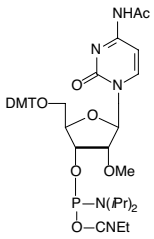
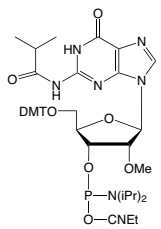
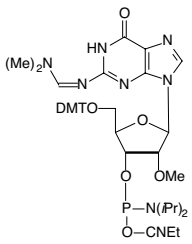


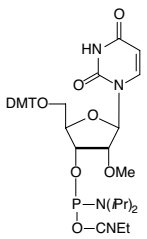
2’-OMe-Ac-C



2’-OMe-iBu-G



2’-OMe-G



2’-OMe-U

ULTRAMILD 2'-OME-RNA

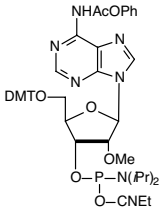
The use of UltraMild monomers in oligonucleotide synthesis has allowed very sensitive dyes like TAMRA, HEX and Cy5 to be used virtually routinely. The DNA and RNA monomers are currently available and we also provide this set of 2'-OMe-RNA monomers. In our version of this chemistry, we use as protecting groups phenoxyacetyl (Pac) for A, acetyl (Ac) for C, and isopropyl-phenoxyacetyl (iPr-Pac) for G.

It has become clear that acetic anhydride in the conventional capping mix can cause transamidation in situations where an amine protecting group is quite labile. This leads to acetyl protection on the amino group that may be slow to be removed. Consequently, if many dG residues are included in the oligonucleotide, we recommend the use of phenoxyacetic anhydride (Pac_2O) in Cap A. This modification removes the possibility of exchange of the iPr-Pac protecting group on the dG with acetate from the acetic anhydride capping mix.

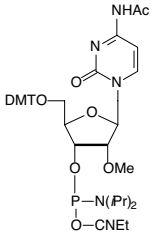
Item	Catalog No.	Pack
2'-OMe-Pac-A-CE Phosphoramidite	10-3601-02	0.25g
	10-3601-05	0.5g
	10-3601-10	1.0g
2'-OMe-Ac-C-CE Phosphoramidite	10-3115-02	0.25g
	10-3115-05	0.5g
	10-3115-10	1.0g
2'-OMe-iPr-Pac-G-CE Phosphoramidite	10-3621-02	0.25g
	10-3621-05	0.5g
	10-3621-10	1.0g

ULTRAMILD SOLVENTS/REAGENTS

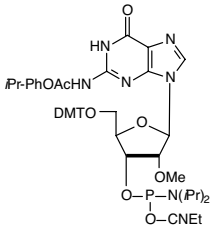
Cap Mix A		
THF/Pyridine/Pac_2O	40-4210-52	200mL
(Applied Biosystems)	40-4210-57	450mL
THF/Pac_2O	40-4212-52	200mL
(Expedite)	40-4212-57	450mL
Deprotection Solution		
0.05M Potassium Carbonate in Methanol	60-4600-30	30mL
	60-4600-52	200mL
	60-4600-57	450mL



2'-OMe-Pac-A



2'-OMe-Ac-C



2'-OMe-iPr-Pac-G

2’-OME-RNA SUPPORTS

ABI-style columns are supplied for 1 µmole and 0.2 µmole scales unless otherwise requested (see note box).

Item	Catalog No.	Pack
2’-OMe-A-RNA-CPG	20-3600-01	0.1g
	20-3600-02	0.25g
	20-3600-10	1.0g
1 µmole columns	20-3700-41	Pack of 4
0.2 µmole columns	20-3700-42	Pack of 4
10 µmole column (ABI)	20-3700-13	Pack of 1
15 µmole column (Expedite)	20-3700-14	Pack of 1
2’-OMe-C-RNA-CPG	20-3610-01	0.1g
	20-3610-02	0.25g
	20-3610-10	1.0g
1 µmole columns	20-3710-41	Pack of 4
0.2 µmole columns	20-3710-42	Pack of 4
10 µmole column (ABI)	20-3710-13	Pack of 1
15 µmole column (Expedite)	20-3710-14	Pack of 1
2’-OMe-Ac-C-RNA-CPG	20-3615-01	0.1g
	20-3615-02	0.25g
	20-3615-10	1.0g
1 µmole columns	20-3715-41	Pack of 4
0.2 µmole columns	20-3715-42	Pack of 4
10 µmole column (ABI)	20-3715-13	Pack of 1
15 µmole column (Expedite)	20-3715-14	Pack of 1
2’-OMe-G-RNA-CPG	20-3621-01	0.1g
	20-3621-02	0.25g
	20-3621-10	1.0g
1 µmole columns	20-3721-41	Pack of 4
0.2 µmole columns	20-3721-42	Pack of 4
10 µmole column (ABI)	20-3721-13	Pack of 1
15 µmole column (Expedite)	20-3721-14	Pack of 1
2’-OMe-U-RNA-CPG	20-3630-01	0.1g
	20-3630-02	0.25g
	20-3630-10	1.0g
1 µmole columns	20-3730-41	Pack of 4
0.2 µmole columns	20-3730-42	Pack of 4
10 µmole column (ABI)	20-3730-13	Pack of 1

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

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Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

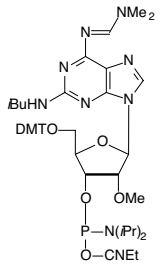
15 µmole column (Expedite)	20-3730-14	Pack of 1

MINOR 2'-OME-RNA PHOSPHORAMIDITES

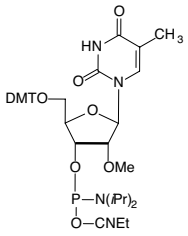
To aid in the evaluation of the structures of 2'-OMe-RNA complexes, we offer the CE phosphoramidites listed below. 2'-OMe-T is useful in triplex studies while the 2-aminopurine derivative may be tested in ribozyme studies. By supporting an additional hydrogen bond, 2,6-diaminopurine (2-amino-adenosine) binds more strongly with uridine than does adenosine. Oligonucleotides containing 2'-OMe-5-Me-C and 2'-OMe-I would be of interest to researchers involved in triplex and antisense studies using 2'-OMe-RNA. The uses of 2'-OMe-5-bromo-U phosphoramidite range from crystallographic studies due to the heavy atom to cross-linking because of its photolability. 5-Fluoro-pyrimidine nucleosides have been useful as therapeutic agents and their effect on the structure and activity of oligonucleotides may be examined using the 2'-OMe-RNA derivatives.

ABI-style vials are supplied unless otherwise requested (see note box).

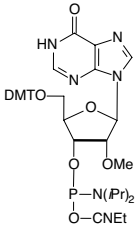
Item	Catalog No.	Pack
2'-OMe-2-Aminopurine-CE Phosphoramidite	10-3123	Discontinued
2'-OMe-2,6-Diaminopurine-	10-3124-95	50 µmole
CE Phosphoramidite	10-3124-90	100 µmole
(2-amino-A)	10-3124-02	0.25g
2'-OMe-5-Me-U-CE Phosphoramidite	10-3131-90	100 µmole
(2'-OMe-T)	10-3131-02	0.25g
2'-OMe-I-CE Phosphoramidite	10-3140-90	100 µmole
	10-3140-02	0.25g
2'-OMe-5-Me-C-CE Phosphoramidite	10-3160-90	100 µmole
	10-3160-02	0.25g
2'-OMe-5-Br-U-CE Phosphoramidite	10-3190-90	100 µmole
	10-3190-02	0.25g
2'-OMe-5-F-U-CE Phosphoramidite	10-3132	Discontinued



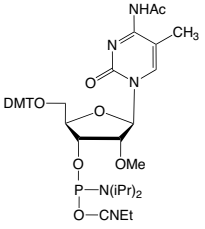
2'-OMe-2-amino-A



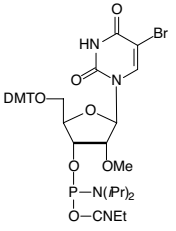
2'-OMe-5-Me-U



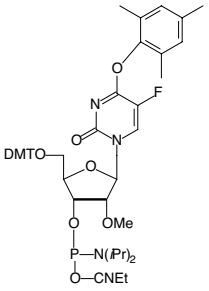
2'-OMe-I



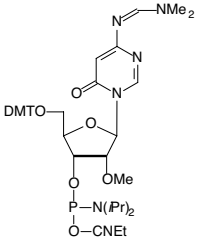
2'-OMe-5-Me-C



2'-OMe-5-Br-U



2'-OMe-TMP-5-F-U



2'-OMe-3-deaza-5-aza-C

2’-OME-THIOPHOSPHORAMIDITES

The phosphorodithioate linkage (PS2) is both achiral and essentially resistant to nucleases. Previous studies have shown very interesting results which include observations that DNA with PS2 linkages activates RNase H *in vitro*, strongly inhibits human immunodeficiency virus (HIV) reverse transcriptase, induces B-cell proliferation and differentiation, and is completely resistant to hydrolysis by various nucleases. 2’-OMe- RNA Thiophosphoramidites are RNA monomers designed to produce oligos combining the PS2 linkage with the 2’-O-methyl ribose modification. These PS2-modified RNA oligos have potential for use in siRNAs and dithiophosphate aptamers (thioaptamers).

Item	Catalog No.	Pack
2’-OMe-A-Thiophosphoramidite	10-3170-90 10-3170-02	100 µmole 0.25g
2’-OMe-C-Thiophosphoramidite	10-3171-90 10-3171-02	100 µmole 0.25g
2’-OMe-G-Thiophosphoramidite	10-3172-90 10-3172-02	100 µmole 0.25g
2’-OMe-U-Thiophosphoramidite	10-3173-90 10-3173-02	100 µmole 0.25g

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

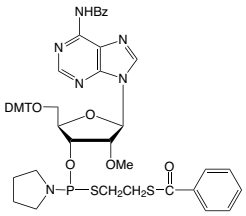
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

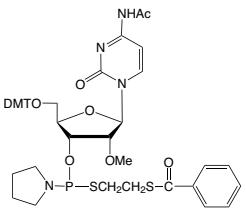
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

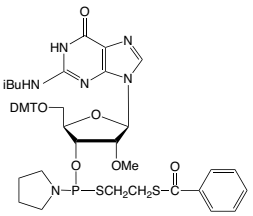
(Please inquire for availability of vials and columns for other instrument types.)



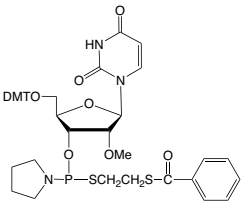
2'-OMe-A-Thiophosphoramidite



2'-OMe-C-Thiophosphoramidite



2'-OMe-G-Thiophosphoramidite



2'-OMe-U-Thiophosphoramidite

2’-MOE RNA PHOSPHORAMIDITES

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

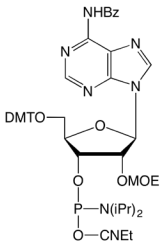
For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)

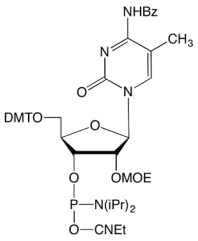
Like the very similar 2’-OMe backbone, the 2’-O-methoxyethyl-RNA (2’-MOE) backbone provides enhanced duplex stability, significant nuclease resistance and relatively low toxicity. As a result, 2’-MOE has been an attractive backbone for many therapeutic candidates, several of which have been approved by the FDA. These drugs have included 1) 2’-MOE/DNA chimeras to facilitate RNase H cleavage of target RNA sequences as well as 2) steric blocking oligonucleotides to alter the splicing of mRNA. The standard 2’-MOE nucleotides are A, 5-Me-C, G and 5-Me-U.

ABI-style vials are supplied unless otherwise requested (see note box).

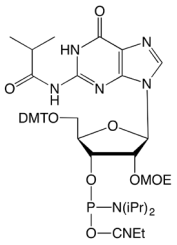
Item	Catalog No.	Pack
A-2'-MOE-Phosphoramidite	10-3200-05	0.5g
	10-3200-10	1.0g
	10-3200-20	2.0g
5-Me-C-2'-MOE-Phosphoramidite	10-3211-05	0.5g
	10-3211-10	1.0g
	10-3211-20	2.0g
G-2'-MOE-Phosphoramidite	10-3220-05	0.5g
	10-3220-10	1.0g
	10-3220-20	2.0g
5-Me-U-2'-MOE-Phosphoramidite	10-3231-05	0.5g
	10-3231-10	1.0g
	10-3231-20	2.0g



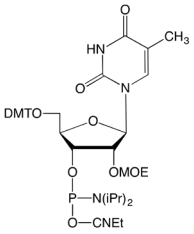
A-2'-MOE



5-Me-C-2'-MOE



G-2'-MOE



5-Me-U-2'-MOE

2’-F-RNA PHOSPHORAMIDITES

2’-Deoxy-2’-fluoro-nucleosides adopt an RNA-type sugar conformation, presumably due to the high electronegativity of fluorine. Because of this sugar conformation, RNA duplexes (A-form) are generally more thermodynamically stable than DNA duplexes (B-form). As expected, the addition of 2’-F-RNA residues to oligodeoxynucleotides progressively increases the thermal stability of their duplexes with RNA. The stabilization is additive at approximately 2° per residue. This compares favorably with 2’-OMe-RNA at around 1.5° and RNA at 1.1° per residue. In the meantime, base pair specificity remains intact.

2’-F-RNA phosphodiester linkages are not nuclease resistant, although the corresponding phosphorothioate linkages are highly resistant. Researchers usually design antisense oligonucleotides to form duplexes with RNA, which are then substrates for RNase H. Uniformly modified 2’-F-RNA/RNA duplexes are not substrates for RNase H. However, it is straightforward to prepare chimeric 2’-F-RNA/DNA phosphorothioate oligonucleotides which exhibit enhanced binding to the RNA target, are substrates for RNase H, and are highly nuclease resistant.

Item	Catalog No.	Pack
2'-F-A-CE Phosphoramidite	10-3400-02	0.25g
	10-3400-05	0.5g
2'-F-Ac-C-CE Phosphoramidite	10-3415-02	0.25g
	10-3415-05	0.5g
2'-F-G-CE Phosphoramidite	10-3420-02	0.25g
	10-3420-05	0.5g
2'-F-U-CE Phosphoramidite	10-3430-02	0.25g
	10-3430-05	0.5g
2'-F-I-CE Phosphoramidite	10-3440-90	100 µmole
	10-3440-02	0.25g

STABILITY NOTE

Synthetic oligonucleotides containing 2’-F-RNA linkages may be deprotected with ammonium hydroxide as normal. Deprotection using AMA at 65°C leads to some degradation and so we recommend the use of AMA at room temperature for 2 hours.

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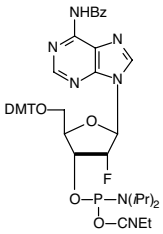
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

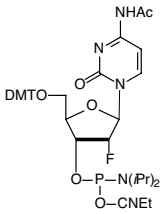
Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



2’-F-A



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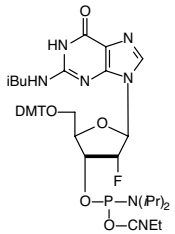
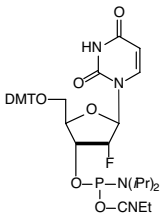
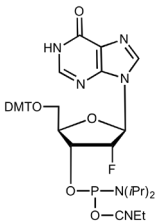


2’-F-G



2’-F-U



2’-F-I

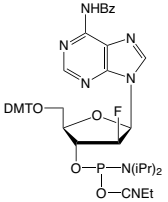
2’-F-ARABINONUCLEIC ACID (2’-F-ANA)

Arabinonucleosides are epimers of ribonucleosides with the chiral switch being at the 2’ position of the sugar residue. 2’-F-ANA adopts a more DNA-like B-type helix conformation, not through the typical C2’-*endo* conformation but, rather, through an unusual O4’-*endo* (east) pucker. However, the presence of the electronegative fluorine leads to a still significant increase (ΔT_m 1.2 °C/mod) in melting temperature per modification.[1] 2’-F-ANA-containing oligonucleotides exhibit very high binding specificity to their targets. Indeed, a single mismatch in a 2’-F-ANA – RNA duplex leads to a ΔT_m of -7.2 °C and in a 2’-F-ANA - DNA duplex a ΔT_m of -3.9 °C.[2]

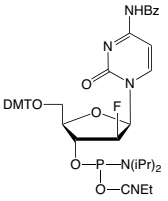
The presence of fluorine at the 2’ position in 2’-F-ANA leads to increased stability to hydrolysis under basic conditions relative to RNA and even 2’-F-RNA.[1,3] The stability of 2’-F-ANA to nucleases also makes this a useful modification for enhancing the stability of oligonucleotides in biological environments.[2] 2’-F-ANA hybridizes strongly to target RNA and, unlike most 2’ modifications, induces cleavage of the target by RNase H. Phosphorothioate (PS) 2’-F-ANA is routinely used in these applications due to its increased nuclease resistance. Alternating 2’-F-ANA and DNA units provide among the highest potency RNase H-activating oligomers. Both the “altimer” and “gapmer” strand architectures consistently outperform PS-DNA and DNA/RNA gapmers.[4]

siRNA oligos were found to tolerate the presence of 2’-F-ANA linkages very well. High potency gene silencing was demonstrated[5] with siRNA chimeras containing 2’-F-RNA and/or LNA and 2’-F-ANA. The high efficacy of these chimeras was attributed to the combination of the rigid RNA-like properties of 2’-F-RNA and LNA with the DNA-like properties of 2’-F-ANA.

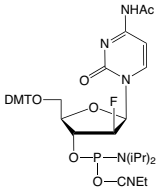
Item	Catalog No.	Pack
2’-F-A-ANA CE Phosphoramidite	10-3800-90	100 µmole
	10-3800-02	0.25g
2’-F-Bz-C-ANA CE Phosphoramidite	10-3810	Discontinued
2’-F-Ac-C-ANA CE Phosphoramidite	10-3815-02	0.25g
	10-3815-05	0.5g
2’-F-G-ANA CE Phosphoramidite	10-3820-90	100 µmole
	10-3820-02	0.25g
2’-F-U-ANA CE Phosphoramidite	10-3830-02	0.25g
	10-3830-05	0.5g
2’-F-Me-U-ANA CE Phosphoramidite	10-3850-02	0.25g
	10-3850-05	0.5g



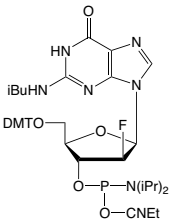
2'-F-A-ANA



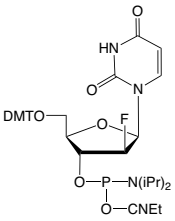
2'-F-Bz-C-ANA



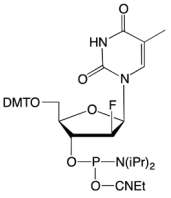
2'-F-Ac-C-ANA



2'-F-G-ANA



2'-F-U-ANA



2'-F-Me-U-ANA

REFERENCES

1. E. Viazovkina, M.M. Mangos, M.I. Elzagheid, and M.J. Damha, ***Curr Protoc Nucleic Acid Chem,*** 2002, **Chapter 4**, Unit 4 15.
2. J.K. Watts, and M.J. Damha, ***Can. J. Chem.,*** 2008, **86**, 641-656.
3. J.K. Watts, A. Katolik, J. Viladoms, and M.J. Damha, ***Org Biomol Chem,*** 2009, **7**, 1904-10.
4. A. Kalota, ***et al., Nucleic Acids Res.***, 2006, **34**, 451.
5. G.F. Deleavey, ***et al., Nucleic Acids Res.,*** 2010, **38**, 4547-4557, J.K. Watts, ***et al., Nucleic Acids Res.***, 2007, **35**, 1441-1451, T. Dowler, ***et al., Nucleic Acids Res.***, 2006, **34**, 1669-1675.

INTELLECTUAL PROPERTY

2’-F-ANA is covered by intellectual property. Key patents covering siRNA and antisense applications are as follows:

WO/2009/146556 (siRNA); WO 03064441 and WO 0220773 (antisense).

STABILITY NOTE

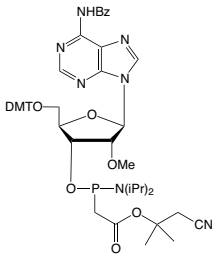
Synthetic oligonucleotides containing 2’-F-RNA linkages may be deprotected with ammonium hydroxide as normal. Deprotection using AMA at 65°C leads to some degradation and so we recommend the use of AMA at room temperature for 2 hours.

2’-OME-RNA-PACE PHOSPHORAMIDITES

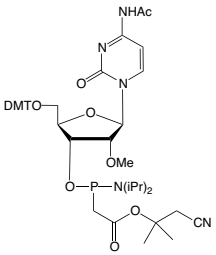
PACE modifications have enjoyed a resurgence in interest as applied to the field of CRISPR gene editing. In an initial publication, it was shown that single guide RNAs (sgRNA) provided significantly higher activity in cells when 2’-O-methylthiophosphonoacetates were incorporated on the ends of the guide RNA to protect against cellular nucleases.[1] In subsequent studies, 2’-OMe PACE modified sgRNAs were also shown to significantly increase on-target specificity of the CRISPR-Cas9 DNA cleavage in eukaryotic cells. In a recent paper, the incorporation of 2’-OMe PACE modified nucleotides in the 20-nucleotide guide region of the sgRNA was shown to decrease off-target cutting by over an order of magnitude while in most cases increasing the overall on-target efficiency as compared to unmodified single guide RNA.[2]

As an optimal cycle, we recommend using DCI as an activator (30-3150-XX) and a 15 minute coupling time. Following coupling, cap using Unicap (10-4410-XX) with a regular coupling time and then oxidize using 0.5 M CSO for 3 minutes. Alternatively, a 33 minute coupling time using 0.45 M tetrazole, oxidation using low-water iodine (40-4032-XX) followed by capping with 6.5% DMAP as Cap B will give acceptable results. For deprotection, pre-treat the synthesis column with 1.5% DBU in anhydrous acetonitrile for 60 minutes at room temperature to remove 1,1-dimethyl-2-cyanoethyl protecting groups. Rinse the column with acetonitrile, dry under argon and complete the deprotection with 40% aqueous methylamine for 2 hours at room temperature.

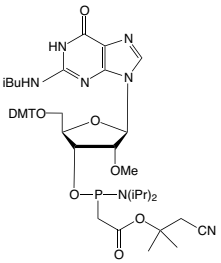
Item	Catalog No.	Pack
2’-OMe-A-PACE Phosphoramidite	10-3150	Discontinued
2’-OMe-Ac-C-PACE Phosphoramidite	10-3151	Discontinued
2’-OMe-G-PACE Phosphoramidite	10-3152	Discontinued
2’-OMe-U-PACE Phosphoramidite	10-3153	Discontinued



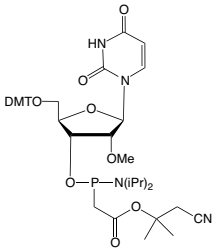
2’-OMe-A-PACE



2’-OMe-Ac-C-PACE



2’-OMe-G-PACE



2’-OMe-U-PACE

REFERENCES

1. A. Hendel, ***et al.***, ***Nat Biotechnol,*** 2015, **33**, 985-989.
2. D.E. Ryan, ***et al.***, ***Nucleic Acids Res,*** 2018, **46**, 792-803.

INTELLECTUAL PROPERTY

These products are covered by patents, US 6,693,187 and 7,067,641, and patents pending owned by Metasense Technologies. Purchase of all or any of these products includes a limited license to use the products solely for the manufacture of oligonucleotides for research use only. This license specifically excludes the use of the product or oligonucleotides containing the product for: (a) therapeutic or diagnostic applications (including kits, pools, libraries and other products or services that incorporate oligonucleotides containing the product), (b) any *in vivo* toxicity/safety study in support of an investigational new drug application (or foreign counterpart), or (c) resale (including sale of kits, pools, libraries and other products or services that incorporate the product or oligonucleotides containing the product). If such activities have commercial application, a separate license is required from Metasense Technologies. Neither the product nor any product created through its use may be used in human clinical trials.

A simple agreement must be signed before end-users and custom oligo services may purchase these products for use as defined above. https://www.glenresearch.com/media/productattach/import/technical_note/PACE.pdf

RELATED

DNA PACE..... 41
DCI..... 34
UniCap..... 36
0.5M CSO..... 36

GLEN-PAK™ PURIFICATION

Glen-Pak™ DNA and RNA cartridges have advantages over Poly-Pak cartridges in that a single loading of the diluted crude deprotection solution is all that is necessary. Also, the range of purification has been extended to 100+ using DMT-ON oligos. In addition, Glen-Pak cartridges allow purification of virtually the complete range of dyes and modifiers.

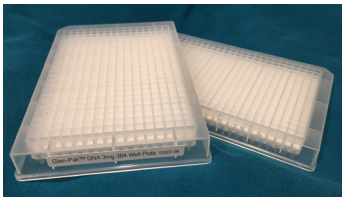
The Glen-Pak DNA Cartridge 3g is a large cartridge capable of purifying 10-20 µmole oligonucleotide syntheses using the standard DMT-ON procedure and Glen-Pak DNA 30mg 96-Well Plates are for parallel purification of up to 50 nmole scale syntheses. The Glen-Pak DNA 3mg 384-Well Plate is designed for use with 384-well plate compatible vacuum manifold systems and can purify up to a 20 nmole scale synthesis. Each well contains 3mg of Glen-Pak DNA resin, which binds about 15 nmoles of full length 40-mer DMT-ON oligo.

Scale suggestions for the Glen-Pak DNA product line are shown below:

Glen-Pak DNA Product	Catalog Number	Synthesis Scale Compatibility
Glen-Pak DNA 50mg Purification Cartridge	60-5000-96	10 nmole – 200 nmole
Glen-Pak DNA Purification Cartridge	60-5100-XX and 60-5200-XX	10 nmole – 1.0 µmole
Glen-Pak DNA Cartridge 3G	60-5300-01	5 µmole – 20 µmole
Glen-Pak DNA 30mg 96-Well Plate	60-5400-01	10 nmole – 50 nmole
Glen-Pak DNA 3mg 384-Well Plate	60-5500-XX	Up to 20 nmole

A User Guide to ***Glen-Pak™ Purification*** describes in detail the process and several applications for DNA and RNA purification. This booklet is available online at: https://www.glenresearch.com/media/productattach/g/l/glen-pak_2.9_1.pdf.

Item	Catalog No.	Pack
DNA Purification Cartridges		
Glen-Pak™ 50mg DNA Purification Cartridge (For use in vacuum manifolds and high-throughput devices)	60-5000-96	Pack of 96
Glen-Pak™ DNA Purification Cartridge (For use in vacuum manifolds and high-throughput devices)	60-5100-10 60-5100-30 60-5100-96	Pack of 10 Pack of 30 Pack of 96
Glen-Pak™ DNA Purification Cartridge (For use with disposable syringes)	60-5200-01 60-5200-10	Pack of 1 Pack of 10
Glen-Pak™ DNA Cartridge 3g	60-5300-01	Pack of 1
Glen-Pak™ DNA 30mg 96-Well Plate	60-5400-01	Pack of 1
Glen-Pak™ DNA 3mg 384-Well Plate	60-5500-01 60-5500-10	Pack of 1 Pack of 10



RELATED

Poly-Pak Reagents 153

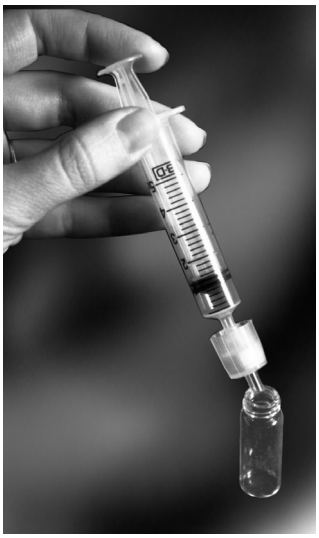
Poly-Pak™ and Glen-Pak™ are trademarks of Glen Research Corporation

GLEN-PAK™ PURIFICATION (CONT.)

Item	Catalog No.	Pack
RNA Purification Cartridges		
Glen-Pak™ RNA Purification Cartridge	60-6100-10	Pack of 10
(For use in vacuum manifolds	60-6100-30	Pack of 30
and high-throughput devices)	60-6100-96	Pack of 96
Glen-Pak™ RNA Purification Cartridge	60-6200-01	Pack of 1
(For use with disposable syringes)	60-6200-10	Pack of 10
Reagents		
RNA Quenching Buffer	60-4120-82	250mL
	60-4120-80	1L
Racks and Seals		
Adapter Rack	60-0010-01	each
(For use with 96 well manifolds)		
Seal for Adapter Rack	60-0020-01	each
(For use on 96 well adapter rack)		

POLY-PAK™ PURIFICATION

The use of Poly-Pak™ packings in cartridges or barrels overcomes several disadvantages usually associated with reverse phase (RP) cartridges. The packing is stable in the pH range 1-13, thus the ammonium hydroxide solution, diluted with water, is loaded directly onto the packing. Also, after elution of failure sequences, the trityl group is removed and washed from the support-bound oligonucleotide. The fully deprotected product can then be eluted and isolated by lyophilization. Poly-Pak™ Cartridges may also be used for desalting normal or labeled oligonucleotides. The original Poly-Pak cartridge and barrel are designed for 0.2 µmole syntheses or less. Poly-Pak II cartridges and barrels are designed for use with 1 µmole syntheses. A booklet, User Guide To Poly-Pak™ Cartridge Purification, describes in detail the process and several applications. This booklet is available online at: https://www.glenresearch.com/media/productattach/import/tbn/PolyPakBooklet.pdf



Poly-Pak Cartridge Used Manually

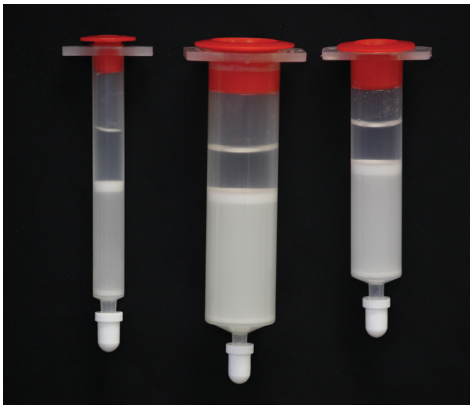
Item	Catalog No.	Pack
Packing, Cartridges and Barrels		
Poly-Pak™ Packing	60-1000-05	5g
	60-1000-25	25g
Poly-Pak™ Cartridge	60-1100-01	Pack of 1
	60-1100-10	Pack of 10
Poly-Pak™ II Cartridge	60-3100-01	Pack of 1
	60-3100-10	Pack of 10
Reagents		
2.0M Triethylamine Acetate (TEAA) HPLC Grade	60-4110-52	200mL
	60-4110-57	450mL
	60-4110-60	960mL
	60-4110-62	2L
2% Aqueous Trifluoroacetic Acid	60-4040-57	450mL

Poly-Pak™ is a trademark of Glen Research Corporation

GLEN GEL-PAK™ DESALTING

The principle of the Glen Research gel filtration column, Glen Gel-Pak™, is based on size exclusion chromatography that separates molecules according to the hydrodynamic volume of the molecule in aqueous solutions. In gel filtration, the mobile phase for size exclusion is an aqueous solution and the stationary phase is a porous resin. The pores of the resin are sized such that they allow small molecules to enter the pores, yet exclude larger molecules from the pores. The small molecules, such as salts and hydrolyzed protecting groups, diffuse into the pores of the resin and move slowly through the column. The larger molecules, such as DNA or proteins, are excluded from the pores and move quickly through the column. The end result is that the larger molecules elute first in the column void volume while the small molecules are still flowing through the resin of the column.

Glen Gel-Pak columns are ideal for desalting and reaction clean up. They can be used for removal of the ammonium hydroxide deprotection solution and hydrolyzed protecting groups after deprotection. The columns can also be used for the clean up of NHS-labeling reactions to separate the labeled oligo and unlabeled oligo from the unreacted NHS ester, the hydrolyzed label, and n-hydroxysuccinimide, thereby greatly simplifying the downstream purification steps.



Glen Gel-Pak 0.2 Glen Gel-Pak 2.5 Glen Gel-Pak 1.0

There are many benefits to Glen Gel-Pak columns:

Versatility:

- Ability to directly desalt oligonucleotides deprotected in either 30% ammonium hydroxide OR 50:50 ammonium hydroxide/40% aqueous methylamine (AMA)
- Easily exchange buffers
- Simple clean-up of labeling reactions
- Mild method for purification from salts and solvents such as DMSO and DMF

Capacity:

- Multiple column sizes (0.2 mL, 1.0 mL and 2.5 mL) are available to match synthesis scale
- Ability to efficiently desalt short and long oligos at different scales using the same protocol
- Suitable for oligos >10mer in length

Item	Catalog No.	Pack
Glen Gel-Pak™ 0.2 Desalting Column	61-5002-05	Pack of 5
(0.2 mL Capacity)	61-5002-50	Pack of 50
Glen Gel-Pak™ 1.0 Desalting Column	61-5010-05	Pack of 5
(1.0 mL Capacity)	61-5010-50	Pack of 50
Glen Gel-Pak™ 2.5 Desalting Column	61-5025-05	Pack of 5
(2.5 mL Capacity)	61-5025-25	Pack of 25

Glen Gel-Pak™ is a trademark of Glen Research Corporation

OLIGO-AFFINITY SUPPORT

Oligo-affinity supports (OAS) should ideally be compatible with automated synthesis, should be non-friable, should not shrink or swell, and should have low non-specific binding of the proteins or DNA. On the support shown below is an Adenosine residue attached through the exocyclic amino group. In this way, synthesis progresses regularly on removal of the 5'-DMT group. However, on treatment with ammonium hydroxide, the oligo is not cleaved from the support. This matrix can then be used as an affinity support for a complementary segment of DNA or RNA. Alternatively, the complementary strand can be annealed to the support and the double stranded DNA can be used as an affinity support for purifying DNA binding proteins.

We expect that OAS PS will be used for purification of components from biological fluids.

Item	Catalog No.	Pack
Oligo-Affinity Support (PS)	26-4001-01	0.1g
(OAS PS)	26-4001-02	0.25g
	26-4001-10	1.0g
Oligo-Affinity Support (PS)		
1 µmole TWIST columns	26-4101-41	Pack of 4

OTHER INSTRUMENT TYPES

All minor bases, RNA products and modifiers are packaged in septum-capped vials suitable for ABI and other instruments. If you would like another type of vial/column add the following to the end of the catalog number.

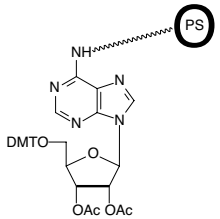
Monomers

For Instrument type	*Add*
Expedite	E
MerMade	M

Columns

For Instrument type	*Add*
Expedite	E
Applied Biosystems 3900	A
MerMade	M

(Please inquire for availability of vials and columns for other instrument types.)



OAS PS

PHYSICAL DATA

The physical data table contains information which is unique to each monomer phosphoramidite. The molecular weight (MW) is the formula weight of the fully-protected monomer phosphoramidite. The MW is used to calculate the volume of solvent required to dilute 0.25g of the monomer to give a final 0.1M concentration. This figure is also shown in the table. The unit molecular weight (Unit FW) is the formula weight of each monomer once inserted into an oligonucleotide with all protecting groups removed. To obtain the molecular weight of a specific oligonucleotide, the following formula is used: Oligonucleotide MW = Sum of Unit FW - 61.96

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-0001	dA-5′-CE Phosphoramidite	857.95	313.21	0.25g/2.91mL
10-0101	dC-5′-CE Phosphoramidite	833.93	289.18	0.25g/3.00mL
10-0301	dT-5′-CE Phosphoramidite	744.83	304.2	0.25g/3.36mL
10-1000	dA-CE Phosphoramidite	857.95	313.21	0.25g/2.91mL
10-1001	7-Deaza-dA-CE Phosphoramidite	856.96	312.22	0.25g/2.92mL
10-1003	N6-Me-dA-CE Phosphoramidite	767.86	327.24	0.25g/3.26mL
10-1004	3′-dA-CE Phosphoramidite	857.95	313.21	0.25g/2.91mL
10-1006	Etheno-dA-CE Phosphoramidite	777.86	337.23	0.25g/3.21mL
10-1007	8-Br-dA-CE Phosphoramidite	887.81	392.11	0.25g/2.82mL
10-1008	8-oxo-dA-CE Phosphoramidite	873.95	329.21	0.25g/2.86mL
10-1010	dC-CE Phosphoramidite	833.93	289.18	0.25g/3.00mL
10-1014	pdC-CE Phosphoramidite	907.1	327.23	0.25g/2.76mL
10-1015	Ac-dC-CE Phosphoramidite	771.85	289.18	0.25g/3.24mL
10-1016	TMP-F-dU-CE Phosphoramidite	866.97	307.18	0.25g/2.88mL
10-1017	Pyrrolo-dC-CE Phosphoramidite	767.85	327.23	0.25g/3.26mL
10-1018	5-Me-dC Brancher Phosphoramidite	942.1	402.36	0.25g/2.65mL
10-1019	Amino-Modifier C6 dC	1049.14	457.42	0.25g/2.38mL
10-1020	dG-CE Phosphoramidite	839.92	329.21	0.25g/2.98mL
10-1021	7-deaza-dG-CE Phosphoramidite	823.93	328.22	0.25g/3.03mL
10-1027	8-Br-dG-CE Phosphoramidite	903.9	408.1	0.25g/2.77mL
10-1028	8-oxo-dG-CE Phosphoramidite	855.93	345.21	0.25g/2.92mL
10-1029	dmf-dG-CE Phosphoramidite	824.92	329.21	0.25g/3.03mL
10-1030	dT-CE Phosphoramidite	744.83	304.2	0.25g/3.36mL
10-1031	5′-OMe-dT-CE Phosphoramidite	456.48	318.22	0.25g/5.48mL
10-1032	O4-Me-dT-CE Phosphoramidite	758.85	318.22	0.25g/3.29mL
10-1034	4-Thio-dT-CE Phosphoramidite	813.95	320.26	0.25g/3.07mL
10-1035	Carboxy-dT	814.88	360.22	0.25g/3.07mL
10-1036	2-Thio-dT-CE Phosphoramidite	879.02	320.26	0.25g/2.84mL
10-1037	Amino-Modifier C2 dT	938.94	402.3	0.25g/2.66mL
10-1038	Biotin-dT	1285.55	684.7	0.25g/1.94mL
10-1039	Amino-Modifier C6 dT	995.05	458.41	0.25g/2.51mL
10-1040	dI-CE Phosphoramidite	754.79	314.19	0.25g/3.31mL
10-1041	2′-DeoxyNebularine-CE Phosphoramidite (Purine)	738.82	298.19	0.25g/3.38mL
10-1042	O6-Phenyl-dI-CE Phosphoramidite	830.92	Varies	0.25g/3.01mL
10-1044	5-Nitroindole-CE Phosphoramidite	780.86	340.23	0.25g/3.20mL
10-1046	2-Aminopurine-CE Phosphoramidite	809.01	313.21	0.25g/3.09mL
10-1047	dP-CE Phosphoramidite	771.85	330.23	0.25g/3.24mL
10-1048	dK-CE Phosphoramidite	853.96	358.25	0.25g/2.93mL
10-1050	dU-CE Phosphoramidite	730.8	290.17	0.25g/3.42mL
10-1051	O4-Triazolyl-dU-CE Phosphoramidite	781.84	varies	0.25g/3.20mL
10-1052	4-Thio-dU-CE Phosphoramidite	799.93	306.23	0.25g/3.13mL
10-1053	5-OH-dU-CE Phosphoramidite	788.83	306.17	0.25g/3.17mL
10-1054	pdU-CE Phosphoramidite	768.85	328.22	0.25g/3.25mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-1055	2'-deoxypseudoU-CE Phosphoramidite	730.8	290.17	0.25g/3.42mL
10-1056	Fluorescein-dT Phosphoramidite	1425.57	815.71	0.25g/1.75mL
10-1057	TAMRA-dT	1311.48	870.85	0.25g/1.91mL
10-1058	Dabcyl-dT	1150.32	709.7	0.25g/2.17mL
10-1059	EDTA-C2-dT-CE Phosphoramidite	1201.32	676.53	0.25g/2.08mL
10-1060	5-Me-dC-CE Phosphoramidite	847.9	303.21	0.25g/2.95mL
10-1061	5-Me-2'-deoxyZebularine-CE Phosphoramidite	728.82	288.19	0.25g/3.43mL
10-1062	5-Hydroxymethyl-dC-CE Phosphoramidite	917	319.21	0.25g/2.73mL
10-1063	5-OH-dC-CE Phosphoramidite	954.03	305.18	0.25g/2.62mL
10-1064	3'-dC-CE Phosphoramidite	833.92	289.18	0.25g/3.00mL
10-1065	dmf-5-Me-isodC-CE Phosphoramidite	798.91	303.21	0.25g/3.13mL
10-1066	5-Carboxy-dC-CE Phosphoramidite	905.97	333.19	0.25g/2.76mL
10-1068	N4-Et-dC-CE Phosphoramidite	757.87	317.42	0.25g/3.30mL
10-1070	O6-Me-dG-CE Phosphoramidite	853.97	343.24	0.25g/2.93mL
10-1072	6-thio-dG-CE Phosphoramidite	934.97	345.26	0.25g/2.67mL
10-1073	7-Deaza-8-aza-dG-CE Phosphoramidite (PPG)	824.91	329.2	0.25g/3.03mL
10-1074	3'-dG-CE Phosphoramidite	824.92	329.21	0.25g/3.03mL
10-1076	7-deaza-dX-CE Phosphoramidite	769.83	329.21	0.25g/3.25mL
10-1078	dmf-isodG-CE Phosphoramidite	1020.13	329.21	0.25g/2.45mL
10-1079	8-Amino-dG-CE Phosphoramidite	895.01	344.22	0.25g/2.79mL
10-1080	5-Br-dC-CE Phosphoramidite	912.82	368.08	0.25g/2.74mL
10-1081	5-I-dC-CE Phosphoramidite	959.83	415.08	0.25g/2.60mL
10-1082	2-F-dI-CE Phosphoramidite	921.96	varies, 2F=332.18	0.25g/2.71mL
10-1083	7-deaza-8-aza-dA-CE Phosphoramidite	808.91	313.2	0.25g/3.09mL
10-1084	3'-dT-CE Phosphoramidite	744.83	304.2	0.25g/3.36mL
10-1085	2-Amino-dA-CE Phosphoramidite	1047.33	328.22	0.25g/2.39mL
10-1086	8-Amino-dA-CE Phosphoramidite	879.01	328.22	0.25g/2.84mL
10-1088	3-deaza-dA-CE Phosphoramidite	856.95	312.22	0.25g/2.92mL
10-1089	Amino-Modifier C6 dA	1068.14	427.4	0.25g/2.34mL
10-1090	5-Br-dU-CE Phosphoramidite	809.69	369.07	0.25g/3.09mL
10-1091	5-I-dU-CE Phosphoramidite	856.69	416.07	0.25g/2.92mL
10-1092	5-F-dU-CE Phosphoramidite	748.79	308.16	0.25g/3.34mL
10-1093	5-Hydroxymethyl-dU-CE Phosphoramidite	802.86	320.19	0.25g/3.11mL
10-1096	Thymidine Glycol CE Phosphoramidite	1007.36	338.21	0.25g/2.48mL
10-1097	AP-dC-CE Phosphoramidite	974.97	438.33	0.25g/2.56mL
10-1098	8,5'-Cyclo-dA CE Phosphoramidite	855.92	311.19	0.25g/2.92mL
10-1100	dA-Me Phosphonamidite	802.91	311.24	0.25g/3.11mL
10-1115	Ac-dC-Me Phosphonamidite	716.81	287.21	0.25g/3.49mL
10-1120	dG-Me Phosphonamidite	784.89	327.24	0.25g/3.19mL
10-1130	dT-Me Phosphonamidite	689.79	302.23	0.25g/3.62mL
10-1140	dA-PACE Phosphoramidite	928.02	354.24	0.25g/2.69mL
10-1150	Ac-dC-PACE Phosphoramidite	841.93	330.21	0.25g/2.97mL
10-1160	dG-PACE Phosphoramidite	910.01	370.24	0.25g/2.75mL
10-1170	dT-PACE Phosphoramidite	814.9	345.22	0.25g/3.07mL
10-1200	dA-H-Phosphonate, TEA Salt	822.9	313.21	0.25g/3.04mL
10-1210	dC-H-Phosphonate, DBU Salt	849.35	289.18	0.25g/2.94mL
10-1220	dG-H-Phosphonate, TEA Salt	804.88	329.21	0.25g/3.11mL
10-1230	dT-H-Phosphonate, TEA Salt	709.78	304.2	0.25g/3.52mL
10-1301	Pac-dA-Me Phosphoramidite	848.93	327.23 (Methyl triester)	0.25g/2.94mL
10-1315	Ac-dC-Me Phosphoramidite	732.81	303.21 (Methyl triester)	0.25g/3.41mL
10-1321	iPr-Pac-dG-Me Phosphoramidite	907.01	343.23 (Methyl triester)	0.25g/2.76mL
10-1330	dT-Me Phosphoramidite	705.79	318.22 (Methyl triester)	0.25g/3.54mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-1440	CleanAmp™-Pac-dA-CE Phosphoramidite	1045.25	523.56 (triester)	0.25g/2.39mL
10-1450	CleanAmp™-Ac-dC-CE Phosphoramidite	929.13	499.54 (triester)	0.25g/2.69mL
10-1460	CleanAmp™-Pac-dG-CE Phosphoramidite	1061.25	539.56 (triester)	0.25g/2.36mL
10-1470	CleanAmp™-dT-CE Phosphoramidite	902.11	514.55 (triester)	0.25g/2.77mL
10-1501	1-Me-dA-CE Phosphoramidite	814.31	328.24	0.25g/3.07mL
10-1503	N6-Ac-N6-Me-dA-CE Phosphoramidite	809.89	327.23	0.25g/3.09mL
10-1504	def-dA-CE Phosphoramidite	836.97	313.21	0.25g/2.99mL
10-1510	5-Hydroxymethyl-dC II-CE Phosphoramidite	785.82	319.21	0.25g/3.18mL
10-1511	5-aza-5,6-dihydro-dC-CE Phosphoramidite	787.89	292.18	0.25g/3.17mL
10-1513	N4-Ac-N4-Et-dC-CE Phosphoramidite	799.89	317.24	0.25g/3.13mL
10-1514	5-Formyl-dC-CE Phosphoramidite	915.96	317.19 (formyl) 349.23 (diol)	0.25g/2.73mL
10-1516	tC-CE Phosphoramidite	835.95	395.33	0.25g/2.99mL
10-1517	tCO-CE Phosphoramidite	819.88	379.26	0.25g/3.05mL
10-1518	tCnitro-CE Phosphoramidite	880.94	440.32	0.25g/2.84mL
10-1527	dW-CE Phosphoramidite	992.30	311.23	0.25g/2.52mL
10-1529	N2-Amino-Modifier C6 dG	965.01	428.38	0.25g/2.59mL
10-1530	5,6-Dihydro-dT-CE Phosphoramidite	746.84	306.21	0.25g/3.35mL
10-1531	N3-Cyanoethyl-dT	797.88	357.26	0.25g/3.13mL
10-1532	5′-Dabsyl-dT-CE Phosphoramidite	729.78	591.53	0.25g/3.43mL
10-1534	N-POM Caged-dT-CE Phosphoramidite	967.99	527.38 (N-POM-dT)	0.25g/2.58mL
10-1535	NHS-Carboxy-dT	897.91	varies, -CO2H=360.22	0.25g/2.78mL
10-1536	Fmoc Amino-Modifier C6 dT	1121.28	458.41(NH2)	0.25g/2.23mL
10-1537	dX-CE Phosphoramidite	1069.1	330.19	0.25g/2.34mL
10-1538	S-Bz-Thiol-Modifier C6-dT	1091.26	546.53	0.25g/2.29mL
10-1539	DBCO-dT-CE Phosphoramidite	1214.57	773.77	0.25g/2.06mL
10-1540	C8-Alkyne-dT-CE Phosphoramidite	834.94	394.32	0.25g/2.99mL
10-1541	C8-TIPS-Alkyne-dC-CE Phosphoramidite	1094.4	393.33	0.25g/2.28mL
10-1542	C8-TMS-Alkyne-dC-CE Phosphoramidite	1010.24	393.33	0.25g/2.47mL
10-1543	C8-Alkyne-dC-CE Phosphoramidite	938.06	393.33	0.25g/2.67mL
10-1544	C8-TIPS-Alkyne-dT-CE Phosphoramidite	991.28	394.32	0.25g/2.52mL
10-1545	C8-TMS-Alkyne-dT-CE Phosphoramidite	907.12	394.32	0.25g/2.76mL
10-1550	5,6-Dihydro-dU-CE Phosphoramidite	732.81	292.19	0.25g/3.41mL
10-1554	5-Ethynyl-dU-CE Phosphoramidite	754.81	314.19	0.25g/3.31mL
10-1555	TIPS-5-Ethynyl-dU-CE Phosphoramidite	911.15	314.19	0.25g/2.74mL
10-1560	Ac-5-Me-dC-CE Phosphoramidite	785.86	303.21	0.25g/3.18mL
10-1564	5-Formyl dC III CE Phosphoramidite	950.02	317.19 375.27 (acetal)	0.25g/2.63mL
10-1576	Ferrocene-dT-CE Phosphoramidite	1125.07	684.45	0.25g/2.22mL
10-1585	Pac-2-Amino-dA-CE Phosphoramidite	1042.21	328.22	0.25g/2.40mL
10-1590	Pyrene-dU-CE Phosphoramidite	955.04	514.42	0.25g/2.62mL
10-1591	Perylene-dU-CE Phosphoramidite	1005.1	564.48	0.25g/2.49mL
10-1598	8,5′-Cyclo-dG-CE Phosphoramidite	619.65	327.19	0.25g/4.03mL
10-1601	Pac-dA-CE Phosphoramidite	887.97	313.21	0.25g/2.82mL
10-1621	iPr-Pac-dG-CE Phosphoramidite	946.05	329.21	0.25g/2.64mL
10-1700	dA-Thiophosphoramidite	955.09	345.34 (dithioate)	0.25g/1.75mL
10-1710	dC-Thiophosphoramidite	931.07	321.31 (dithioate)	0.25g/1.79mL
10-1720	dG-Thiophosphoramidite	937.07	361.34 (dithioate)	0.25g/1.78mL
10-1730	dT-Thiophosphoramidite	841.97	336.32 (dithioate)	0.25g/1.98mL
10-1891	Methacrylate C6 Phosphoramidite	385.48	247.23	0.25g/6.49mL
10-1900	Chemical Phosphorylation Reagent	656.77	79.98	0.25g/3.81mL
10-1901	Chemical Phosphorylation Reagent II	722.82	79.98	0.25g/3.46mL
10-1902	Solid Chemical Phosphorylation Reagent II	692.79	79.98	0.25g/3.61mL
10-1905	5′-Amino-Modifier 5	577.71	167.1	0.25g/4.33mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-1906	5'-Amino-Modifier C6	589.76	179.16	0.25g/4.24mL
10-1907	5'-DMS(O)MT-Amino-Modifier C6	681.34	179.16	0.25g/3.67mL
10-1908	5'-Hexynyl Phosphoramidite	298.36	160.11	0.25g/8.38mL
10-1909	Spacer Phosphoramidite 9	652.77	212.14	0.25g/3.83mL
10-1910	1-Ethynyl-dSpacer CE Phosphoramidite	644.74	204.12	0.25g/3.88mL
10-1912	5'-Amino-Modifier C12	673.92	263.32	0.25g/3.71mL
10-1913	Spacer Phosphoramidite C3	578.69	138.06	0.25g/4.32mL
10-1914	dSpacer CE Phosphoramidite	620.73	180.1	0.25g/4.03mL
10-1915	Pyrrolidine-CE Phosphoramidite	841.97	178.1	0.25g/2.97mL
10-1916	5'-Amino-Modifier C6-TFA	413.42	179.16	0.25g/6.05mL
10-1917	5'-Amino-Modifier TEG CE-Phosphoramidite	489.47	255.21	0.25g/5.11mL
10-1918	Spacer Phosphoramidite 18	784.93	344.3	0.25g/3.18mL
10-1919	5'-Aminooxy-Modifier-11-CE Phosphoramidite	711.82	271.21	0.25g/3.51mL
10-1920	Symmetric Doubler Phosphoramidite	1095.32	351.31	0.25g/2.28mL
10-1922	Trebler Phosphoramidite	1417.72	370.33	0.25g/1.76mL
10-1923	5'-Amino-Modifier C3-TFA	371.34	137.08	0.25g/6.73mL
10-1925	Long Trebler Phosphoramidite	1475.78	428.41	0.25g/1.69mL
10-1926	5'-Thiol-Modifier C6	576.78	196.2	0.25g/4.33mL
10-1927	Abasic II Phosphoramidite	750.98	196.1	0.25g/3.33mL
10-1928	Spacer C12 CE Phosphoramidite	704.93	264.3	0.25g/3.55mL
10-1931	5'-I-dT-CE Phosphoramidite	552.35	414.09	0.25g/4.53mL
10-1932	5'-Amino-dT-CE Phosphoramidite	713.81	303.21	0.25g/3.50mL
10-1933	5'-Aldehyde-Modifier C2 Phosphoramidite	480.58	228.14	0.25g/5.20mL
10-1934	5-Formylindole-CE Phosphoramidite	763.86	323.24	0.25g/3.27mL
10-1935	5'-Carboxy-Modifier C10	485.56	varies, -CO2H = 250.23	0.25g/5.15mL
10-1936	Thiol-Modifier C6 S-S	769.05	328.4 (disulfide) 196.2 (thiol)	0.25g/3.25mL
10-1938	5'-Maleimide-Modifier Phosphoramidite	437.47	299.22 (pre-retro-DA) 203.09 (maleimide)	0.25g/5.71mL
10-1939	Spermine Phosphoramidite	1233.17	408.52	0.25g/2.03mL
10-1941	5'-DBCO-TEG Phosphoramidite	708.82	570.57	0.25g/3.53mL
10-1945	5'-Carboxy-Modifier C5	595.11	180.1	0.25g/4.20mL
10-1946	5'-Bromohexyl Phosphoramidite	381.29	243.04 (bromide) 205.15 (azide)	0.25g/6.56mL
10-1947	5'-Amino-Modifier C6-PDA	478.57	179.15	0.25g/5.22mL
10-1948	5'-Amino-Modifier C12-PDA	562.7	263.32	0.25g/4.44mL
10-1949	5'-Amino-Modifier TEG PDA	554.62	255.21	0.25g/4.51mL
10-1952	DesthiobiotinTEG Phosphoramidite	980.19	539.56	0.25g/2.55mL
10-1953	Biotin Phosphoramidite	876.1	435.48	0.25g/2.85mL
10-1955	BiotinTEG Phosphoramidite	1010.24	569.61	0.25g/2.47mL
10-1963	Fluorescein Phosphoramidite	1207.5	598.56	0.25g/2.07mL
10-1964	6-Fluorescein Phosphoramidite	1176.35	566.48	0.25g/2.13mL
10-1973	Acridine Phosphoramidite	891.53	450.86	0.25g/2.80mL
10-1974	5'-GalNAc C3 Phosphoramidite	1206.38	609.61	0.25g/2.07mL
10-1975	Cholesteryl-TEG Phosphoramidite	1196.6	755.97	0.25g/2.09mL
10-1976	5'-Cholesteryl-TEG Phosphoramidite	820.13	682.89	0.25g/3.05mL
10-1977	a-Tocopherol-TEG Phosphoramidite	1139.56	698.91	0.25g/2.19mL
10-1979	Stearyl Phosphoramidite	470.71	332.46	0.25g/5.31mL
10-1981	Asymmetric Doubler (Lev) Phosphoramidite	891.04	352.32	0.25g/2.81mL
10-1982	Psoralen C2 Phosphoramidite	502.55	364.29	0.25g/4.97mL
10-1983	Psoralen C6 Phosphoramidite	558.65	420.4	0.25g/4.48mL
10-1985	DNP-TEG Phosphoramidite	950.00	509.41	0.25g/2.63mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-1986	5′-Trimethoxystilbene Cap Phosphoramidite	571.65	433.39	0.25g/4.37mL
10-1987	5′-Pyrene Cap Phosphoramidite	501.6	363.35	0.25g/4.98mL
10-1991	Dithiol Serinol Phosphoramidite	853.08	412.46	0.25g/2.93mL
10-1992	Alkyne-Modifier Serinol Phosphoramidite	758.88	318.26	0.25g/3.29mL
10-1993	Protected Biotin Serinol Phosphoramidite	1051.28	450.45	0.25g/2.38mL
10-1994	6-Fluorescein Serinol Phosphoramidite	1191.3	582.45	0.25g/2.10mL
10-1995	Protected BiotinLC Serinol Phosphoramidite	1298.57	697.74	0.25g/1.93mL
10-1996	COT Serinol Phosphoramidite	822.97	382.35	0.25g/3.04mL
10-1997	Amino-Modifier Serinol Phosphoramidite	887.01	224.15	0.25g/2.82mL
10-1998	DBCO-Serinol Phosphoramidite	909.08	468.45	0.25g/2.75mL
10-2000	Bz-A-LA-CE Phosphoramidite	885.96	341.22	0.25g/2.82mL
10-2011	5-Me-Bz-C-LA-CE Phosphoramidite	875.96	331.22	0.25g/2.85mL
10-2029	dmf-G-LA-CE Phosphoramidite	852.93	357.22	0.25g/2.93mL
10-2030	T-LA-CE Phosphoramidite	772.84	332.20	0.25g/3.23mL
10-3000	Pac-A-CE Phosphoramidite	1018.23	329.21	0.25g/2.46mL
10-2101	beta-L-Pac-dA-CE Phosphoramidite	887.97	313.21	0.25g/2.82mL
10-2115	beta-L-Ac-dC-CE Phosphoramidite	771.85	289.18	0.25g/3.24mL
10-2121	beta-L-iPr-dG-CE Phosphoramidite	946.05	329.21	0.25g/2.64mL
10-2130	beta-L-dT-CE Phosphoramidite	744.83	304.20	0.25g/3.36mL
10-3003	Bz-A-CE Phosphoramidite	988.21	329.21	0.25g/2.53mL
10-3004	A-TOM-CE Phosphoramidite	998.24	329.21	0.25g/2.50mL
10-3005	N6-Methyl-A-CE Phosphoramidite	1032.25	343.23	0.25g/2.42mL
10-3011	Zebularine-CE Phosphoramidite	845.05	290.17	0.25g/2.96mL
10-3012	Pyridin-2-one-CE Phosphoramidite	844.06	289.18	0.25g/2.96mL
10-3014	C-TOM-CE Phosphoramidite	974.22	305.18	0.25g/2.57mL
10-3015	Ac-C-CE Phosphoramidite	902.11	305.18	0.25g/2.77mL
10-3017	Pyrrolo-C-TOM-CE Phosphoramidite	970.23	343.27	0.25g/2.58mL
10-3021	iPr-Pac-G-CE Phosphoramidite	1076.31	345.21	0.25g/2.32mL
10-3024	G-TOM-CE Phosphoramidite	1014.24	345.21	0.25g/2.46mL
10-3025	Ac-G-CE Phosphoramidite	941.43	345.21	0.25g/2.66mL
10-3030	U-CE Phosphoramidite	861.06	306.17	0.25g/2.90mL
10-3034	U-TOM-CE Phosphoramidite	933.17	306.17	0.25g/2.68mL
10-3039	Amino-Modifier C6-U Phosphoramidite	1197.41	474.4	0.25g/2.09mL
10-3040	I-CE Phosphoramidite	885.08	330.19	0.25g/2.82mL
10-3050	5-Me-U-CE Phosphoramidite	875.08	320.19	0.25g/2.86mL
10-3052	4-Thio-U-TOM-CE Phosphoramidite	1002.29	322.22	0.25g/2.49mL
10-3055	PseudoUridine-CE Phosphoramidite	861.05	306.17	0.25g/2.90mL
10-3056	1-Methyl-PseudoUridine Phosphoramidite	875.07	320.19	0.25g/2.86mL
10-3064	5-Me-C-TOM-CE Phosphoramidite	988.25	319.21	0.25g/2.53mL
10-3070	2-Aminopurine-TBDMS-CE Phosphoramidite	954.19	329.21	0.25g/2.62mL
10-3072	6-Thio-G-CE Phosphoramidite	1039.31	361.26	0.25g/2.41mL
10-3083	8-Aza-7-deaza-A-CE Phosphoramidite	939.16	329.21	0.25g/2.66mL
10-3085	2,6-Diaminopurine-TOM-CE Phosphoramidite	1113.36	344.22	0.25g/2.25mL
10-3090	Br-U-CE Phosphoramidite	939.96	385.06	0.25g/2.66mL
10-3091	5-I-U-CE Phosphoramidite	986.96	432.07	0.25g/2.53mL
10-3100	2′-OMe-A-CE Phosphoramidite	887.97	343.24	0.25g/2.82mL
10-3110	2′-OMe-C-CE Phosphoramidite	863.95	319.21	0.25g/2.89mL
10-3111	2′-OMe-TMP-5-F-U-CE Phosphoramidite	897.08	337.2	0.25g/2.79mL
10-3115	2′-OMe-Ac-C-CE Phosphoramidite	801.88	319.21	0.25g/3.12mL
10-3116	2′-OMe-3-deaza-5-aza-C-CE Phosphoramidite	816.91	319.21	0.25g/3.06mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-3120	2′-OMe-ibu-G-CE Phosphoramidite	869.97	359.24	0.25g/2.87mL
10-3121	2′-OMe-G-CE Phosphoramidite	854.93	359.24	0.25g/2.92mL
10-3123	2′-OMe-2-Aminopurine-CE Phosphoramidite	839.04	343.24	0.25g/2.98mL
10-3124	2′-OMe-2,6-Diaminopurine-CE Phosphoramidite	924.05	358.25	0.25g/2.71mL
10-3130	2′-OMe-U-CE Phosphoramidite	760.82	320.2	0.25g/3.29mL
10-3131	2′-OMe-5-Me-U-CE Phosphoramidite	774.84	334.22	0.25g/3.23mL
10-3132	2′-OMe-5-F-U-CE Phosphoramidite	778.78	338.19	0.25g/3.21mL
10-3140	2′-OMe-I-CE Phosphoramidite	784.85	344.22	0.25g/3.19mL
10-3150	2′-OMe-A-PACE Phosphoramidite	958.07	385.27	0.25g/2.61mL
10-3151	2′-OMe-Ac-C-PACE Phosphoramidite	871.97	361.25	0.25g/2.87mL
10-3152	2′-OMe-G-PACE Phosphoramidite	940.05	401.27	0.25g/2.66mL
10-3153	2′-OMe-U-PACE Phosphoramidite	830.92	362.23	0.25g/3.01mL
10-3160	2′-OMe-5-Me-C-CE Phosphoramidite	815.9	333.24	0.25g/3.06mL
10-3170	2′-OMe-A-Thiophosphoramidite	985.12	375.36	0.25g/1.69mL
10-3171	2′-OMe-C-Thiophosphoramidite	899.02	351.34	0.25g/1.85mL
10-3172	2′-OMe-G-Thiophosphoramidite	967.1	391.36	0.25g/1.72mL
10-3173	2′-OMe-U-Thiophosphoramidite	857.97	352.32	0.25g/1.94mL
10-3190	2′-OMe-5-Br-U-CE Phosphoramidite	839.72	399.09	0.25g/2.98mL
10-3200	A-2'-MOE-Phosphoramidite	932.03	387.29	0.25g/2.68mL
10-3211	5-Me-C-2'-MOE-Phosphoramidite	922.03	377.29	0.25g/2.71mL
10-3220	G-2'-MOE-Phosphoramidite	914.01	403.29	0.25g/2.74mL
10-3231	5-Me-U-2'-MOE-Phosphoramidite	818.90	378.27	0.25g/3.05mL
10-3400	2′-F-A-CE Phosphoramidite	875.93	331.2	0.25g/2.85mL
10-3415	2′-F-Ac-C-CE Phosphoramidite	789.84	307.18	0.25g/3.17mL
10-3420	2′-F-G-CE Phosphoramidite	857.91	347.19	0.25g/2.91mL
10-3430	2′-F-U-CE Phosphoramidite	748.79	308.16	0.25g/3.34mL
10-3440	2′-F-I-CE Phosphoramidite	772.82	332.18	0.25g/3.23mL
10-3501	1-Me-A-CE Phosphoramidite	944.57	344.24	0.25g/2.65mL
10-3517	Ribo-tC° Phosphoramidite	950.16	395.26	0.25g/2.63mL
10-3601	2′-OMe-Pac-A-CE Phosphoramidite	917.99	343.24	0.25g/2.72mL
10-3621	2′-OMe-iPr-Pac-G-CE Phosphoramidite	976.07	359.24	0.25g/2.56mL
10-3800	2′-FANA-A-CE Phosphoramidite	875.93	331.2	0.25g/2.85mL
10-3815	2′-FANA-Ac-C-CE Phosphoramidite	789.83	307.17	0.25g/3.16mL
10-3820	2′-FANA-G-CE Phosphoramidite	857.91	347.19	0.25g/2.91mL
10-3830	2′-FANA-U-CE Phosphoramidite	748.79	308.16	0.25g/3.34mL
10-3850	2′-F-5-Me-U-ANA-CE Phosphoramidite	762.80	322.18	0.25g/3.28mL
10-3914	rSpacer CE Phosphoramidite	823.09	196.09	0.25g/3.04mL
10-3915	rSpacer TBDMS CE Phosphoramidite	750.99	196.09	0.25g/3.33mL
10-4410	UniCap Phosphoramidite	334.39		0.25g/7.48mL
10-4906	PC Amino-Modifier Phosphoramidite	605.59	371.32	0.25g/4.13mL
10-4913	PC Spacer Phosphoramidite	784.88	344.26	0.25g/3.19mL
10-4920	PC Linker Phosphoramidite	699.78	259.15	0.25g/3.57mL
10-4950	PC Biotin Phosphoramidite	1038.25	597.62	0.25g/2.41mL
10-4960	3-Cyanovinylcarbazole Phosphoramidite (CNVK)	836.95	396.33	0.25g/2.99mL
10-5800	Azobenzene Phosphoramidite	815.94	375.32	0.25g/3.06mL
10-5901	5′-Fluorescein Phosphoramidite	843.95	537.46	0.25g/2.96mL
10-5902	5′-Hexachloro-Fluorescein Phosphoramidite	1050.62	744.13	0.25g/2.38mL
10-5903	5′-Tetrachloro-Fluorescein Phosphoramidite	981.73	675.24	0.25g/2.55mL
10-5905	SIMA (HEX) Phosphoramidite	1065.02	759.54	0.25g/2.35mL
10-5906	5′-Dichloro-dimethoxy-Fluorescein Phosphoramidite II	972.88	666.4	0.25g/2.57mL
10-5912	5′-Dabcyl Phosphoramidite	568.69	430.18	0.25g/4.40mL
10-5913	Cyanine 3 Phosphoramidite	953.64	507.59	0.25g/2.62mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
10-5914	Cyanine 3.5 Phosphoramidite	1053.76	607.7	0.25g/2.37mL
10-5915	Cyanine 5 Phosphoramidite	979.68	533.63	0.25g/2.55mL
10-5916	Cyanine 5.5 Phosphoramidite	1171.25	633.74	0.25g/2.13mL
10-5920	Redmond Red® Phosphoramidite	971.09	445.34	0.25g/2.57mL
10-5921	Yakima Yellow® Phosphoramidite	1023.81	718.33	0.25g/2.44mL
10-5923	5′-AquaPhluor® 593 CE Phosphoramidite	1239.17	787.82	0.25g/2.02mL
10-5924	5′-CDPI3 MGB™ Phosphoramidite	1323.42	872.96	0.25g/1.89mL
10-5925	Eclipse® Quencher Phosphoramidite	978.5	537.89	0.25g/2.55mL
10-5931	5′-BHQ-1 Phosphoramidite	676.75	538.49	0.25g/3.69mL
10-5932	5′-BHQ-2 Phosphoramidite	678.72	540.47	0.25g/3.68mL
10-5934	5′-BBQ-650®-CE Phosphoramidite	802.9	665.65	0.25g/3.11mL
10-5941	BHQ-1-dT	1401.56	960.93	0.25g/1.78mL
10-5942	BHQ-2-dT	1403.53	962.91	0.25g/1.78mL
10-5944	BBQ-650®-dT-CE Phosphoramidite	1441.57	1000.95	0.25g/1.73mL
10-5945	SIMA (HEX)-dT Phosphoramidite	1646.64	1037.79	0.25g/1.52mL
10-5950	5′-Biotin Phosphoramidite	846.08	405.45	0.25g/2.95mL
10-5961	Methylene Blue II Phosphoramidite	967.67	489.57	0.25g/2.58mL
10-7001	2′,3′-ddA-CE Phosphoramidite	574.7	297.21	0.25g/4.35mL
10-7101	2′,3′-ddC-CE Phosphoramidite	550.68	273.18	0.25g/4.54mL
10-7201	2′,3′-ddG-CE Phosphoramidite	506.54	313.2	0.25g/4.94mL
10-7301	2′,3′-ddT-CE Phosphoramidite	426.45	288.19	0.25g/5.86mL
10-9201	dmf-dG-5′-CE Phosphoramidite	824.92	329.21	0.25g/3.03mL
11-1330	Cis-syn Thymine Dimer Phosphoramidite	1024.01	608.39	0.25g/2.44mL
13-1000	AAA Trimer Phosphoramidite	1911.5		0.25g/1.31mL
13-1001	AAC Trimer Phosphoramidite	1887.5		0.25g/1.32mL
13-1011	ACC Trimer Phosphoramidite	1863.5		0.25g/1.34mL
13-1013	ACT Trimer Phosphoramidite	1774.5		0.25g/1.41mL
13-1020	AGA Trimer Phosphoramidite	1893.5		0.25g/1.32mL
13-1031	ATC Trimer Phosphoramidite	1774.5		0.25g/1.41mL
13-1032	ATG Trimer Phosphoramidite	1780.5		0.25g/1.40mL
13-1102	CAG Trimer Phosphoramidite	1869.5		0.25g/1.34mL
13-1103	CAT Trimer Phosphoramidite	1774.5		0.25g/1.41mL
13-1110	CCA Trimer Phosphoramidite	1863.5		0.25g/1.34mL
13-1112	CCG Trimer Phosphoramidite	1845.5		0.25g/1.35mL
13-1122	CGG Trimer Phosphoramidite	1851.5		0.25g/1.35mL
13-1123	CGT Trimer Phosphoramidite	1756.5		0.25g/1.42mL
13-1132	CTG Trimer Phosphoramidite	1756.5		0.25g/1.42mL
13-1200	GAA Trimer Phosphoramidite	1893.5		0.25g/1.32mL
13-1201	GAC Trimer Phosphoramidite	1869.5		0.25g/1.34mL
13-1203	GAT Trimer Phosphoramidite	1780.5		0.25g/1.40mL
13-1210	GCA Trimer Phosphoramidite	1869.5		0.25g/1.34mL
13-1212	GCG Trimer Phosphoramidite	1851.5		0.25g/1.35mL
13-1213	GCT Trimer Phosphoramidite	1756.5		0.25g/1.42mL
13-1223	GGT Trimer Phosphoramidite	1762.5		0.25g/1.42mL
13-1230	GTA Trimer Phosphoramidite	1780.5		0.25g/1.40mL
13-1233	GTT Trimer Phosphoramidite	1667.5		0.25g/1.50mL
13-1301	TAC Trimer Phosphoramidite	1774.5		0.25g/1.41mL
13-1313	TCT Trimer Phosphoramidite	1661.4		0.25g/1.50mL
13-1321	TGC Trimer Phosphoramidite	1756.5		0.25g/1.42mL

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
13-1322	TGG Trimer Phosphoramidite	1762.5		0.25g/1.42mL
13-1331	TTC Trimer Phosphoramidite	1661.4		0.25g/1.50mL
13-1333	TTT Trimer Phosphoramidite	1572.4		0.25g/1.59mL
20-0002	dA-5'-CPG		313.21	
20-0102	dC-5'-CPG		289.18	
20-0202	dG-5'-CPG		329.21	
20-0302	dT-5'-CPG		304.2	
20-2000	dA-CPG 500		313.21	
20-2001	dA-CPG 1000		313.21	
20-2002	dA-CPG 2000		313.21	
20-2004	3'-dA-CPG		313.21	
20-2010	dC-CPG 500		289.18	
20-2011	dC-CPG 1000		289.18	
20-2012	dC-CPG 2000		289.18	
20-2013	Ac-dC-CPG 500		289.18	
20-2015	Ac-dC-CPG 1000		289.18	
20-2017	2',3'-ddC-CPG		273.19	
20-2019	3'-Amino-Modifier C6 dC CPG		457.42	
20-2020	dG-CPG 500		329.21	
20-2021	dG-CPG 1000		329.21	
20-2022	dG-CPG 2000		329.21	
20-2029	dmf-dG-CPG		329.21	
20-2030	dT-CPG 500		304.2	
20-2031	dT-CPG 1000		304.2	
20-2032	dT-CPG 2000		304.2	
20-2040	dI-CPG 500		314.19	
20-2041	dI-CPG 1000		314.19	
20-2050	dU-CPG 500		290.17	
20-2051	dU-CPG 1000		290.17	
20-2056	3'-Fluorescein-dT CPG		815.71	
20-2064	3'-dC-CPG		289.18	
20-2074	3'-dG-CPG		329.21	
20-2084	3'-dT-CPG		304.2	
20-2090	5-Br-dU-CPG		369.07	
20-2101-61	dA-CPG 1000		313.21	
20-2101-62	dA-CPG 1000		313.21	
20-2101-65	dA-CPG 1000		313.21	
20-2115-61	Ac-dC-CPG 1000		289.18	
20-2115-62	Ac-dC-CPG 1000		289.18	
20-2115-65	Ac-dC-CPG 1000		289.18	
20-2129-61	dmf-dG-CPG		329.21	
20-2129-62	dmf-dG-CPG		329.21	
20-2129-65	dmf-dG-CPG		329.21	
20-2131-61	dT-CPG 1000		304.2	
20-2131-62	dT-CPG 1000		304.2	
20-2131-65	dT-CPG 1000		304.2	
20-2601	Pac-dA-CPG		313.21	
20-2621	iPr-Pac-dG-CPG		329.21	
20-2900	3'-Phosphate CPG		79.98	
20-2902	3'-Glyceryl CPG		154.06	
20-2903	3'-CPR II CPG		79.98	

Cat. No.	Item	Phosphoramidite MW	Unit FW	Dilution (0.1M)
20-2913	3′-Spacer C3 CPG		138.06	
20-2933	3′-Thiol-Modifier C3 S-S CPG		154.12 (thiol), 244.27 (disulfide)	
20-2938	3′-Thiol-Modifier 6 S-S CPG		198.18 (thiol), 332.37 (disulfide)	
20-2952	DesthiobiotinTEG-CPG		539.56	
20-2954	3′-PT-Amino-Modifier C3 CPG		137.07	
20-2955	3′-BiotinTEG CPG		569.61	
20-2956	3′-PT-Amino-Modifier C6 CPG		179.15	
20-2958	3′-Amino-Modifier C7 CPG 1000		209.18	
20-2961	3′-(6-FAM) CPG		569.46	
20-2963	3′-Fluorescein CPG		598.56	
20-2964	3′-(6-Fluorescein) CPG		566.48	
20-2973	3′-Acridine CPG		450.86	
20-2974	GalNAc C3 CPG		609.61	
20-2975	3′-Cholesteryl-TEG CPG		755.97	
20-2980	3′-Uaq Cap CPG		539.39	
20-2981	3′-Amino-dT CPG		303.21	
20-2982	3′-Propargyl-5-Me-dC CPG		341.26	
20-2991	3′-Dithiol Serinol CPG		412.46	
20-2992	3′-Alkyne-Modifier Serinol CPG		334.26	
20-2993	3′-Protected Biotin Serinol CPG		450.45	
20-2994	3′-6-Fluorescein Serinol CPG		584.47	
20-2995	3′-Protected BiotinLC Serinol CPG		697.74	
20-2997	3′-Amino-Modifier Serinol CPG		224.15	
20-3300	Pac-A-RNA-CPG		329.21	
20-3303	Bz-A-RNA-CPG		329.21	
20-3304	Ac-A-RNA-CPG		329.21	
20-3315	Ac-C-RNA-CPG		305.18	
20-3321	iPr-Pac-G-RNA-CPG		345.21	
20-3324	Ac-G-RNA-CPG		345.21	
20-3330	U-RNA-CPG		306.17	
20-3600	2′-OMe-A-RNA-CPG		343.24	
20-3610	2′-OMe-C-RNA-CPG		319.21	
20-3615	2′-OMe-Ac-C-RNA-CPG		319.21	
20-3621	2′-OMe-G-RNA-CPG		359.24	
20-3630	2′-OMe-U-RNA-CPG		320.2	
20-4040	Puromycin-CPG		533.48	
20-5910	3′-TAMRA CPG		623.6	
20-5911	3′-Dabsyl CPG		498.49	
20-5912	3′-Dabcyl CPG		462.44	
20-5913	Cyanine 3 CPG		507.59	
20-5915	Cyanine 5 CPG		533.63	
20-5920	Redmond Red® CPG		445.34	
20-5921	Yakima Yellow® CPG		718.33	
20-5923	AquaPhluor® 593 CPG		900.93	
20-5924	CDPI3 MGB™ CPG		831.87	
20-5925	Eclipse® Quencher CPG		537.89	
20-5931	3′-BHQ-1 CPG		554.49	
20-5932	3′-BHQ-2 CPG		556.47	
20-5933	3′-BHQ-3 CPG		597.63	
20-5934	BBQ-650® CPG		667.63	
20-9202	dmf-dG-5′-CPG		329.21	

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21-2000	dA-Q-CPG 500		313.21	
21-2010	dC-Q-CPG 500		289.18	
21-2013	Ac-dC-Q-CPG 500		305.18	
21-2029	dmf-dG-Q-CPG 500		329.21	
21-2030	dT-Q-CPG 500		304.2	
25-2000	dA-High Load-CPG		313.21	
25-2010	dC-High Load-CPG		289.18	
25-2020	dG-High Load CPG		329.21	
25-2030	dT-High Load-CPG		304.2	
25-2900	3'-Phosphate CPG (High Load)		79.98	
26-2600	dA PS		313.21	
26-2610	dC PS		289.18	
26-2629	dmf-dG PS		329.21	
26-2630	dT-PS		304.2	
26-2900	3'-Phosphate PS		79.98	
26-2955	3'-BiotinTEG PS		569.61	
26-2956	3'-PT-Amino-Modifier C6 PS		179.15	
26-2961	3'-(6-FAM) PS		569.46	
26-5910	3'-TAMRA PS		623.6	
26-5912	3'-Dabcyl PS		462.44	
50-1904	Azidobutyrate NHS Ester	226.19	113.12	
50-1905	Alkyne-NHS Ester	225.2	110.11	
50-1941	DBCO-sulfo-NHS Ester	532.5	316.37	
50-1960	Methylene Blue NHS Ester	538.96	425.89	
50-1970	Thiazole Orange NHS Ester	538.06	386.51	
50-2000	BiotinTEG Azide	444.55		
50-2001	DesthiobiotinTEG Azide	414.5		
50-2002	Dipivaloyl 6-FAM-TEG Azide	744.79		
50-2003	6-FAM-TEG Azide	576.55		
50-2004	Coumarin Azide	203.15		
50-2005	6-HEX Azide	665.09		
50-2006	6-TET Azide	596.2		
50-2007	TEMPO Azide	197.26		
50-2008	TEMPO-TEG Azide	373.47		
50-2009	Psoralen Azide	283.28		
50-2010	Disulfo-Cyanine 7 Azide	829.08		
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