Sintra Technical Specifications

SHEET DIMENSION TOLERANCES

	DIMENSIONS	TOLERANCES
WIDTH	48" or 60"	0 to .125"
LENGTH	96" or 120"	0 to .250"
DIAGONAL		±.250"

GAUGE (THICKNESS) TOLERANCES

GAUGE		TOLERANCES	
METRIC (MM)	U.S. (APPROX. IN.)	METRIC (MM)	U.S. (IN.)
1	.039	±.20	±.008
2	.078	±.20	±.008
3	.118	±.25	±.010
4	.157	±.30	±.012
5	.197	±.35	±.014
6	.236	±.40	±.016
10	.394	±.60	±.024
13	.512	±.75	±.030
19	.748	±1.05	±.041

GAUGE VS. WEIGHT AND DENSITY

GAUGE		APPROX. WEIGHT	APPARENT DENSITY	SPECIFIC GRAVITY
METRIC (MM)	U.S. (APPROX. IN.)	(LBS./FT. ^{2})	(LBS./FT. ^{3})	(G/CC)
1	.039	.144	44	0.70
2	.078	.287	44	0.70
3	.118	.429	44	0.70
4	.157	.576	44	0.70
5	.197	.722	44	0.70
6	.236	.858	44	0.70
10	.394	1.03	31	0.50
13	.512	1.34	31	0.50
19	.748	1.95	31	0.50

IMPACT RESISTANCE
AT 70°, 30° AND 0° FAHRENHEIT (ASTM D-2794, GARDNER IMPACT TESTER)

GAUGE		IMPACT RESISTANCE (INCH/POUNDS)		
METRIC (MM)	U.S. (APPROX. IN.)	70°F	30°F	0°F
1	$^5/_{128}$	1	<0.5	<0.5
2	$^5/_{64}$	2	1	<0.5
3	$^1/_8$	5	3	2
4	$^5/_{32}$	7	5	3
5	$^3/_{16}$	15	13	12
6	$^1/_4$	28	22	16
10	$^3/_8$	160+	120	105
13	$^1/_2$	160+	160+	140

Sintra Technical Specifications

SINTRA MATERIAL TECHNICAL SPECIFICATIONS

PROPERTY	ASTM TEST (IF APPLICABLE)	UNIT OF MEASURE	VALUES 1-6 MM*		VALUES 10, 13 AND 19 MM**	
DENSITY AND HARDNESS:						
Specific gravity	ASTM D-792	g/cc	0.70 (Nominal)		0.50 (Nominal)	
Apparent density	ASTM D-1622	lb./ft. ^{3}	44		31	
Shore hardness	ASTM D-2240	"D"	66		78	
STRESS-STRAIN/ FLEXURAL			MACHINE DIRECTION	TRANSVERSE DIRECTION	MACHINE DIRECTION	TRANSVERSE DIRECTION
Tensile strength	ASTM D-638	PSI	2,850	2,070	1,460	1,450
Elongation at break	ASTM D-638	%	38	37	36	45
Flexural modulus	ASTM D-790	PSI	235,000	190,000	160,000	115,000
Flexural strength	ASTM D-790	PSI	5,000	3,900	3,550	2,670
PERFORMANCE AT ELEVATED TEMPERATURE:			MACHINE DIRECTION	TRANSVERSE DIRECTION	MACHINE DIRECTION	TRANSVERSE DIRECTION
A. Dimensional change	ASTM D-1042					
120 min. at 158 ° F		%	+0.2	+0.4	+.03	+.03
75 min. at 284° F		%	-6.3	+2.0	+1.3	-2.1
B. Deflection temperature under load (HDT)	ASTM D-648	°F@ 264 PSI	160	162		
ELECTRICAL PROPERTIES						
Dielectric strength	ASTM D-149	KV/CM	112			
Surface resistivity	ASTM D-257	ohms	10^{14}			
Volume resistivity	ASTM D-257	ohms cm	2.4×10^{15}			
Dielectric constant 50 cps	ASTM D-150		1.9			
Dissipation factor 50 cps TAN	ASTM D-150		0.013			
WATER ABSORPTION	ASTM D-2842	% BY WT.	1.0		1.0	

*Values in table are typical for 4 mm.
**Values in table are typical for 10 mm.

Archival Qualities

An important criteria for materials expected to be in long term contact with photos, documents, and other artifacts is that they are "archival grade." This is often a consideration in museum work. Archival attributes of Sintra material include its being "Acid Free" and having minimal "Outgassing" qualities.

Acid Free

Both .700 specific gravity and .500 specific gravity Sintra materials are "acid free"/pH neutral—where the pH is slightly above 7.0.

Outgassing

Both .700 specific gravity and .500 specific gravity Sintra materials have exhibited <0.001% HCL released when subjected to 158 degrees F for a total of 14 days.

Sintra Technical Specifications

Resistance to Standard Reagents

Generalizations:

Mineral Acids	Resistant to most (check resistance to specific acids)
Bases	Resistant
Salts	Resistant
Alcohols	Resistant
Paraffinic Hydrocarbons	Resistant
Oils and Greases	Resistant
Chlorinated Hydrocarbons	Not resistant
Aromatic Hydrocarbons	Not resistant
Esters	Not resistant
Ketones	Not resistant

Resistance to certain other fluid mixtures such as fuel oils with moderate aromatic content cannot be determined on the basis of immersion testing alone. Actual use data must be obtained.

It should be noted that in addition to temperature and reagent concentration, other factors such as stress level can also affect the chemical resistance of Sintra material. Because of this, the final determination of suitability must often depend on some in-service testing.

CODE:

1–Resistant 2–Limited Resistance 3–Little Resistance 4–Not Resistant

(Chemical resistance of Sintra material at an ambient temperature to standard reagents according to ASTM D-543)

Acetic acid
.glacial 2
.5% 1
Acetone 4
Ammonium hydroxide:
.conc. 1
10% .....
Aniline 4
Benzene 4
Carbon tetrachloride 3
Chromic acid 10% 1
Citric acid 10% 1
Cottonseed oil .....
Detergent solution 0.025% 1
Diethyl ether .....

Dimethyl formamide 4
Distilled water 1
Ethyl acetate 4
Ethyl alcohol:
95% 1
50% 1
1 2-ethylhexyl sebacate 4
Heptane 1
Hydrochloric acid:
conc. 1
10% 1
Hydrofluoric acid 40% 1
1 Hydrogen peroxide:
28% 1
1 3% 1

Sintra Technical Specifications

Isooctane 1
Kerosene 1
Methyl alcohol 1
Mineral oil 1
Nitric acid
conc. 4
40% 1
10% 1
Oleic acid 1
Olive oil 1
Phenol solution 5% 1
Soap solution 1%
Sodium carbonate solution:
20% 1
2% 1
1 Sodium chloride solution 10% 1
Sodium hydroxide solution:
60% 1
10% 1
1% 1
Sodium hypochlorite solution 6% 1
Sulfuric acid:
conc. 1
30% 1
3% 1
Toluene 4
Transformer oil 1
Turpentine 1

Rigid P.V.C. Type I Qualification Testing

REQUIREMENTS AND TEST RESULTS

CHEMICAL RESISTANCE	REQUIREMENTS GRADE 1	GRADE 2	GRADE 3	MATERIAL	SINTRA
H_2SO_4/93%/14d/55° C					
Change in weight: increase max. %	5.0	25.0	5.0		3.2
Flexural yield strength: decrease max. %	25.0	50.0	25.0		4.3
H_2SO_4/80%/30d/60° C					
Change in weight: increase max. %	NA	5.0	NA		0.8
Flexural yield strength: increase max. %	NA	15.0	NA		6.9
ASTM OIL NO. 3/30d/23° C					
Change in weight: increase max. %	1.0	1.0	1.0		0.7

Sintra material compiles with the requirements of ASTM D-1784 for Rigid P.V.C. Type I.

Sintra Technical Specifications

General Comments

Field performance over a 2–4 year period shows good weatherability in outdoor applications currently in operation in various environmental conditions. Reliable predictions, however, can only be made on the strength of long-term outdoor ("real-time") weathering. Such testing is currently in progress at various geographical locations.

Outdoor Mounting of Sintra Material

The effects of outdoor exposure on tensile, color, impact resistance and dimensional stability are as follows:

A. Tensile

The effects of medium altitude outdoor exposure with a comparatively high U.V. level on Sintra material during 24 months show virtually no change in tensile strength.

B. Color Changes

Field testing reported by many Sintra material customers shows acceptable color maintenance using white material. In general, white has been found to have superior weatherability over colors. Black Sintra also has had success outdoors. Other colors are not recommended for long term exterior usage.

Colored Sintra materials are produced with organic pigments. Exterior light and some interior light fixtures emit light waves in the lower range of the light spectrum. These low range light waves may cause a fading of the Sintra material colors over time.

Sintra material exterior color fastness may be improved when used with some PVC compatible UV resistant, non-yellowing inks, clear top coat paints or clear laminates. (See Table III on page 6.) In addition to coatings and films, many light fixture manufacturers produce UV filtering dif fusers that may also reduce or minimize these color changes for interior use.

Sintra Material is a P.V.C., therefore it will experience "browning out" or fading over time. This phenomenon is significantly less in white. While Sintra Material has been used in a variety of exterior applications, the degree of generic P .V.C. "browning out" cannot be predicted in advance of a specific application. Therefore no guarantee on color fastness can be made.

C. Impact Resistance and Environmental Stress

1. Effect of Temperature—With decreasing temperature, there is a tendency towards decreased impact resistance. However, measurement of the cold crack temperature with a bending apparatus for sheets of 2 mm and 3 mm thickness and a 1/2" mandrel show that under normal winter conditions, no immediate serious embrittlement is to be expected. A 2 mm, white Sintra material sheet can be bent around a 1/2" mandrel for 180° at an ambient temperature of -15 ° C (5° F) without fracture.

2. Effect of Chemicals—Certain solvents (such as cyclohexanone) present in inks can cause environmental stress, cracking, and poor impact resistance. For this reason, the solvent systems used to dilute screen printing inks must be carefully chosen.

Sintra Technical Specifications

UL 1975
Fire Test For Foamed Plastics Used For Decorative Purposes

The purpose of this test method is to determine the ability of foamed plastics used for decorative purposes to resist rapid heat release when subjected to a flaming ignition source.

Section 11.303.c of the 1991 Uniform Fire Code regulates the use of Flammable Decorative Material. Section 11.303.c.4 defines the limits for the use of foam plastics as being:

A. Exhibit booth construction shall have a maximum heat-release of 100 kilowatts when tested in accordance with nationally recognized standards. (See section 2.304.b).

B. Decorative objects, including but not limited to mannequins, murals, and signs, shall have a maximum heat-release rate of 150 kilowatts when tested in accordance with nationally recognized standards. (See section 2.304.b.)

Section 2.304.b lists the UL 1975 as the standard for Fire Test for Foamed Plastics Used for Decorative Purposes.

The following Table provides a summary of the test results.

THICKNESS	DENSITY (lbs/ft ^{3})	MAX. INST. RHR (kW)
1 mm	44	38
6 mm	44	42
10 mm	28	80
19 mm	28	62

SwRI Project No. 01-3780-220

Sintra Technical Specifications

FIRE TEST RESULTS

TEST	UL 94V-0	UL 94-5V	ASTM E-84	
TEST DESCRIPTION	5"x 1/2" bar mounted vertically. Flame applied to each of five specimens. Two consecutive 10 second burns on each specimen.	Vertical test like 94V-O, except more severe. Length of burner flame increased, and flame applied at 20° to one of the bottom corners of the bar. Flame applied to each specimen five times at 5 second intervals, each burn lasting 5 seconds.	Test also called UL Steiner Tunnel Test. 20"–24" wide by 24' long sample fits under roof of 25' long tunnel forming ceiling of tunnel. Gas Burners at one end impinge flame on 7 square feet of specimen. Rate of progression of flame observed as it passes side windows—decrease of light measured by photometer. Flame progression plotted as distance (of windows vs. time when flame passes window). Photometer data plotted as percent of absorption vs. time. Ratios of areas under curve to those of red oak, tested similarly and calculated. Red oak has a flame spread index of 100 and a smoke developed index of 100.	
CRITERIA	A. No burning up to specimen clamp. No dripping. B. 10 seconds max. time of flaming after each burn. C. 50 seconds max. total time of flaming for all burns of 5 specimens. D. 30 seconds max. time of glowing after last burn of specimen. E. Repeat (A) to (D) after conditioning 168H at 70° C.	94-5VA Criteria A. Not have any bar specimens that burn with flaming or glowing combustion for more than 60 seconds after the fifth flame. B. Not have any bar specimens that drip flaming particles that ignite dry absorbent surgical cotton located 12 inches below the test specimen. C. Not have any plaque specimens that exhibit a burn through (hole). 94-5VB Criteria A. Not have any bar specimens that burn with flaming or glowing combustion for more than 60 seconds after the fifth flame. B. Not have any bar specimens that drip flaming particles that ignite dry absorbent surgical cotton located 12 inches below the test specimen. C. Permit a burn through (hole) on plaque specimens.		
	SINTRA MATERIAL PERFORMANCE VS. ABOVE CRITERIA: A B C D E	UL 94 FLAMMABILITY CLASSIFICATION	SINTRA MATERIAL PERFORMANCE VS. ABOVE CRITERIA:	
			FLAME SPREAD	SMOKE DEV.
1 mm White	Pass →	94-5VB		
2 mm White	Pass →	94-5V A		
2 mm Grey	Pass →	94-5VA	20	380
3 mm all colors	Pass →	94-5VA	20	315
4 mm	Pass →	94-5V A	20	425
5 mm	Pass →	94-5VA	20	>450
6 mm all colors	Pass →	94-5V A	20	>450
10 mm White	Pass →	94-5VA	25	>450
13 mm White	Pass →	94-5VA	>25	>450
19 mm White	Pass →	94-5VA	>25	>450

Sintra Technical Specifications

Re lative Flammability Comparisons to Other Materials

In addition to its unique balance of performance properties, Sintra material has the following advantages as fire-retardant material:

1. Self extinguishing—remove the flame and the burning stops.
2. Relatively high ignition resistance—the heat content of Sintra material is 8,600 BTU/LB. Heat produced by a flame from Sintra material is not enough to produce those necessary vapors which combine with atmospheric oxygen to create a combustible mixture. Because of its low heat of combustion, Sintra material will not support combustion.
3. High oxygen index—ASTM D-2863 measures the percent of oxygen in an oxygen/nitrogen mixture which barely supports burning. The oxygen content of the earth's atmosphere is about 21%. Materials with oxygen index values of approximately 26 and above should not continue burning after the flame source is removed, because the normal atmospheric oxygen content is insufficient to support combustion.

   The oxygen index values of Sintra material is 46–49%. Many other plastics and natural products have values under 26, as this title indicates.

LIMITING OXYGEN INDICES (LOI) OF PLYMERS
(A LOW LOI VALUE INDICATES HIGH FLAMMABILITY)

BELOW 22 (MATERIAL BURNS BY ITSELF)	22–28 (MAY BURN UPWARDS)	ABOVE 28 (MATERIAL WILL NOT BURN BY ITSELF)
Polyacetal 15	Red Oak 23	Polysulfone 30-50
Cotton 16-17	Polyvinyl fluoride 23	Polyimides 31-45
Polymethylmethacrylate 17	Polyphenylene oxide 24	Polyphenylene sulfide 40
Polyethylene 17	Nylon 6/6 24	Rigid polyvinyl chloride 40-49
Polypropylene 18	Polycarbonate 25	Sintra ® material 46-49
Polystyrene 18	Nylon 6 26	Polyvinylidene fluoride 44
Filter paper (cellulose) 18	Plasticized polyvinyl chloride ..22-32	Chlorinated PVC 45-60
ABS 19		Polyvinylidene chloride 60
Cellulose acetate 19		Polytetrafluoroethylene 95
Styrene acrylonitrile 19		
Polyethylene terephthalate 20		
Birch 20.5		
Fir 21.5		

4. No "flaming drip"—Some burning polymers produce molten flaming drips which contribute to flame spread. Sintra material produces a form-retaining carbonaceous char. This char totally prevents fire-spreading flaming drips.