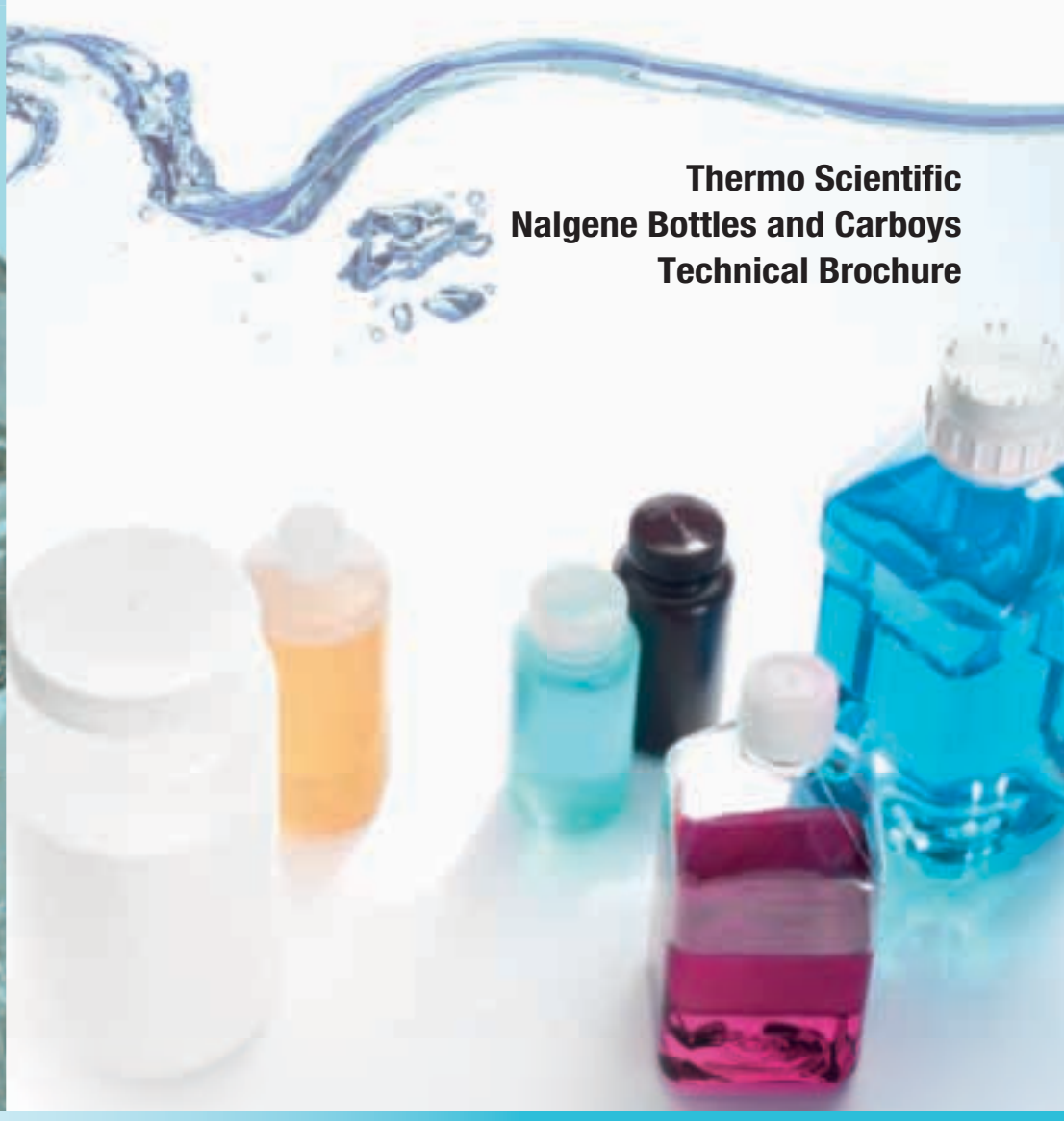


Thermo Scientific
Nalgene Bottles and Carboys
Technical Brochure

not all containers
are created equal

Thermo
SCIENTIFIC

Thermo Scientific Nalgene Bottles and

Looks like they're just sitting there, doesn't it? **Don't let them fool you.**

It's easy to take for granted the containers you entrust with your valuable samples and solutions.

But not all bottles and carboys are created equal, and some actually may threaten your work with extractables that can compromise or destroy your research. That's only one reason why Thermo Scientific Nalgene is the #1 choice for bottles and carboys, with more than 3,000,000 safely at work in laboratories around the world.

Nalgene® containers are made in the USA with the highest quality resins. Choose from the widest range of quality containers you can trust, worry-free for all of your application requirements. Lower-cost alternatives come with a price that may not be obvious, such as inferior resins or construction. **Don't be fooled.**

9 reasons to use Nalgene products

1 >> *Rugged and durable: leakproof guarantee*
2 >> *Shatterproof*
3 >> *High purity resins*
4 >> *Economical and ecological*
5 >> *Unmatched selection of plastics and sizes*
6 >> *Available technical support*
7 >> *Scalable from lab to production*
8 >> *Meets regulatory standards*
9 >> *Nalgene Quality ISO 13485:2003*

What exactly is the Thermo Scientific Nalgene advantage?

Our leakproof guarantee: we stand behind every Nalgene container you buy

Nalgene bottles and closures are engineered to work together with a proprietary valve seal and a strong, semi-buttress thread design. We offer a leakproof guarantee because we manufacture and test both components together as part of our routine quality inspection process. In addition, most Nalgene closures come with no liner that can wear, corrode, crease or leak, or cause contamination. If any Nalgene bottle doesn't meet our leakproof standards, simply return it to us and we will replace it – guaranteed.

High quality plastic resins mean low-level extractables

Nalgene containers are made from only the highest quality resins that meet pharmaceutical, laboratory and food grade standards. Plastics contain far lower concentrations of trace element extractables than glass. Our resins are selected to minimize additives and reduce potential leachables. We don't use plasticizers or fillers, and our plastics have lower total ash content – a measure of impurities – than the plastics used in competitive container offerings.

** PMP resin is not food grade*

Alternative to glass: shatterproof-safe

Plastic containers are less likely to break than glass, but the superior materials and construction of Nalgene containers amplify this advantage, assuring you the protection you expect for your valuable work.

Unequaled selection of plastic offerings and container sizes

Nalgene containers are made from a wide variety of plastic types to meet virtually any laboratory application. Choices include chemically-resistant LDPE, HDPE, FLPE and PP bottles, plus autoclavable PP, PMP and PC offerings. PETG bottles are sold presterilized and exhibit low gas permeability. Also available are FEP and PFA fluoropolymer bottles for the ultimate in chemical resistance, temperature tolerance and inertness.

Quality constructed in the USA

Nalgene bottles and carboys are manufactured in our ISO 13485:2003 registered manufacturing facilities. We use an injection blow-molding process in the manufacture of many of our products, resulting in more uniform wall thickness and overall durability. Leakproof-testing is also performed throughout each and every manufacturing lot.

Standards compliant, supporting your critical applications

Most of our resins are DMF registered and meet a number of regulatory specifications, including: USP Class VI, EP monographs and EU food-contact directives, CONEG, RoHS, CA Prop 65, SARA Title III Sec. 313, and 21 CFR pt 177.

Economical and ecological: save container cost and the environment

Nalgene containers are reusable and extremely durable, reducing the waste of disposable containers and preventing the leakage of hazardous materials. But our commitment to protecting the environment doesn't end there. The Nalgene manufacturing facilities in the US are very sensitive to the environmental impact of our products, manufacturing processes and packaging. We've implemented numerous processes to assure our position of ecological leadership in manufacturing everything we make. For more information, visit **www.nalgenelabware.com.**

Thermo Scientific Nalgene Container Selection matrix

5 Easy Steps

Step 1

Check the chemical compatibility

Keynotes below.

Step 2

Verify the temperature range

Step 3

What are the sterilization requirements

Chemical Compatibility											Temp Range °C	Sterilization Requirements		
Acids		Alcohols Aliphatic	Alde-hydes	Bases	Esters	Hydocarbons			Aromatic	Ox. Agents Strong		Pre-Sterilized	Autoclavable	Gamma Stable
Dilute/ Weak	Strong/ Conc.					Aliphatic	Aromatic	Haloge-nated						
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-100 to 120	No	No	Yes
E	G	E	G	E	G	F	N	N	N	F	-100 to 80	No	No	Yes
E	G	E	G	E	G	F	N	N	N	F	-100 to 80	No	No	Yes
E	G	E	G	E	G	F	N	N	N	F	-100 to 80	No	No	Yes
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	0 to 135	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	0 to 135	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	G	E	G	E	G	G	N	N	N	F	-40 to 121	No	Yes	No
E	E	E	G	E	E	G	N	N	F	G	20 to 145	No	Yes	No
E	N	G	F	N	N	G	N	N	N	F	-135 to 135	No	Yes	Yes
E	N	G	F	N	N	G	N	N	N	F	-135 to 135	No	Yes	Yes
E	N	G	F	N	N	G	N	N	N	F	-135 to 135	No	Yes	Yes
E	N	G	F	N	N	G	N	N	N	F	-135 to 135	No	Yes	Yes
E	N	G	F	N	N	G	N	N	N	F	-135 to 135	No	Yes	Yes
G	N	G	G	N	F	G	N	N	N	F	-40 to 70	Yes	No	–
G	N	G	G	N	F	G	N	N	N	F	-40 to 70	Yes	No	–
E	E	E	E	E	E	E	E	E	E	E	-270 to 205	No	Yes	No
E	E	E	E	E	E	E	E	E	E	E	-270 to 205	No	Yes	No
E	E	E	E	E	E	E	E	E	E	E	-270 to 205	No	Yes	No
E	E	E	E	E	E	E	E	E	E	E	-270 to 260	No	Yes	No
E	G	E	G	F	G	E	E	G	G	F	-100 to 120	No	No	Yes
E	G	E	G	F	G	E	E	G	G	F	-100 to 120	No	No	Yes
E	G	E	G	F	G	E	E	G	G	F	-100 to 120	No	No	Yes
E	G	E	G	F	G	E	E	G	G	F	-100 to 120	No	No	Yes

Keynotes

E	**Excellent** - 30 days of constant exposure to the reagent causes no effect.
G	**Good** - Little or no damage after 30 days of constant exposure to the reagent.
F	**Fair** - Some effect after 7 days of constant exposure to the reagent.
N	**Not recommended** for continuous use. Immediate damage may occur.

Thermo Scientific USB scientists

Step 4

Choose the color and clarity

Step 5

Final step, pick the size, shape and dimensions

Nalgene Catalog Number = RESULTS

OR LET US DO THE WORK: use the online container selection guide at **www.thermoscientific.com/nalgenecontainers**

Color	Clarity	Size, Shape & Dimensions				Nalgene Container Selection	
		Size Range	Shape	Mouth	Spigot/Drain	Material	Container Families (Catalog number)
Natural	Milky White	4ml-5L	Round	WM	No	HDPE	2104, 2189, 2120, 2125, 2199
Natural	Milky White	4ml-1L	Round	NM	No	HDPE	2002, 2089, 2099
Amber	Opaque	4ml-1L	Round	WM	No	HDPE	2106, 2185
Amber	Opaque	4ml-10L	Round	NM	No	HDPE	2004, 2085, 2204, 2256
Amber	Translucent	30ml-1L	Round	WM	No	HDPE	2184
Amber	Translucent	4ml-1L	Round	NM	No	HDPE	2084
White	Opaque	4ml-1L	Round	NM	No	HDPE	2008
Natural	Milky White	125ml-20L	Rectangular	WM	No	HDPE	2007, 2211, 2214, 2241
Natural	Milky White	9L-20L	Rectangular	WM	Yes	HDPE	2320, 2303
Amber	Opaque	125ml-2L	Rectangular	WM	No	HDPE	2009
Natural	Milky White	6L-20L	Rectangular	NM	No	HDPE	2240, 2243
Natural	Milky White	60ml-4L	Square	WM	No	HDPE	2114, 2123
Natural	Milky White	30ml-1L	Square	NM	No	HDPE	2018
Natural	Milky White	8L-15L	Lowboy	WM	Yes	HDPE	2323
Natural	Milky White	30ml-50L	Round	WM	No	LDPE	2103, 2234
Natural	Milky White	8ml-50L	Round	NM	No	LDPE	2003, 2202, 2210, 2220, 2340, 2088
Natural	Milky White	1L-50L	Round	NM	Yes	LDPE	2302, 2318
Natural	Milky White	30ml-20L	Round	WM	No	PPCO	2105, 2187, 2121, 2235
Natural	Milky White	4ml-8L	Round	NM	No	PPCO	2006, 2087, 2203, 2126, 2221
Amber	Opaque	2L-8L	Round	NM	No	PPCO	2204
Natural	Milky White	10L-50L	Round	NM	No	PP	2250, 2226, 2630
Natural	Milky White	10L-50L	Round	NM	Yes	PP	2319, 2301, 2640
Natural	Milky White	60ml-4L	Square	WM	No	PPCO	2110, 2122
Natural	Milky White	30ml-1L	Square	NM	No	PPCO	2016
Natural	Milky White	8L-15L	Lowboy	WM	Yes	PPCO	2324
Natural	Milky White	9L-20L	Rectangular	WM	No	PPCO	2212
Natural	Milky white	9L-20L	Rectangular	WM	Yes	PPCO	2321
Natural	Hazy Clear	125ml-1L	Round	WM	No	PMP	2107
Natural	Window Clear	30ml-20L	Round	NM	No	PC	2205, 2261, 2251, 2127
Natural	Window Clear	10L-20L	Round	NM	Yes	PC	2317
Natural	Window Clear	30ml-2L	Square	NM	No	PC	2015
Natural	Window Clear	9L-20L	Rectangular	WM	No	PC	2213
Natural	Window Clear	9L-20L	Rectangular	WM	Yes	PC	2322
Natural	Window Clear	30ml-2L	Square	NM	No	PETG	2019
Natural	Window Clear	3ml-20ml	Round	NM	No	PETG	2035
Natural	Hazy Clear	125ml-2L	Round	WM	No	FEP	2100, 2101
Natural	Hazy Clear	30ml-2L	Round	NM	No	FEP	1600
Black	Opaque	500ml-1L	Round	NM	No	FEP	1620
Natural	Hazy Clear	30ml-1L	Round	WM	No	PFA	1630
Natural	Milky yellow	125ml-2L	Round	WM	No	FLPE	2197, 2124
Natural	Milky yellow	250ml-20L	Round	NM	No	FLPE	2097
Natural	Milky yellow	20L-50L	Rectangular	WM	Yes	FLPE	2327
Natural	Milky yellow	12L-25L	Rectangular	NM	No	FLPE	2242

Now that you have the catalog number, visit www.thermoscientific.com/nalgenecontainers to get more detailed information to purchase your product.

- *>> find information about available sizes; review bottle dimensions and drawings*
- *>> get technical support*
- *>> locate a distributor or purchase the product online*
- *>> request a sample kit*
- *>> click on the USB scientist image to see how you can get this guide on a scientist USB stick!*

BOTTLE WEIGHTS & PACKAGING OPTIONS

Closure is one-piece linerless. The closure and bottle system work together to supply a guaranteed leakproof system.

Shrink Ring at the neck of most Nalgene bottles is molded so the inside surface is smooth, minimizing content entrapment.

Uniform Walls are resistant to splitting or puncturing.

Seal Ring is molded inside the closure. It fits tightly against the beveled inner edge (chamfer) of the bottle neck. No closure liner to wear, crease or cause contamination.

Threads on bottles and closures have continuous, straight-shouldered semi-buttress threads, not low-quality round threads.

Anatomy of a Thermo Scientific Nalgene Bottle

Bottom has curved inner corners for easy cleaning.

Stable base has permanent, molded-in resin code and volume.

Nalgene bottles are available in a variety of weights and packaging configurations to accommodate a broad range of applications, budgets and scales of use. Choose a lightweight bottle for light-duty solutions, or a standard weight bottle for more critical containment. Start with small quantity lab packs and scale up to bulk packed production bottles without changing plastics.

Lab Quality Bottles

Nalgene Lab Quality Bottles are the classic standard weight Nalgene bottle. They offer the ultimate in solution containment and protection. Available in 9 different resins, leakproof, strong and durable Nalgene Lab Quality Bottles provide unbeatable performance and protection.

Recommended for continuous lab use, critical applications, high-value or hazardous material containment, long-term storage, shipping liquids, rugged field conditions, and an unlimited number of general lab and field uses.

Lab Quality Bottles include these catalog number series:

2104	2114	2107
2105	2018	2019
2106	2110	1600
2002	2016	2197
2004	2205	2099
2006	2015	*and many more*

Nalgene Economy Bottles

It's easy to choose high-quality lab bottles and stay within budget. Nalgene Economy Bottles are lightweight versions of the original Nalgene Lab Quality Bottles.

These bottles are suitable for light-duty, general purpose laboratory applications such as containing samples and daily working solutions like buffers and bench reagents. Like most Nalgene bottles, the Economy Bottles are guaranteed leakproof and are made in our ISO-certified manufacturing facility. Available in chemical-resistant high density polyethylene (HDPE) or autoclavable polypropylene copolymer (PPCO), they are selected for a wide variety of laboratory applications. Priced below low-quality plastic or glass bottle brands, Nalgene Economy Bottles are the economical, quality choice for lighter-duty lab use.

Economy Bottles include these catalog number series:

2089	332089
2189	332189
DS2085	DS2185
2087	2187

Scale Up To Nalgene Packaging Bottles

A large offering of Nalgene Lab Quality Bottles and lightweight Nalgene Economy Bottles are available bulk packed and unassembled for production scale filling. Access the complete offering by visiting www.nalgenepackaging.com.

CERTIFIED CLEAN CONTAINERS

"Clean" can mean a lot of different things to different people. Common use of the term might mean the container is sterile, low in particulates, no detectable trace elements or free from contaminating compounds. We provide some of the most commonly requested Nalgene containers certified clean to specific application parameters. We also recommend our EP Scientific custom cleaning and certification services to accommodate our customers' own specific container application requirements.

Certified Clean PETG Containers

Nalgene Certified Clean PETG Containers (382019-series) are manufactured in a clean room certified to the ISO 14644-1 Class 7 standard. The containers are lot-to-lot tested and certified using liquid particle count analysis for particulate control as specified in the following international compendia: USP <788>, EP 2.9.19, JP 14th edition Part 1, Section 24.

Liquid Particle Count Limits – Light Obscuration Test

Particle Size	≥ 10µm	≥ 25µm
Container working volume ≤100ml	6,000	600
Container working volume >100ml	25/ml	3/ml

Additionally, the certified clean PETG containers are certified non-cytotoxic, non-pyrogenic, non-hemolytic, and sterile. We follow ANSI/AAMI/ISO 11137 guidelines in establishing an irradiation dose level to support a sterility assurance level (SAL) of 10^{-6} for the Nalgene Certified Clean PETG containers. Sterilization Dose Audit testing in accordance with the ISO 11137 Guideline is performed on a quarterly basis to determine the continued validity of the sterilization dose. Microbial aerosol challenge testing has been conducted on product to support a 5-year sterility and performance claim.

Certified Clean PETG Containers are ideal for processing and storing critical reagents and bulk intermediates such as vaccine and protein therapeutic preparations.

LDPE and FEP Low Particulate and Low Metals Certified Bottles

Nalgene Low Particulate and Low Metals Certified Bottles (382003-series and 381600-series) are manufactured in a general factory environment, and are then processed by a secondary wash procedure to achieve a particulate level <20 particles per ml at 0.3µm and greater. Bottles are certified for metals to ppb (µg/L) levels <0.20 Hg, <0.5 Be, <1.0 As, Cd, Pb, <2.0 Sb, Se, <5.0 Ag, Co, Cr, Cu, Mn, Th, V, <10 Ba, Ni, Zn, <50 Mg, <75 Al, <100 Ca, Fe, K, Na. Each bottle is double bagged under Class 10 laminar flow hoods inside a Class 100 clean room. A certificate of analysis is included in each case of bottles.

Nalgene Low Particulate and Low Metals Certified Bottles are excellent for high purity chemical storage and ICP-MS reagent and standard storage. Particulate and metals levels are designed to meet microelectronics industry demands.

HDPE Low Particulate IP2 Bottles

Nalgene HDPE Low Particulate IP2 Bottles (382099-series) are manufactured in a controlled environment and are lot certified to contain <30 particles per ml at 0.3µm and greater. Each lot is tested and certified using liquid particle count analysis. Additionally, bottles are leak tested at 15psi (103 kPa) per 49 CFR 173.27 (c)(2), ICAO Technical Instructions Part 4; 1.1.6, and IATA Dangerous Goods Regulations Section 5.0.2.9.

Nalgene HDPE Low Particulate IP2 Bottles can be used in compliance with the regulations for customer who are designing, assembling and certifying their own combination packaging systems.

Custom Bottle Cleaning and Certification Services

Custom bottle cleaning and certification using our EP Scientific cleaning services are available even for small quantities of Nalgene bottles. Common cleaning services include depyrogenation, particulate cleaning, WFI rinse, irradiation, autoclaving, and a variety of custom wash procedures. For more information about cleaning and certification services for Nalgene bottles, contact EP Scientific Customer Service at 800-331-7425 (USA) or visit www.epscientific.com.

INSPECTION & TESTING

Thermo Scientific Nalgene bottles and closures are engineered, manufactured and sold to work together as a system. These procedures are followed before any product is released to the marketplace.

Receiving Inspection

Checks are currently performed on incoming lots of material as noted below. All tests are based on Nalgene container historical data and information supplied by our resin manufacturers.

1. **Resin Flow**
   Melt Flow Indexes are performed on selected lots of incoming resin per ASTM D1238.

2. **Visuals**
   A visual comparison of each lot of resin is performed to assure that there is limited lot-to-lot color variation during manufacturing runs. Each lot's granular size and configuration is also checked to ensure that uniform molding will be accomplished.

Molding Inspection

Molding inspection is performed in two major steps. Step one is the First Piece Approval stage. Manufacturing must obtain First Piece Approval from Quality Control before any parts can be assigned to stock.

Step two is the critical In-process Inspection. Parts are continually checked at specific intervals during the entire production run. Inspection criteria for the above steps are:

Bottles and Closures
First Piece/In-Process

- >> *Physical defects/appearance*
- >> *Molding integrity/completeness of threads and sealing ring (closure)*
- >> *Standard Nalgene container leak test*
- >> *Wall thickness (bottle only)*
- >> *Molding integrity of threads and neck chamfer (bottles)*
- >> *Dimensional checks*

**Leak testing is performed at higher psig levels when required for specific product claims.*

Leak Testing

The standard Nalgene container leak test for bottles

NOTE: Standard Nalgene container leak tests are performed with water. The same tests, using other liquids, may not yield the same results. We advise customers to test Nalgene bottles and closures under the conditions of their planned application to ensure safe usage of the product.

Warning: Do not use Nalgene bottles, carboys or other containers under pressure or vacuum, except those products that are specifically designed, specified and tested for these applications. The application of pressure or vacuum to products not designed for such use may result in failure of the products, damage to property and/or personal injury.

Production bottles are randomly selected throughout the run. Bottles are filled with a sufficient volume of water. Then standard test closures, with fittings to allow pressure application, are screwed onto the bottles at specified torque values. The bottles are inverted, so that water covers the juncture of the bottle and closure. Air pressure of 2 psig* is applied for 2 minutes. The pressure is then released. The closures are removed and then inspected. If no water is found on the closure or bottle threads, the bottles are judged to be leakproof. This protocol applies to bottles with closures 83mm or smaller (except 70mm). For 70-, 100- and 120mm closures, see below.

The standard leak test for closures

In a complementary procedure, closures are randomly selected throughout the production run. Standard test bottles are filled with water. The selected closures are applied to the bottles at specified torque values are attached to the bottoms of the test bottles.

Air pressure of 2 psig* is applied for 2 minutes. The pressure is then released. The closures are removed and then inspected. If no water is found on the closure or bottle threads, the closures are judged to be leakproof. This protocol applies to closures 83mm or smaller (except 70mm).

To test all jars and bottles/carboys with large closures

A standard test closure (70, 100, or 120mm) is applied onto a container filled with water at specified torque values. The container is placed on its side for 15 minutes. If no water escapes, the container is leakproof. 70-, 100- and 120-mm closures are tested in a complementary procedure using standard test containers.

The accept/reject criteria for the Nalgene container program is "0" accept and "1" reject. When a defect is discovered, all parts molded from the time of the last "Acceptable" inspection are held until molding variances are corrected. These parts are then inspected and disposition is made based on the results.

Application Notes

Closure application torques

Torque must be properly applied in measured amounts to Nalgene closures to assure leakproof sealing. To maintain the closure/bottle seal and minimize back-off during shipment, Nalgene closures should be tightly applied using the guidelines provided.

NOTE: Bottle and closure threads must be dry when torque is applied to the system.

Because different applications will require different torques for the same closure/bottle system, it is recommended that users determine these values on their own filling and capping lines. With automatic capping machines, application torque must be correlated to removal torque using torque wrenches.[1]

Recommended application torques for Nalgene closures

Closure Size, mm	Minimum Torque		Maximum Torque[2]	
	in.-lb.	1cm-kg	in.-lb.	1cm-kg
11	2	3	3	4
13-415	5	6	7	8
20-415	10	11	14	16
24-415	12	13	17	19
28-415	16	18	22	25
33-415	20	23	28	32
38*	27	31	33	38
38-415	22	25	31	38
38-430	27	31	33	38
43-415	28	32	39	44
48-415	30	34	42	48
48*	30	34	42	48
53-415	33	38	46	52
53B	38	43	53	60
63-415	40	46	56	64
70	44	50	62	71
83B	60	69	84	96

[1]For details, refer to the Handbook of Package Engineering, Third Edition by Joseph F. Hanlon

[2]This number should not be exceeded. It is strongly recommended that users verify these torque numbers, based on their applications. For more information, contact technical support

** Biotainer closures*

Light transmission through Nalgene bottles

Many chemicals, reagents and media components are light sensitive. Actinic light, radiation capable of producing a photochemical reaction, is often the concern. In practice, this usually means "near" ultra-violet (UV) or blue visible light. The U.S. Pharmacopeia current edition, <671>, Containers, Performance Testing, Light Transmission, states that a container intended to provide protection from light, or offered as a "light-resistant" container, must comply with requirements for maximum light transmission. USP criteria state that the container cannot allow more than 10% light transmission for any wavelength between 290 and 450 nanometers, measured every 20 nm. (For reference, UV is usually defined as 200 nm to 375 nm; 400 nm is blue light.)

NOTE: Our testing of Nalgene bottles for light transmission using UV/Visible Spectroscopy indicates that Nalgene amber and opaque bottles pass the USP light transmission test.

Nalgene IP2 Bottles

IP2 bottles are designed and tested for compliance with the United Nations Performance-oriented Packaging regulations and are recommended for customers designing and certifying their own combination packaging. Nalgene IP2 bottles are evaluated at 15 psi (103 kPa) per 49 CFR 173.27 (c)(2), and ICAO Technical Instructions Part 4; 1.1.6, and IATA Dangerous Goods Regulations Section 5.0.2.9. Nalgene IP2 bottles are safe, durable, and cost-effective for packaging and transporting hazardous and critical materials. Designed to resist splitting and puncturing from shipping shocks; proven effective by industrial users. Molded into the bottom: IP2 marking, material, volume, registration notch and Nalgene name. Available with a narrow mouth opening (2099-, 312099- and 382099-series) or wide mouth (2199- and 312199-series).

REGULATORY SUPPORT

We understand the critical importance to many of our customers that Thermo Scientific Nalgene containers are manufactured in compliance with documented quality systems from controlled and traceable high quality materials. We make it our mission to support our customers' regulated high value applications with:

- *ISO 13485:2003 and GMP Class I certified manufacturing systems*
- *Resin and product validation data support*
- *Lot specific product certificates on demand*
- *Change control procedures*
- *Change notification services and support*
- *Customer onsite audits by appointment*

Manufacturing Certifications

The Thermo Fisher Scientific Rochester, New York and Fairport, New York manufacturing facilities extended their Quality Management System to be in compliance to ISO 13485 in May 2003. This upgrade supersedes the ISO 9001 system that was in place since May 1995. These sites are also registered as GMP (Good Manufacturing Practices) facilities for Class I devices (design exempt) with the US Food and Drug Administration, and many of the GMP practices are extended to Nalgene bottle manufacturing though the Nalgene bottles themselves are not registered medical devices.

Resin and Product Validation Data

Most of our resins are DMF registered by the supplier and meet a number of regulatory specifications including USP Class VI, EP monographs and EU food-contact directives, CONEG, RoHS, CA Prop 65, SARA Title III Sec. 313, 21 CFR pt 177. Most Nalgene resins are free from ADC's, BPA, phthalates, and contact with latex. Compliance statements by catalog number are available by contacting Technical Support.

A validation binder containing compliance data and product specifications is available under customer confidentiality agreement. Contact our Regulatory Support team: rocregsupport@thermofisher.com

For Technical Support contact information refer to the back cover of this brochure.

Certificates on Demand

Nalgene customers can receive a lot-specific product certificate on demand any time day or night from our website at www.nalgenelabware.com. Click the "Technical Data" dropdown and select "Certificate of Compliance." Enter your contact data and the product lot number and submit your request. A PDF copy of the certificate is delivered instantly for print or download. Or click "Forward Your Request" to email your request to us.

Change Control Procedures

In accordance with ISO and GMP requirements, changes to manufacturing procedures, packaging and product specifications require methods following specific documented processes for approval and implementation. All changes are documented and traceable.

Customer Notification Services

Customers can receive electronic notification of changes to product form, fit, function, manufacturing location, tooling and major process changes by registering in our customer change notification database. To get registered for change notification for a specific list of Nalgene items, submit your request on company letterhead to our Regulatory Support team: rocregsupport@thermofisher.com

Onsite Audits

We invite our critical application customers to visit the Nalgene container manufacturing facilities for an onsite audit.

PLASTIC USE & CARE GUIDE

General Cleaning

We recommend using non-alkaline detergents for cleaning plastic labware, especially those products made of polycarbonate, which is particularly sensitive to alkaline attack.

Nalgene L-900 Liquid Detergent (Cat. No. 900-4000) is designed to clean all plastics at a neutral pH. A 5% solution in water is usually sufficient but can be increased to 20% for stubborn residue or heavily-soiled labware. L-900 Detergent can be used in automatic washers for lightly- to normally-soiled items.

Soak the labware in the detergent for up to 3 hours, then gently wash with a cloth or sponge. Soak heavily-soiled items in a 5 to 20% concentration in water for 4 or more hours prior to washing. Rinse with tap water and then distilled water.

- *Do not use abrasive cleaners or scouring pads on any plastic labware.*
- *Periodically disassemble and clean spigots and threads on bottles and closures to prevent salt build-up, which can cause leakage.*
- *Most plastics, particularly the polyolefins (LDPE, HDPE, PP, PMP and PPCO) and fluoropolymers (FEP and PFA) have non-wetting surfaces that resist attack and are easy to clean.*

Dishwashers

Labware washing machines can be used with all resins listed in this brochure except LDPE and PETG due to temperature limitations.

SPECIAL NOTE ON POLYCARBONATE (PC): Repeated washings in the dishwasher weaken the exceptional strength of PC. PC labware that has been exposed to high stresses (such as those caused by centrifugation or use in vacuum chambers) should always be washed by hand using a mild, neutral pH, non-abrasive detergent without sheeting agents, such as Nalgene L-900.

Keep the dishwasher cycle time to a minimum. Use the plastics cycle and set the water temperature at 135°F (57°C) or lower. Remove the labware as soon as possible after cooling is complete. Avoid excessive abrasion of plastics by covering metal spindles with soft material such as plastic tubing. Plastic labware should be weighted down and held in place with accessory racks.

Ultrasonic Cleaners

Ultrasonic cleaning units may be used to clean labware as long as the labware does not rest directly on the transducer diaphragm.

Special Problems

Greases and Oils

For many applications, washing with a mild detergent will remove greases and oils. When more rigorous cleaning is needed, organic solvents may be used with caution. Extended exposure to these solvents may cause some swelling of polyolefins. Rinse off all solvents before using labware. Use only alcohols on PC.

Organic Matter

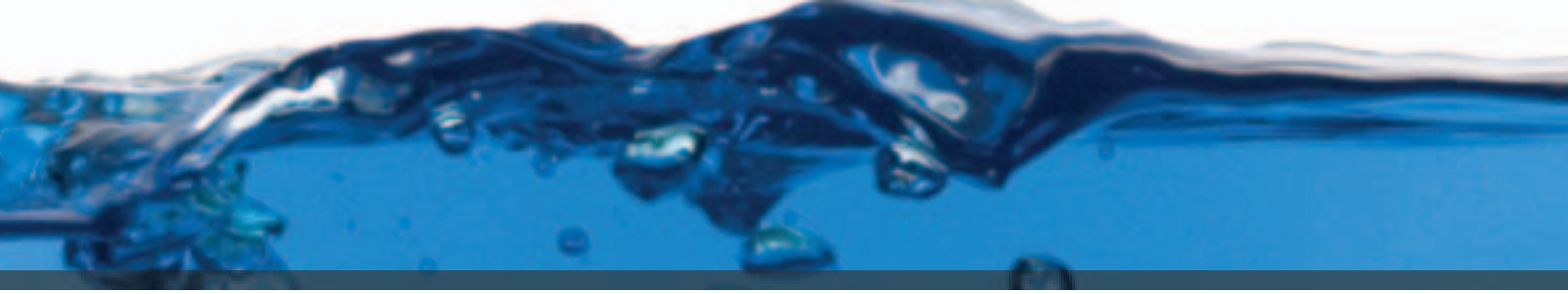
Chromic acid solution will remove organic matter, but will eventually embrittle plastics. To minimize embrittlement, soak plastic for no more than 4 hours. The following formula is the recommended cleaning agent:

Using proper personal protection in a fume hood, dissolve 120 grams of sodium dichromate (Na_2. Cr_2O_7-$2H_2O$) in 1000 ml tap water. Carefully add 1600 mL concentrated sulfuric acid. Note: Because this solution generates considerable heat, we recommend external cooling. Do not mix in a plastic container.

This solution is designed to produce an excess of dichromate in the form of a precipitate which actually extends the useful life of chromic acid and dissolves as needed. This chromic acid solution can be used repeatedly until it begins to develop a greenish color, indicating a loss of potency. As a result of the excess dichromate built into this formula, the solution lasts much longer than commercially-available solutions. Sodium hypochlorite solutions (bleach) are also effective in removing organic matter. Use at room temperature.

More questions *about the use and care of plastic laboratory products?* ***Contact us!***

See back page for details.



Trace Level Cleaning

Summary of Average Element Content of Plastics and Borosilicate Glass			
Material	**No. of Elements**	**Total Conc., ppm**	**Major Constituents[1]**
LDPE	18	23	Ca, Cl, K
PC	10	85	Cl, Br, Al
PMP	14	178	Ca, Mg, Zn
FEP	25	241	K, Ca, Mg
PP/PPCO	21	519	Cl, Mg, Ca
HDPE	22	654	Ca, Zn, Si, Al, Na
ETFE	32	1,007	Cl, Pb, Si
Borosilicate Glass	14	497,249	Si, B, Na

[1] NOTE: Values listed in the chart above represent typical contents for major constituents. Various grades of plastics may vary from these values. Additional data on trace elements associated with plastics can be found in: Selection and Cleaning of Plastic Containers for Storage of Trace Element Samples, John R. Moody and Richard Lindstrom, ANALYTICAL CHEMISTRY, Vol. 49, Page 2264, December 1977.

As the chart "Summary of Average Element Content of Plastics and Borosilicate Glass" shows, for most trace metal analysis, plastic is generally "cleaner" or less contaminated than glass or other materials. However, plastic does contain trace levels of certain metals. To minimize potential low-level contamination, remove these metals or leach them from plastic by soaking in 1N HCl and rinsing in distilled water. For extremely precise work, use HCl, followed by soaking in 1N HNO_3 and rinsing in distilled water. Soaking time may vary according to individual needs, but plastic should be soaked no longer than 8 hours. If more rigorous cleaning is desired, increase the concentration of acids used.

CAUTION: concentrated nitric acid is a strong oxidizing agent and will embrittle many plastics.

To remove trace organics which contribute to trace metal absorption, clean plastic surfaces with alcohol, alkalies, alcoholic alkalies or chloroform. A final rinse of 1N HCl also minimizes absorption of trace elements.

PLASTIC USE & CARE GUIDE

Hazardous Matter

Before labware contaminated with infectious or toxic materials is removed from the work area, it should be sterilized appropriately. Autoclaving is the preferred method for sterilization; however, any method of chemical disinfecting or heat sterilization appropriate for the particular plastic may be used. Liquid waste containing biohazardous materials must always be decontaminated before disposal.

Labware that is contaminated with both biohazardous and radioactive material must first be sterilized. Methods for removing radioactive material depend on the isotope used, its quantity, half-life, material and solubility. For routine decontamination of non-infectious/non-toxic materials, first soak in decontaminant/cleaner for 24 hours at room temperature. Follow with several rinsings in distilled water. To accelerate decontamination, increase the cleaner concentration and solution temperature. Agitation and careful scrubbing with non-abrasive materials will also speed this process. Be particularly careful not to scratch PC. Always dispose of radioactive wastes and effluents properly.

For additional information on handling contaminated labware, contact your Biosafety/Radiation Safety Office, or refer to NIH Biohazards Safety Guide, Laboratory Safety Monograph and Radiation Safety Guide.

How to Remove RNase or DNase from Plastic Containers

RNase, an enzyme that breaks down RNA, and DNase, which breaks down DNA, are contaminants that can interfere with nucleotide research. DNase can be destroyed by autoclaving for 15 minutes at 121°C OR by following any of the procedures listed here. One or more of the following techniques will inhibit or remove RNase from your plastic container. Match the resin code on the bottom of your Nalgene container with the correct technique.

1. **Heat** at 180°C for at least 8 hours[1]
2. **Rinse** in chloroform[1]
3. **Soak** in a 0.1% aqueous solution of diethyl pyrocarbonate[2] (DEPC) for 2 hours at 37°C; rinse several times with sterile (DEPC-treated) water[2,3]; heat to 100°C for 15 minutes OR autoclave for 15 minutes at 121°C on a liquid/slow exhaust cycle. (Heating or autoclaving will remove DEPC residues.) Note heating variations in the following chart.
4. **Clean** equipment with a detergent solution, rinse thoroughly with water and rinse with 95% ethanol to dry. Soak the equipment in a 3% hydrogen peroxide (H_2O_2) solution for ten minutes at room temperature. Rinse the equipment thoroughly with DEPC-treated water[1,2,3,4]
5. **Soak** equipment in 0.1N Sodium Hydroxide (NaOH) in 0.1% EDTA in water overnight and then rinse thoroughly with DEPC-treated water.[2,3]

RNase and DNase Removal Chart - Techniques

Plastic Resin	1(Heat)	2(Rinse)	3(Soak)	4(Clean)	5(Soak)	Comments
ETFE		X	X	X	X	
FEP	X	X	X	X	X	
HDPE		X*	X	X	X	Heat to 100°C for 20 minutes
LDPE		X*	X	X	X	Heat to 70°C for 120 minutes
PC			X†	X†		
PETG			X	X	X	Heat to 60°C overnight
PFA	X	X	X	X	X	
PP/PPCO		X*	X	X	X	
PMP		X*	X	X	X	
TPE			X	X	X	

*Rinse only, no long-term contact

†Rinse copiously to minimize chemical attack

[1] *Sambrook, J.;Fritsch, E.F.; Maniatis, T.; "Extraction and Purification of RNA"; Molecular Cloning: A Laboratory Manual, Second Edition; 7.3, Cold Spring Harbor Laboratory Press (1989).*

[2] *Caution: DEPC is a suspected carcinogen and should be handled with care. DEPC solutions are irritating to the eyes, mucous membranes and skin.*

[3] *DEPC-treated water: Add 0.1% DEPC to water and allow to sit for at least 12 hours at 37°C. Then heat the water to 100°C for 15 minutes or autoclave at 121°C (250°F) for 15 minutes.*

[4] *Titus, David E.; Nucleic Acid Detection, Purification and Labeling; Rapid isolation of Total RNA; PROMEGA Protocals and Applications Guide, Second Edition; pp. 125-126, 203; Promega Corporation (1991).*

Autoclaving

Thermo Scientific Nalgene plasticware recommended autoclaving cycle is 121˚C, 15 psig for 20 minutes

For best results use slow exhaust cycle.

We recommend the following autoclave cycle of 121˚C, 15 psi for 20 minutes. In order to ensure proper sterilization of internal and external container surfaces, containers should not have a closure or any other obstruction over the container opening. Remove the closure and set it on top the container at an angle, so threads do not engage or remove the closure entirely. Clean and rinse item with distilled water before autoclaving. Certain chemicals will be compatible with resins at room temperature, but could cause deterioration at autoclaving temperatures.

Avoid these practices when autoclaving plastic products:

1. DO NOT stack jars, bottles, and carboys
2. DO NOT place the product in an autoclaving basket with other objects placed on top
3. DO NOT tighten the closure – removing closure is better
4. DO NOT place aluminum foil, gauze, cotton, tape or steri-wrap over the opening

The above guidelines are for empty containers. We do not provide any validation information on autoclaving with liquid inside any of our products. The consumer must perform all validation work.

Due to our inability to control all of the variables involved in autoclaving, we do not make any statement on the autoclavable life expectancy of our products.

AUTOCLAVABLE RESINS INCLUDE:

Polycarbonate*

Polymethylpentene

Polypropylene

Polypropylene Copolymer

Teflon® FEP

Teflon® PFA

Other methods of sterilization may be appropriate and are resin-specific. Consult the resin reference chart on pages 19-20 for guidance.

**Sterilizing reduces mechanical strength. Do not use polycarbonate vessels for vacuum applications if they have been autoclaved. Refer to Use and Care Guidelines for Nalgene Labware in the Nalgene Labware Catalog, for detailed information on sterilizing.*

Select your containers online –

www.thermoscientific.com/nalgenecontainers

It's the easy way to find the best products for your application, locate a distributor or place an order.

PLASTIC RESINS

High Quality Plastic Resins

Thermo Scientific Nalgene containers are made from only top quality laboratory, pharmaceutical, and food grade resins.[1] Our resins are selected to minimize additives and reduce potential leachables. We don't use plasticizers or fillers. Plastics contain far lower concentrations of trace element extractables than glass. Nalgene resins have lower total ash content (a measure of inorganic impurities) than competitive plastics.

Most of our resins are DMF registered and meet a number of regulatory specifications including USP Class VI, EP monographs and EU food-contact directives, CONEG, RoHS, CA Prop 65, SARA Title III Sec. 313, 21 CFR pt 177. Most Nalgene resins are free from ADC's, BPA,[2] phthalates[3] and contact with latex.

Resin specific regulatory data is available for use in critical applications under customer confidentiality. Contact our Technical Support department.

[1] PMP bottles are not made from food grade resin

[2] Polycarbonate contains BPA

[3] DEHP may be present at trace levels in PP/PPCO products

Polyolefins

Polyolefins are high molecular weight hydrocarbons. They include low density and high density polyethylene, polypropylene copolymer and polypropylene. All are break resistant, nontoxic and non-contaminating. These are the only plastics lighter than water. They easily withstand exposure to nearly all chemicals at room temperature for up to 24 hours. Strong oxidizing agents eventually cause embrittlement. All polyolefins can be damaged by long-term exposure to ultraviolet light.

Polyethyelene*

The polymerization of ethylene results in an essentially straight-chain, high molecular weight hydrocarbon. The polyethylenes are classified according to the relative degree of branching (side chain formation) in their molecular structures, which can be controlled with selective catalysts.

Like other polyolefins, the polyethylenes are chemically inert. Strong oxidizing agents will eventually cause oxidation and embrittlement. They have no known solvent at room temperature. Aggressive solvents will cause softening or swelling, but these effects are normally reversible.

Low-density polyethylene* (LDPE) has more extensive branching, resulting in a less compact molecular structure

High-density polyethylene* (HDPE) has minimal branching, which makes it more rigid and less permeable than LDPE

Polypropylene* (PP) is similar to polyethylene, but each unit of the chain has a methyl pendant group attached. It is translucent, autoclavable, and has no known solvent at room temperature. It is slightly more susceptible than polyethylene to strong oxidizing agents. It offers the best stress-crack resistance of the polyolefins. Products made of polypropylene are less impact-resistant than polyethylene and may crack or break if dropped from benchtop height.

Polymethylpentene (PMP) is similar to polypropylene, but it has an isobutyl group instead of a methyl group attached to each monomer group of the chain. Its chemical resistance is close to that of PP. It is more easily softened by unsaturated and aromatic hydrocarbons, and chlorinated solvents. PMP is slightly more susceptible than PP to attack by oxidizing agents. Its excellent transparency, rigidity and resistance to chemicals and high temperatures make PMP a superior material for labware. PMP withstands repeated autoclaving. It can withstand intermittent exposure to temperatures as high as 175˚C. Products made of polymethylpentene are brittle at ambient temperature and may crack or break if dropped from benchtop height.

Engineering Resins

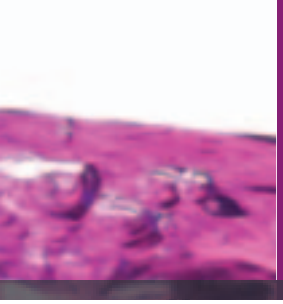
These resins offer exceptional strength and durability in demanding applications. For specific uses, they are superior to the polyolefins.

Polyethylene terephthalate G copolymer* (PETG/PET) is similar to many other engineering resins. However, its glass-like clarity, toughness and excellent gas-barrier properties make it an outstanding choice for storing biologicals. Tests have shown PETG/PET to be biologically equivalent to, or better than Type 1 borosilicate glass bottles for cell culture applications. In tests using a wide variety of cell lines, PETG/PET was determined to be non-cytotoxic, and media stored in PETG/PET bottles demonstrated proliferative and morphological characteristics comparable to control media. In fact, the PETG/PET bottles allowed growth of good monolayers directly on the surface of the bottle. PETG/PET can be sterilized with radiation or compatible chemicals but cannot be autoclaved. Chemical resistance is fair.

Polycarbonate* (PC) is window-clear, amazingly strong and rigid. It is autoclavable, non-toxic and the toughest of all thermoplastics.

PC is a special type of polyester in which dihydric phenols are joined through carbonate linkages. These linkages are subject to chemical reaction with bases and concentrated acids, hydrolytic attack at elevated temperatures (e.g. during autoclaving), and make PC soluble in various organic solvents. For many applications, the transparency and unusual strength of PC offset these limitations.

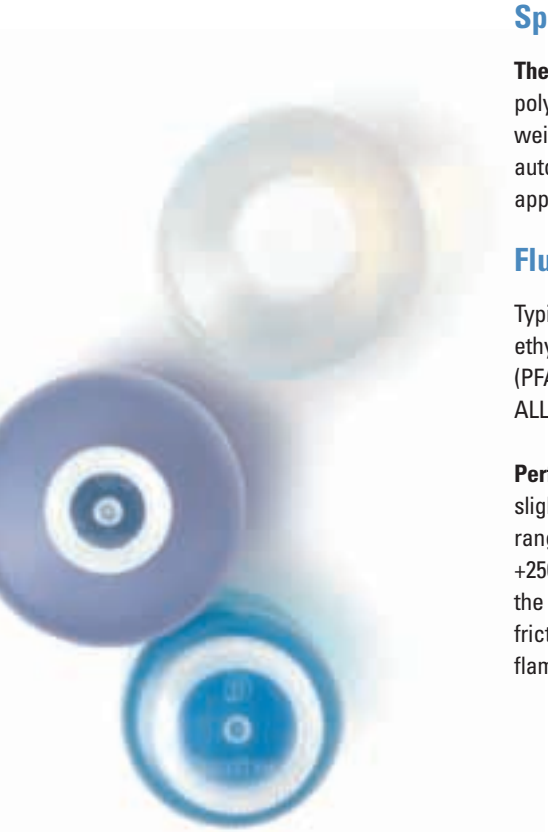
*Meets the requirements of the Food Additives Amendment of the Federal Food, Drug and Cosmetic Act.



PLASTIC RESINS

Resin Properties

					Sterilization[5]						Permeability (cc-mil/100 in^2- 24 hr.-atm)				
Resin	Max Use Temp[1] (°C)	HDT[2] Temp. (°C)	Brittle-ness[3] Temp. (°C)	Transparency	Micro-wave-ability	Auto-claving	Gas	Dry Heat	Radiation	Disin fectants	Specific Gravity	Flexibility	N_2	O_2	CO_2
LDPE	80	45	-100	Translucent	Yes	No	Yes	No	Yes	Yes	0.92	Excellent	180	500	2,700
HDPE	120	65	-100	Translucent	No	No	Yes	No	Yes	Yes	0.95	Rigid	42	185	580
PP	135	107	0	Translucent	Yes	Yes	Yes	No	No	Yes	0.9	Rigid	48	240	800
PPCO	121	90	-40	Translucent	Marginal[4]	Yes	Yes	No	No	Yes	0.9	Moderate	45	200	650
PMP	145	80	20	Clear	Yes	Yes	Yes	Yes	No	Yes	0.83	Rigid	8,000	32,000	115,000
FLPE	120	65	-100	Translucent	No	No	Yes	No	Yes	Yes	0.95	Rigid	42	185	580
ETFE	150	104	-105	Translucent	Yes	Yes	Yes	Yes	Yes	Yes	1.7	Rigid	30	100	250
FEP	205	70	-270	Translucent	Marginal[4]	Yes	Yes	Yes	No	Yes	2.15	Excellent	320	750	2,200
PFA	260	166	-270	Translucent	Yes	Yes	Yes	Yes	No	Yes	2.15	Excellent	291	881	2,260
PETG	70	70	-40	Clear	Marginal[4]	No	Yes	No	Yes	Some	1.27	Moderate	10	25	125
PC	135	138	-135	Clear	Marginal[4]	Yes[6]	Yes	No	Yes	Yes	1.2	Rigid	50	300	1,075
TPE	121	<23	<-50	Opaque	Yes	Yes	Yes	No	Yes	Some	0.93	Excellent	31-145	85-646	900-8,634



Specialty Resins

Thermoplastic elastomer* (TPE) is a type of polyolefin which, due to structure, molecular weight and chemistry, can be molded into autoclavable parts which are rubber-like in application and performance.

Fluorocarbons

Typical fluorocarbons are Teflon® fluorinated ethylene propylene (FEP*), Teflon perfluoroalkoxy (PFA*) and ethylene tetrafluoroethylene (ETFE*). ALL have remarkable chemical resistance.

Perfluoroalkoxy* (PFA) is translucent and slightly flexible. It has the widest temperature range of the fluoropolymers- from -270°C to +250°C with superior chemical resistance across the entire range. PFA has a low coefficient of friction, outstanding anti-stick properties and is flame-resistant.

Fluorinated ethylene propylene* (FEP) is translucent, flexible and feels heavy because of its high density. It resists all known chemicals except molten alkali metals, elemental fluorine and fluorine precursors at elevated temperatures. It should not be used with concentrated perchloric acid. FEP withstands temperatures from -270°C to +205°C, and may be sterilized repeatedly by all known chemical and thermal methods. It can even be boiled in nitric acid.

Ethylene-tetrafluoroethylene* (ETFE) is white, translucent and slightly flexible. It is a close analog of PFA and FEP fluorocarbons, an ethylene tetrafluoroethylene copolymer. ETFE shares the remarkable chemical and temperature resistance of FEP, and has even greater mechanical strength and impact resistance.

* Meets the requirements of the Food Additives Amendment of the Federal Food, Drug and Cosmetic Act.

Permeability (cc.-mm/m²-24hr.-Bar)			Water Vapor Transmission Rate (g-mm/m² 24 hr.-Bar at 38°C, 90% RH)	Water Adsorption (%)	Non-Cytotoxicity[7]	Suitability for Food and Bev. Use[8]	Reg Part 21 CFR	Refractive Index	Melting Point Range (°C)	Glass Transition Temperature Range (°C)
N_2	O_2	CO_2								
69.94	154.28	1,049.09	15.5–23.3	<0.01	Yes	Yes[9]	177.1520	1.5400	85 to 125	-25
16.32	71.88	225.36	4.6–6.2	<0.01	Yes	Yes[9]	177.1520	1.5100	125 to 138	-25
18.65	93.25	310.84	3.9	<0.02	Yes	Yes	177.1520	1.4735	160 to 176	-20 to -5
17.48	77.71	252.56	4.40	<0.02	Yes	Yes	177.1520	1.4735–1.5100	150 to 175	-20
3,109.42	12,433.68	44,683.32	775	0.01	Yes	No	—	1.4630	235	N/A
16.32	71.88	225.36	4.6	<0.01	Yes	Yes[9]	177.1615	1.5100	125–138	-125
11.66	38.86	97.14	1.65	0.03	Yes	Yes	177.1550	1.3580	265	N/A
124.34	291.41	854.82	6.20	<0.01	Yes	Yes	177.1550	1.3380	275	N/A
118.07	342.31	878.13	2.00	<0.02	Yes	Yes	177.1550	1.3580	302 to 310	N/A
3.89	9.71	48.57	18.13	0.13	Yes	Yes[10]	177.1315	1.57	265	81
19.43	116.57	417.69	115	0.35	Yes	Yes	177.1580	1.5860	N/A	154
12.05-56.34	33.03-251	0.70-3,354.76	—	0.05-5.1	Yes	Yes	177.2600	—	N/A	N/A

1. Ratings based on 5-minute tests using 600 watts of power on exposed, empty labware. CAUTION: Do not exceed Max. Use Temp., or expose labware to chemicals which heating causes to attack the plastic or be rapidly absorbed.

2. Heat Deflection Temperature is the temperature at which a bar deflects 0.01" at 66 psig (ASTM D648). Materials may be used above their heat deflection temperatures in non-stress applications; see maximum use temperature.

3. The brittleness temperature is the temperature at which an item made from the resin may break or crack if dropped. This is not the lowest use temperature if care is exercised in use and handling.

4. Plastic will absorb heat.

5. STERILIZATION
- Autoclaving (121˚C, 15 psig for 20 minutes) – clean and rinse items with distilled water before autoclaving. (Always completely disengage thread before autoclaving.) Certain chemicals which have no appreciable effect on resins at room temperature may cause deterioration at autoclaving temperatures unless removed with distilled water beforehand.
- Gas – Ethylene oxide, formaldehyde, hydrogen peroxide
- Dry Heat (160˚C, 120 minutes)
- Disinfectants – benzalkonium chloride, formalin/ formaldehyde, ethanol, etc.
- Radiation – gamme irradiation at 25 kGy (2.5 MRad) with unstabilized plastic

6. Autoclaving reduces mechanical strength. Do not use PC vessels for vacuum applications if they have been autoclaved.

7. "Yes" indicates the resin has been determined to be non-cytotoxic, based on USP and ASTM biocompatibility testing standards utilizing an MEM elution technique on a WI38 human diploid lung cell line.

8. Resins meet requirements of CFR21 section of Food Additives Amendment of the Federal Food and Drug Act. End users are responsible for validation of compliance for specific containers used in conjunction with their particular packaging applications.

9. Acceptable for:
- Nonacid, aqueous products; may contain salt, sugar or both (pH above 5.0).
- Dairy products and modifications; oil-in-water emulsions, high or low fat.
- Moist bakery products with surface containing no free fat or oil.
- Dry solids with the surfaces containing no free fat or oil (no end-test required) and under all conditions as described in Table 2 of FDA Regulation 177.1520 except condition A–high temperature sterilization (e.g. over 100°C/212°F).

10. Acceptable for:
- Alcoholic foods containing not more than 15% (by volume) alcohol; fill and storage temperature not to exceed 49°C (120°F).
- Non-alcoholic foods of hot fill to not exceed 82°C (180°F) and 49°C (120°F) in storage.
- Not suitable for carbonated beverages or beer or packaging food requiring thermal processing.

PLASTIC RESINS

Chemical Resistance Classification										
	ETFE	FLPE	HDPE	LDPE	PC	PETG	FEP/PFA	PMP	PP/ PPCO	TPE **
Acids, dilute or weak	E	E	E	E	E	G	E	E	E	G
Acids *strong and concentrated	E	G	G	G	N	N	E	E	G	F
Alcohols, aliphatic	E	E	E	E	G	G	E	E	E	E
Aldehydes	E	G	G	G	F	G	E	G	G	G
Bases/Alkali	E	F	E	E	N	N	E	E	E	F
Esters	G	G	G	G	N	F	E	E	G	N
Hydrocarbons, aliphatic	E	E	G	F	G	G	E	G	G	E
Hydrocarbons, aromatic	G	E	N	N	N	N	E	N	N	N
Hydrocarbons, halogenated	G	G	N	N	N	N	E	N	N	F
Ketones, aromatic	G	G	N	N	N	N	E	F	N	N
Oxidizing Agents, strong	E	F	F	F	F	F	E	G	F	N

*Except for oxidizing acids: for oxidizing acids, see "Oxidizing Agents, strong."
** TPE gaskets.

Chemical Resistance Classification

E: 30 days of constant exposure causes no damage. Plastic may even tolerate for years.

G: Little or no damage after 30 days of constant exposure to the reagent.

F: Some effect after 7 days of constant exposure to the reagent. Depending on the plastic, the effect may be crazing, cracking, loss of strength or discoloration.

Solvents may cause softening, swelling and permeation losses with LDPE, HDPE, PP, PPCO and PMP. The solvent effects on these five resins are normally reversible; the part will usually return to its normal condition after evaporation.

N: Not recommended for continuous use. Immediate damage may occur. Depending on the plastic, the effect will be a more severe crazing, cracking, loss of strength, discoloration, deformation, dissolution or permeation loss.

This information is only a summary.
To access our chemical resistance database, go to:
www.nalgenelabware.com/techdata/chemical/index.asp

Resin Codes	
ETFE	Tefzel† ETFE (ethylene-tetrafluoroethylene)
FEP	Teflon† FEP (ethylene-tetrafluoroethylene)
FLPE	fluorinated high-density polyethylene
HDPE	high-density polyethylene
LDPE	low-density polyethylene
PC	polycarbonate
PETG	polyethylene terephthalate copolyester
PFA	Teflon† PFA (perflouroalkoxy)
PMP	polymethylpentene ("TPX")
PP	polypropylene
PPCO	polypropylene copolymer
TPE	thermoplastic elastomer

† Or equivalent
Tefzel and Teflon are registered trademarks of DuPont.

Resin Quick Reference Chart

	Poly-propylene (PP)	Poly-propylene Copolymer (PPCO)	Low Density Polyethylene (LDPE)	High Density Polyethylene (HDPE)	Poly-carbonate (PC)	Poly-methylpentene (PMP)	Polyethylene Terephthalate G Copolyester (PETG)	Teflon (FEP)†	Teflon (PFA)†	Teflon (ETFE)†
High Temperature	135°C	121°C	80°C	120°C	135°C	145°C	70°C	205°C	260°C	150°C
Low Temperature	0°C	-40°C	-100°C	-100°C	-135°C	20°C	-40°C	-270°C	-270°C	-105°C
Autoclavable	Y	Y	N	N	Y	Y	N	Y	Y	Y
Microwaveable	Y	Marginal	Y	N	Marginal	Y	Marginal	Marginal	Y	Y
Dry Heat (Oven)	N	N	N	N	Y	Y	N	Y	Y	Y
Freeze	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Flexibility	Rigid	Moderate	Excellent	Moderate	Rigid	Rigid	Moderate	Excellent	Excellent	Rigid
Clarity	Translucent	Translucent	Translucent	Translucent	Clear	Clear	Clear	Translucent	Nearly Clear	Translucent
Chemical Resistance	Good	Good	Good	Good	Minimal	Good	Minimal	Excellent	Excellent	Excellent
Recycling Symbol	5 PP	5 PP	4 LDPE	2 HDPE	7 OTHER	7 OTHER	1 PETE	7 OTHER	7 OTHER	7 OTHER

† Or equivalent

More questions *about the use and care of plastic laboratory products?* ***Contact us!***

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