Resin Characteristics

Resin	Max. Use Temp. °C	HDT[1] Temp. °C	Brittle-ness Temp °C[13]	Transparency	Microwav-ability[2]	Autoclav-ing[4]	Sterilization[4]				Specific Gravity	Flexibility	Permeability (cc.-mil/100in²-24 hr.-atm)		
							EtO Gas	Dry Heat	Radi-ation	Dis-infec-tants			N_2	O_2	CO_2
ACL	120	177	-55	Opaque	Marginal[3]	Yes5	Yes	No	No	Yes	1.61	Rigid	0.51	1.03	4.12
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[3]	Yes	Yes	No	No	Yes	0.9	Moderate	45	200	650
PMP	145	80	20	Transparent	Yes	Yes	Yes	Yes	No	Yes	0.835	Rigid	8,000	32,000	115,000
FLPE	120	65	-100	Translucent	No	No	Yes	No	Yes	Yes	0.95	Rigid	42	185	580
ECTFE	150	90	<-76	Translucent	Yes	Yes	Yes	Yes	Yes	Yes	1.68	Rigid	10.00	25.00	110.00
ETFE	150	104	-105	Translucent	Yes	Yes	Yes	Yes	Yes	Yes	1.7	Rigid	30.00	100.00	250.00
FEP	205	70	-270	Translucent	Marginal[3]	Yes	Yes	Yes	No	Yes	2.15	Excellent	320.00	750.00	2,200.00
PFA	260	166	-270	Translucent	Yes	Yes	Yes	Yes	No	Yes	2.17	Excellent	291	881	2,260
PTFE/TFE	260	200	-100	Opaque	Yes	Yes	Yes	Yes	No	Yes	2.2	Rigid	--	307.50	--
PETG	70	70	-40	Transparent	Marginal[3]	No	Yes	No	Yes	Some	1.27	Moderate	10	25	125
PC	135	138	-135	Transparent	Marginal[3]	Yes5	Yes	No	Yes	Some	1.20	Rigid	50	300	1,075
PSF	165	174	-100	Transparent	Yes	Yes	Yes	Yes[5]	Yes	Yes	1.24	Rigid	55	300	700
PS	90	96	20	Transparent	No	No	Yes	No	Yes	Some	1.05	Rigid	20 - 25	300 - 400	1,000 - 1,500
PVC (rigid)	70	90	-30	Transparent	Yes	No	Yes	No	No	Some	1.34	Rigid	2 - 20	4	4
PVC (tubing)	82	-32	-32	Transparent	Yes	Yes	Yes	No	No	Some	1.34	Excellent	8.3 - 33.3	16.7 - 100.1	166.8 - 583.8
ResMer™	130 to 150	200 to 300	20	Opaque	Marginal[3]	Yes	Yes	No	Yes	Some	1.15 - 1.45	Rigid	--	--	--
PEI	171	210	<20	Transparent Amber	Yes	Yes	Yes	Yes	Yes	Yes	1.28	Rigid	18.60	37.00	171.30
PMMA	50	93	20	Transparent	No	No	No	No	Yes	Some	1.19	Rigid	2.78	12.35	67.94
PUR	82 - 115	32 - 68	<-40 - <-94	Transparent	No	No	Yes	No	Yes	Yes	1.10 - 1.26	Excellent	41-119	75-327	450-1650
PVDF	150	139	-62	Translucent	Marginal[3]	Yes	Yes	No	No	Yes	1.78	Rigid	9.00	14.00	505.00
XLPE	65	59	-118	Translucent	No	No	Yes	No	Yes	Yes	0.93	Rigid	42.00	185	580
TPE	121	<23	<-50	Opaque	Yes	Yes	Yes	No	Yes	Some	0.9	Excellent	31 - 145	85 - 646	900 - 8634
EPR	145	< 20	-90	Opaque	Yes	Yes	Yes	No	No	Some	0.86	Excellent	25 - 150	75 - 650	800 - 8000
SAN	85	98	20	Transparent	Yes	No	Yes	No	Yes	No	1.07	Rigid	--	--	--
Silicone Gaskets	204	-46	-68	Transparent - Opaque	Yes	Yes	Yes	Yes	Yes	Yes	1.1 - 1.5	Moderate - Excellent	--	--	--

1. Heat Deflection Temperature is the temperature at which a bar deflects 0.01" at 66 psig (ASTM D648). Materials may be used above Heat Deflection temperatures in non-stress applications; see Max. Use Temp.
2. 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 cause to attack the plastic or be rapidly absorbed.
3. Plastic will absorb heat.
4. 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—gamma irradiation at 25 kGy (2.5 MRad) with unstabilized plastic.
5. Sterilizing reduces mechanical strength. Do not use PC vessels for vacuum applications if they have been autoclaved. Refer to Use and Care Guidelines for Nalgene Labware, for detailed information on sterilizing.
6. "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.
7. 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.
8. Acceptable for aqueous foods only, at temperatures up to 121°C/250°F. Not sanctioned for use with alcoholic or fatty foods at any temperature.
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.
11. Straight-sided jars, beakers and graduated cylinders only.
12. Acceptable for aqueous, oil, dairy, acidic, and alcoholic foods up to 71° C/160° F.
13. The brittleness temperature is the temperature at which an item made from the resin may break or cracked if dropped. This is not the lowest use temperature if care is exercised in use and handling.
14. The tubing will become opaque from absorbed water, see the current Nalgene® Labware catalog for details.
15. WVTR = Water Vapor Transmission rate in g-mm/m^2 - 24 hr. - 1 BAR at 37°C and 90% Relative Humidity.
16. Acceptable for Dry Solids with the surface containing no free fat or oil (no end test required).

Resin	Permeability (cc.-mm/m²-24 hr.-Bar))			Water Vapor Tranmission Rate (g-mm/m²-24 hr. - Bar at 37°C, 90% RH)[15]	Water Vapor Tranmission Rate (g-mm/100 in²-24 hr. - Bar at 37°C, 90% RH)[16]	Water Adsorb-tion (%)	Non-Cyto-toxicity[6]	Suitability for Food and Bev. Use[7]	Reg. Part 21 CFR	Refractive Index	Melting Point Range (°C)	Glass Transition Temperature Range (°C)
	N_2	O_2	CO_2									
ACL	0.20	0.40	1.60	--	--	0.6	Yes	Yes[8]	177.2480	--	210-220	100
LDPE	69.94	194.28	1,049.09	15.5 - 23.3	1.0 - 1.5	<0.01	Yes	Yes[9]	177.1520	1.5400	85 to 125	-25
HDPE	16.32	71.88	225.36	4.6 - 6.2	0.30 - 0.40	<0.01	Yes	Yes[9]	177.1520	1.5100	125 to 138	-25
PP	18.65	93.25	310.84	3.90	0.25	<0.02	Yes	Yes	177.1520	1.4735	160 to 176	-20 to -5
PPCO	17.48	77.71	252.56	4.40	0.28	<0.02	Yes	Yes	177.1520	1.4735 - 1.5100	150 to 175	-20
PMP	3,108.42	12,433.68	44,683.53	775.00	50.00	0.01	Yes	Yes[11]	177.1520	1.4630	235	--
FLPE	16.32	71.88	225.36	4.6	0.30	<0.01	Yes	Yes[9]	177.1615	1.5100	125 to 138	-25
ECTFE	3.89	9.71	42.74	3.15	0.20	<0.1	Yes	Yes	177.1380	1.4200	242	85
ETFE	11.66	38.86	97.14	1.65	0.11	0.03	Yes	Yes	177.1380	1.3580	265	--
FEP	124.34	291.41	854.82	6.200	0.40	<0.01	Yes	Yes	177.1550	1.341 - 1.347	275	--
PFA	113.07	342.31	878.13	2.00	0.13	<0.02	Yes	No	--	1.3580	302 to 310	90 & -80
PTFE/TFE	--	119.48	--	4.00	0.26	<0.01	Yes	Yes	177.1550	1.3500	320 to 330	120 to 130
PETG	3.89	9.71	48.57	18.13	1.17	0.13	Yes	Yes[10]	177.1315	1.57	265	81
PC	19.43	116.57	417.69	115.00	7.42	0.35	Yes	Yes	177.1580	1.5860	--	154
PSF	21.37	116.57	271.99	--	--	0.3	Yes	Yes	177.1655	1.6330	--	185 to 195
PS	7.77 - 9.71	116.57 - 155.42	388.55 - 582.83	1220.47 - 6102.35	78.74 - 393.70	0.05	Yes	Yes	177.1640	1.5894	--	74 to 110
PVC (rigid)	0.78 - 7.77	1.55	1.55	14 - 79	0.90 - 5.1	0.15 to 0.75	Yes	Yes[12]	176.180 / 175.300	1.5390	--	75 to 105
PVC (tubing)	3.22 - 12.94	2.60 - 38.89	64.81 - 226.84	15 - 80	1.0 - 5.15	0.15 to 0.75	Yes	Yes[12]	176.180 / 175.300	1.5390	--	75 to 105
ResMer™	--	--	--	--	--	0.01	--	--	--	--	200 to 270	90 to 110
PEI	7.23	14.38	66.56	5.80	0.37	0.25	--	Yes	177.1595	1.4600	--	215
PMMA	1.08	4.80	26.40	55.20	3.56	0.35	Yes	Yes	177.1010	1.4893	85 to 105	--
PUR	15.93 - 46.24	29.14 - 127.06	174.85 - 641.11	--	--	0.03	Yes	Yes[16]	177.1680	--	75 to 160	-30 to - 0
PVDF	3.50	5.44	196.22	29.76	1.92	0.05	Yes	Yes	177.2510	1.4200	141 to 178	-60 to -20
XLPE	16.32	71.88	225.36	4.6 - 6.2	0.30 - 0.40	<0.01	Yes	No	--	1.5400	--	--
TPE	12.05 - 56.34	33.03 - 251	349.70 - 3354.76	--	--	0.05 to 0.1	Yes	Yes	177.2600	--	--	--
EPR	9.71 - 58.29	29.14 - 252.57	310.84 - 3108.43	--	--	0.05	--	Yes[9]	177.2600	--	--	-54
SAN	--	--	--	--	--	0.2	--	Yes	177.1040	1.5700	108	--
Silicone Gaskets	--	--	--	--	--	0.1	--	Yes[9]	177.2600	--	--	-130 to -120

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