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COMPLIANCE CERTIFICATE

DENALI

Michigan Technological University's 2015-2016 Concrete Canoe team hereby certifies that the construction and finishing of *Denali* has been completed in compliance with the rules and regulations set forth by the National Concrete Canoe Competition. Additionally, the canoe was completely built within the current academic year of the competition. The nine (9) registered participants are qualified, eligible, student members and National Student Members of ASCE as specified in the rules and regulations of the National Competition. The team acknowledges that all material safety data sheets (MSDS) have been read by the project management team and acknowledges receipt of the *Request for Information (RFI) Summary*.

Registered Members of the 2015-2016 Michigan Tech Concrete Canoe Team

Philip Doederlein	9920081	Taylor Wiegand	9921099
Luke Cinader	10083232	Makenna Stelpflug	10240870
Robert Herrick	10273592	Shaye Maetzold	10402509
Mitchell Finnegan	9920791	Katie Tigges	10274172
Anthony Peszek	9916873		

Denali Dimensions					
Maximum Length			19'0"		
Maximum Width			30.8"		
Maximum Depth			15.1 "		
Nominal Thickness			0.375"		
Overall Weight			163 lbs		
Denali Concrete Properties					
	Unit Weight (Density)		14-day Compressive Strength	14-day Tensile Strength	Volumetric Air Content
	Wet	Dry			
Structural	59.6 pcf	56 pcf	1600 psi	400 psi	7.0%
Finishing	81.2 pcf	78 pcf	1420 psi	250 psi	22.5%
Outlay	78.1 pcf	72 pcf	1350 psi	350 psi	27.6%
Pigmented	61.6 pcf	60 pcf	1410 psi	240 psi	3.5%
Composite Properties					
14-day Flexural Strength			1390 psi		

We certify that the aforementioned information is valid.

Kathrine Cipriano 5/09/16
Date

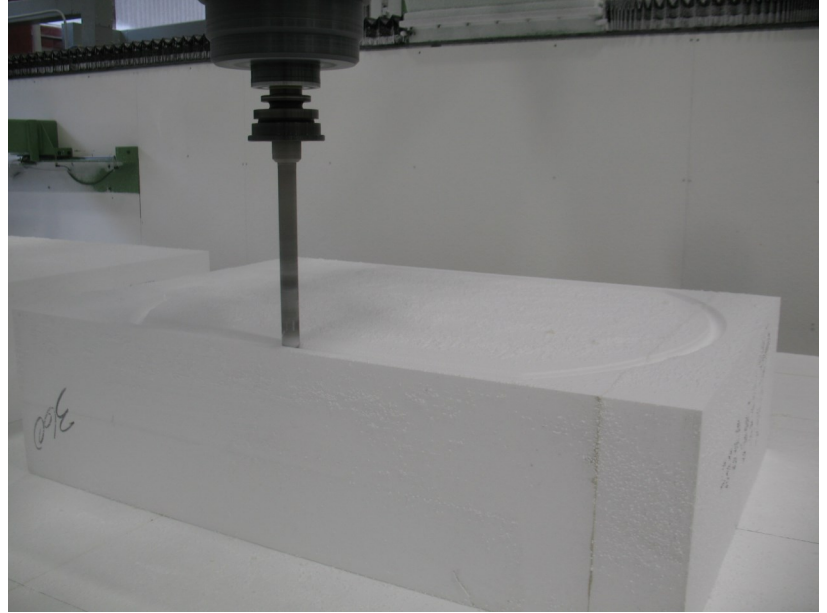
Tess M. Ahlborn 5/10/16
Date

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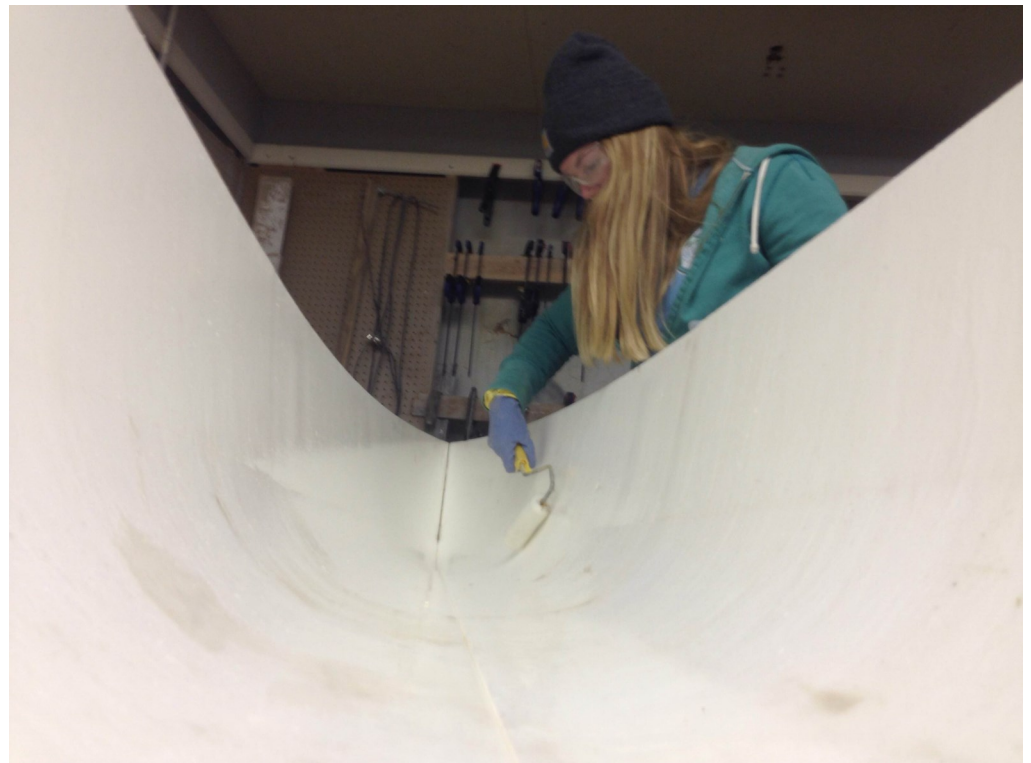
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MOLD CONSTRUCTION

After engineering the 2015-2016 canoe dimensions, a three-dimensional (3D) model of the canoe was created using NX. The team's CNC milling industry partner used the 3D model to mill a canoe mold to the specified dimensions using 10% pre-consumer recycled high-density polystyrene. The figure to the right demonstrates the milling process used to create the mold.



Seven layers of epoxy were applied to the mold to provide a hardened surface for the application of a release agent and placement of the first layer of concrete



The figure to the right shows the 1/4" by 8" bolt assembly that was used to secure the ends of the mold. This prevented centerline separation during



The mold was then properly aligned and secured to a wooden table top to provide stability during casting day.

Inlay designs were traced on the mold. The traction tape was then aligned and traced for cutting.



Traction tape was cut and placed in layers in order to create intricate designs.

Grooves 5/8" deep were cut into foam strips and a coat of epoxy resin was applied to create gunwale cap molds.



Twenty minutes prior to casting, a release agent was rolled on to the mold. Special care was taken to ensure the inlay design was not removed during the application of the release agent.

CANOE CONSTRUCTION



To the left, the troweling team places the first of three layers of concrete using hand trowels.

Four QC/QA members assisted the eight person troweling team to verify that troweling was to the correct depth. 3D-printed depth gauges were designed to ensure a nominal thickness of 3/8" was met.



To the right, the reinforcement team lays the first layer of the Basalt reinforcement. The transverse orientation of the first layer was from gunwale to gunwale.



Above, the second layer of concrete is being placed. Concrete was hand placed over the first layer of reinforcement and then troweled to the correct thickness. This was done to prevent cold joints and possible delamination between the two layers.



Left, the second layer of reinforcement is being placed. The second layer of reinforcement went from gunwale to gunwale to prevent punching shear, as well as torsional failure.

Right, the third layer of concrete is being placed. Concrete was securely placed over the second layer of reinforcement and then troweled to thickness.



The picture to the right shows the construction of the gunwale caps. The foam molds were secured using clamps and wooden spacers. The first layer of concrete was placed, followed by a strip of reinforcement, and then a second layer of concrete. Trowels were used to finish the top of the gunwale caps.



After the main body of *Denali* was cast, extruded polystyrene foam was inserted into the bow and stern for floatation, as seen in the figure below. The foam was then encased in concrete.

Finishing Techniques



After the mix cured, Denali was sanded by hand to smooth out the concrete. This helped achieve a smoother finish.

After sanding the canoe, exterior concrete inlays were applied by placing pigmented concrete into voids left by traction tape that was applied prior to casting. Interior inlays were constructed by rotary sanding to a depth of 1/16 inch, then cross hatching with a rotary tool, and then filling the void with pigmented concrete.





Outlays were formed on both the exterior and interior of the canoe to create aesthetically pleasing features including the Denali mountain range and leaves. Outlays were made by placing fresh pigmented concrete in the void left between foam mat guides . Then, outlays were sculpted in the voids left from the mats.

The entire canoe will be sealed according to rules ten days before competition to allow for a full cure. The aesthetics process will be completed as well as the design and construction of *Denali*.



HULL THICKNESS CALCULATIONS



Calculations per Section 4.3.1

Annotation

$T_1 = 0.0022$ in Average thickness of first layer of reinforcement, 5 mm Basalt Mesh, measured in accordance with Section 4.3.1

$T_2 = 0.0022$ in Average thickness of second layer of reinforcement, 5 mm Basalt Mesh, measured in accordance with Section 4.3.1

$T_h = 0.375$ in Nominal thickness of the canoe hull

Determine that the reinforcement at any point in the canoe will not exceed 50% of the total hull thickness.

Solution

Within the canoe, a maximum of two layers of 5 mm Basalt Mesh were used along the bottom of the canoe.

$\frac{T_1 + T_2}{T_h} * 100 = 11.73\%$ The two layers of reinforcement make up approximately 11.73% of the hull. This value is less than the maximum value of 50% outlined in section 4.3.1, demonstrating compliance.

GUNNEL CAP THICKNESS CALCULATIONS

Calculations per Section 4.3.1

Annotation

$T_1 = 0.0022$ in Average thickness of first layer of reinforcement, 5 mm Basalt Mesh, measured in accordance with Section 4.3.1

$T_h = 0.625$ in Nominal thickness of the gunwale cap

Determine that the reinforcement at any point in the canoe will not exceed 50% of the total hull thickness.

Solution

One layer of 5 mm Basalt Mesh was used throughout the gunnel cap.

$\frac{T_1}{T_h} * 100 = 3.52\%$ The two layers of reinforcement make up approximately 3.52% of the gunnel cap. This value is less than the maximum value of 50% outlined in section 4.3.1, demonstrating compliance.

PERCENT OPEN AREA CALCULATIONS

Calculations per Section 4.3.2

Sample: 5mm Basalt Mesh

Given

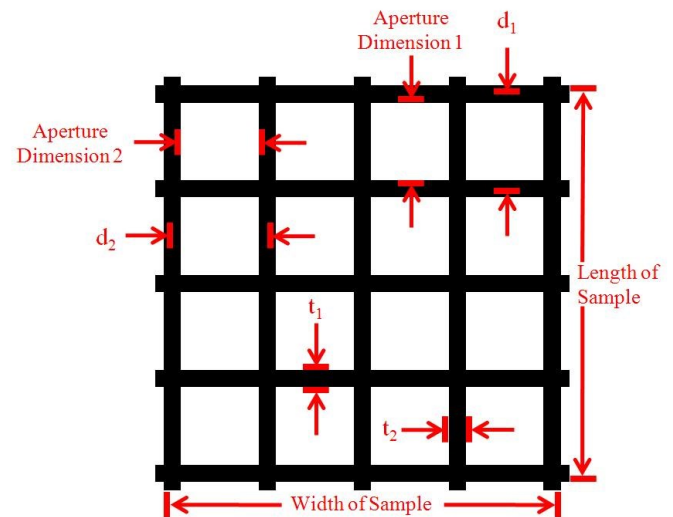
$n_1 = 6$ Number of apertures along length

Number of apertures along width

$n_2 = 6$

$t_1 = 0.024$ in Average thickness of reinforcement along length

$t_2 = 0.036$ in Average thickness of reinforcement along width



Sample of Reinforcement

Aperture_Dimension_1 = 0.164 in

Aperture_Dimension_2 = 0.185 in

$d_1 = \text{Aperture_Dimension_1} + 2 \cdot (t_1/2)$ $d_1 = 0.19$ in

$d_2 = \text{Aperture_Dimension_2} + 2 \cdot (t_2/2)$ $d_2 = 0.26$ in

Average spacing of reinforcement (center-to-center) along the sample length

Average spacing of reinforcement (center-to-center) along the sample width

Determine Solution Percent Open Area (POA) for the 5 mm Basalt Mesh

$$\text{Length}_{\text{Sample}} = n_1 \cdot d_1$$

$$\text{Width}_{\text{Sample}} = n_2 \cdot d_2$$

$$\text{Length}_{\text{Sample}} = 1.13 \text{ in}$$

$$\text{Width}_{\text{Sample}} = 1.54 \text{ in}$$

$$\text{Area}_{\text{Open}} = n_1 \cdot n_2 \cdot \text{Aperture_Dimension_1} \cdot \text{Aperture_Dimension_2}$$

$$\text{Area}_{\text{Total}} = \text{Length}_{\text{Sample}} \cdot \text{Width}_{\text{Sample}}$$

$$\text{Area}_{\text{Open}} = 1.09 \text{ in}^2$$

$$\text{Area}_{\text{Total}} = 1.74 \text{ in}^2$$

$$\text{POA} = (\text{Area}_{\text{Open}} / \text{Area}_{\text{Total}}) \cdot 100$$

$$\text{POA} = 62.6\%$$

The POA is greater than the 40% minimum required, demonstrating compliance.

[HOME](#)

Technical Data Sheet

ASTM C-150



PRODUCT NAME:
White Portland Cement:
Federal
White Type I
ASTM Designation C-150

MSDS

MANUFACTURER:
Federal White Cement
P.O. Box 548
Woodstock, Ontario
Canada
N4S 7Y5

Phone: 800-265-1806
Phone: 519-485-5410
Fax: 519-485-5892

DESCRIPTION:

Federal White Type I Cement is a true portland cement manufactured with selected raw materials to insure negligible amounts of iron and manganese oxides so as not to produce the gray color of normal portland cement.

INSTALLATION:

Architect should approve the color and surface texture of samples submitted by the contractor or precaster. Contact Federal White Cement for further information or assistance.

MAINTENANCE:

Concrete and other products manufactured with Federal White Cement should require no additional maintenance if designed and constructed following proper and accepted procedures.

TECHNICAL DATA:

Federal White Portland Cement is manufactured to conform to all current requirements of ASTM Designation C-150.

See table for physical properties.

BASIC USE:

Federal White Cement can be used for all types of architectural or structural concrete construction where a whiter or brighter color may be needed for aesthetic or safety reasons. Such application as pre-cast panels and systems, cast-in-place, masonry units, tilt-up panel systems, roofing tiles, terrazzo floors, highway median barriers, tile grout, swimming pools, stucco, colored masonry products, cement paints and coatings and ornamental precast concrete items lend themselves to using Federal White Cement. Federal White Cement may also be used to satisfy low alkali requirements.

AVAILABILITY AND COST:

Federal White Cement can be shipped to most destinations in the United States and Canada from our manufacturing plant or terminal. Cement shipments can be made by rail or truck in bags or in bulk.

The price, F.O.B. destination, of Federal White Cement will be furnished by the manufacturer upon request.

WARRANTY:

Federal White Type I Portland Cement complies with the current ASTM C-150. Federal White Cement makes no guarantee or warranty, expressed or implied, including, without limitation, warranties of fitness or merchantability with respect to this product.

TECHNICAL SERVICES:

Technical service, consultation, and additional product information are available by contacting Federal White Cement.

PHYSICAL PROPERTY	FEDERAL WHITE Typical Type I	ASTM C – 150 Specification Type I
Fineness:		
Specific Surface (sq. m / kg)	400	280 minimum
Setting Time – Vicat Minutes	120	
not less than		45
not more than		375
Air Content %	8	12 maximum
Compressive Strength, psi(MPa)		
1 day	2000 (13.8)	--
3 day	3900 (26.9)	1740 (12.0) minimum
7 day	4800 (33.1)	2760 (19.0) minimum
28 day	6500 (44.8)	--

Analytical Testing Service Laboratories, Inc.
P.O. Box 1118, Joplin, Missouri 64802
(417) 782-6573

Headwaters Resources
4319 S.National # 127
Springfield, MO 65810-2607
(417)882-0965

December 15, 2015

Attn: Kristy Rotramel

Re: 55598 - Jeffrey Fly Ash Sample - 2000 Ton Composite - Unit 1 10/ 22-11/02 /2015

	AASHTO-M295 Class "C" <u>Requirements</u>	ASTM C-618 Class "C" <u>Requirements</u>	<u>Actual</u>
Fineness (+325 Mesh)	34% Max	34% Max	10.00%
Moisture Content	3% Max	3% Max	0.06%
Density g/cm ³ C188	5% Max	****	2.76
Density Variation	5.0% Max	5.0% Max	0.36%
Loss on Ignition	5% Max	6% Max	0.24%
Soundness	0.8% Max	0.8% Max	0.08%
S.A.I., 7 Days	75% Min	75% Min	100.60%
S.A.I., 28 Days	75% Min	75% Min	104.20%
Water Req. % Control	105% Max	105% Max	94.20%
Silica SiO ₂	****	****	29.81%
Aluminum Oxide Al ₂ O ₃	****	****	19.22%
Ferric Oxide Fe ₂ O ₃	****	****	5.43%
Total	50% Min	50% Min	54.46%
Sulfur Trioxide SO ₃	5% Max	5% Max	3.42%
Calcium Oxide CaO	****	****	30.32%
Magnesium Oxide MgO	****	****	7.13%
Available Alkalies as Na ₂ O	1.50% Max	-----	1.49%

We certify the above was tested in accordance with ASTM C-618 and AASHTO M295.

Analytical Testing Service Laboratories, Inc.



John K. Cupp, Manager

Analytical Testing Service Laboratories, Inc.
P.O. Box 1118, Joplin, Missouri 64802
(417) 782-6573

Headwaters Resources
4319 S.National # 127
Springfield, MO 65810-2607
(417)882-0965

January 07, 2016

Attn: Kristy Rotramel

Re: 55787 - Jeffrey Fly Ash Sample - 2000 Ton Composite - Unit 2 - 11/ 15-30 /2015

	AASHTO-M295 Class "C" <u>Requirements</u>	ASTM C-618 Class "C" <u>Requirements</u>	<u>Actual</u>
Fineness (+325 Mesh)	34% Max	34% Max	9.30%
Moisture Content	3% Max	3% Max	0.05%
Density g/cm ³ C188	5% Max	****	2.81
Density Variation	5.0% Max	5.0% Max	1.39%
Loss on Ignition	5% Max	6% Max	0.18%
Soundness	0.8% Max	0.8% Max	0.08%
S.A.I., 7 Days	75% Min	75% Min	100.00%
S.A.I., 28 Days	75% Min	75% Min	107.30%
Water Req. % Control	105% Max	105% Max	93.40%
Silica SiO ₂	****	****	31.05%
Aluminum Oxide Al ₂ O ₃	****	****	19.60%
Ferric Oxide Fe ₂ O ₃	****	****	5.15%
Total	50% Min	50% Min	55.80%
Sulfur Trioxide SO ₃	5% Max	5% Max	2.63%
Calcium Oxide CaO	****	****	29.17%
Magnesium Oxide MgO	****	****	7.79%
Available Alkalies as Na ₂ O	1.50% Max	-----	1.50%

We certify the above was tested in accordance with ASTM C-618 and AASHTO M295.

Analytical Testing Service Laboratories, Inc.



John K. Cupp, Manager

Analytical Testing Service Laboratories, Inc.
P.O. Box 1118, Joplin, Missouri 64802
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4319 S.National # 127
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December 28, 2015

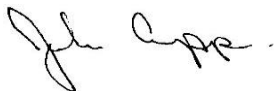
Attn: Kristy Rotramel

Re: 55668 - Jeffrey Fly Ash Sample - 2000 Ton Composite - Unit 3 - 11/ 10-24 /2015

	AASHTO-M295 Class "C" <u>Requirements</u>	ASTM C-618 Class "C" <u>Requirements</u>	<u>Actual</u>
Fineness (+325 Mesh)	34% Max	34% Max	11.00%
Moisture Content	3% Max	3% Max	0.12%
Density g/cm ³ C188	5% Max	****	2.73
Density Variation	5.0% Max	5.0% Max	1.43%
Loss on Ignition	5% Max	6% Max	0.18%
Soundness	0.8% Max	0.8% Max	0.10%
S.A.I., 7 Days	75% Min	75% Min	105.70%
S.A.I., 28 Days	75% Min	75% Min	110.80%
Water Req. % Control	105% Max	105% Max	94.20%
Silica SiO ₂	****	****	30.05%
Aluminum Oxide Al ₂ O ₃	****	****	19.81%
Ferric Oxide Fe ₂ O ₃	****	****	5.15%
Total	50% Min	50% Min	55.01%
Sulfur Trioxide SO ₃	5% Max	5% Max	3.00%
Calcium Oxide CaO	****	****	29.60%
Magnesium Oxide MgO	****	****	7.13%
Available Alkalies as Na ₂ O	1.50% Max	-----	1.44%

We certify the above was tested in accordance with ASTM C-618 and AASHTO M295.

Analytical Testing Service Laboratories, Inc.



John K. Cupp, Manager

Product specifications

according to DIN EN 13055-1

Designation	Poraver® basic granular sizes						Special granular sizes			
Granular size mm	0.1-0.3	0.25-0.5	0.5-1	1-2	2-4	4-8	0.04-0.125	high-strength 0.2-0.7	0.5-1.25	8-16
Bulk density lb/ft³ Nominal	25	21.2	16.9	14.4	11.9	11.2	33.1	33.1	16.2	8.7
Apparent granular density lb/ft³ Nominal	56.2	36.8	29.3	24.3	20	18.8	*	59.3	28.7	16.9
Compressive strength PSI	406	377	290	232	203	174	–	942.5	246.5	116
Oversize grains	≡ 10 M. %									
Undersize grains	≡ 15 M. %									

* on request

The following data
are valid for all grain sizes:

pH value	9 - 12									
Moisture content on delivery	< 0.5 %									
Softening point	approx. 700° C									
Colour	creamy white									
Thermal conductivity W/mK	–	–	–	–	0.07**	0.07**	–	–	–	–

** Calculated values DIBt according to Approval Z-23.11-114

The Poraver® strengths may vary within the tolerance range of the bulk density.

The availability and delivery conditions for special grain sizes will be agreed on an individual basis.





Apparent bulk density

How to determine apparent bulk density

in accordance with DIN EN 1097-3

Pour loose Poraver[®] into a 1 litre measuring vessel and carefully level off any test material left on top.

Then weigh the test material in the vessel. The bulk density is the quotient of the weight and the volumes in lb/ft³.

Standard granular size mm	0.1 - 0.3	0.25 - 0.5	0.5 - 1	1 - 2	2 - 4	4 - 8
Apparent bulk density in lb/ft ³	25	21.2	16.9	14.4	11.9	11.2

Special granular size in mm	0.04 - 0.125	high-strength 0.2 - 0.7	0.5 - 1.25	8 - 16
Apparent bulk density in lb/ft ³	33.1	33.1	16.2	8.7

The following deviations from the given DIN apply:

- There is no drying, because Poraver[®] is generally supplied dry.
- The equilibrium moisture does not require conditioning.
- The measuring vessel indicates a volume of 1 litre even with granular sizes greater than 4 mm.
- One measuring value is given for each test.



Apparent granular density

How to determine apparent granular density

in accordance with DIN 4226

What is required to determine apparent granular density (ρ) is approx. 400ml of material that is weighed (m). Place the granular material into a cylinder with 1 litre nominal capacity and add 0.5 litre of water. Tap the measuring vessel to remove any air bubbles. Push a plunger with known volumes (V_s) into the measuring cylinder to prevent granular material from floating to the surface. After reading off the total volume (V) in cm^3 , you can calculate the granular density in lb/ft^3 by using the following formula:

Calculation formula:

$$\rho = \frac{m}{V - (V_s + 500)}$$

Standard granular size in mm	0.1 - 0.3	0.25 - 0.5	0.5 - 1	1 - 2	2 - 4	4 - 8
Apparent granular density in lb/ft^3	56.2	36.8	29.3	24.3	20	18.8

Special granular size in mm	0.04 - 0.125	high-strength 0.2 - 0.7	0.5 - 1.25	8 - 16
Apparent granular density in lb/ft^3	*	59.3	28.7	16.9

* on request

The following deviations from the given DIN apply:

- There is no drying, because Poraver® is generally supplied dry.
- This testing method is used for Poraver® granular sizes from 0.1 – 16 mm.
- One measuring value is given for each test.



Compressive strength

How to determine granular compressive strength

in accordance with DIN EN 13055-1

To determine the compressive strength, pour 1 litre of Poraver[®] into a defined steel cylinder and compress. To do this, use an attached plunger to press down the granular material in this cylinder by 20 mm with a compressor. The force required for this is indicated as the granular strength.

Standard granular size in mm	0.1 - 0.3	0.25 - 0.5	0.5 - 1	1 - 2	2 - 4	4 - 8
Compressive strength PSI	406	377	290	232	203	174

Special granular size in mm	0.04 - 0.125	high-strength 0.2 - 0.7	0.5 - 1.25	8 - 16
Compressive strength PSI	–	942.5	246.5	116

The following deviations from the given DIN apply:

- ▶ Undersize and oversize grains are not removed within individual granular groups.
- ▶ Force is applied at a constant speed of 0.15 kN/s for all granular sizes.
- ▶ One measuring value is given for each test.



Water absorption

How to determine water absorption

in accordance with DIN V 18004

To determine water absorption, weigh approx. 0.4 litre of Poraver[®] to an accuracy of 0.1 g.

Procedure 1:

For granular sizes below 2 mm, store the water in a suction filter, and extract the water by means of a water-operated vacuum pump to dry the surface.

Procedure 2:

For granular sizes in excess of 2 mm, store the water in a density bottle. Here, dab the sample to dry the surface.

The difference between the mass of the surface-damp condition and the dry sample in relation to the dry sample is water absorption W in M.-%.

Calculation formula

$$\begin{aligned} \text{WA [M. \%]} &= (\text{Mf} - \text{Mtr}) / \text{Mtr} \\ \text{WA [V. \%]} &= \text{WA [Vol. \%]} \times \text{KRD} \end{aligned}$$

Mw - Mass of water absorbed [g]
Mtr - Mass of sample dry [g]
KRD - Apparent granular density [kg/m³]

Standard granular size in mm	0.1 - 0.3	0.25 - 0.5	0.5 - 1	1 - 2	2 - 4	4 - 8
Water absorption in WA	35 M. %	30 M. %	25 M. %	20 M. %	15 M. %	10 M. %

Special granular size in mm	0.04 - 0.125	high-strength 0.2 - 0.7	0.5 - 1.25	8 - 16
Water absorption in WA	–	20 M. %	22 M. %	15 M. %

The following deviations from the given DIN apply:

- There is no drying, because Poraver[®] is generally supplied dry.
- Procedure 1 is used for granular sizes up to 2 mm, Procedure 2 only being used for granular sizes greater than 2 mm.
- Water storage of approx. 5 min. is used as standard in both procedures.



Chemical analysis

in accordance with test report 043077.1 of the MPA Hanover

Serial No.	Constituent	Applied to the sample dried at 105°C	Heat-loss-free (%)	Analysis method
1	Heat loss	0.3	–	DIN EN 1744-1
2	Insoluble residue	91.5	–	EN 196-2
3	CaO	8.9	9.0	spectrally photometric atomic emission
4	SiO ₂	71.7	71.9	
5	Al ₂ O ₃	2.5	2.5	
6	TiO ₂	0.1	0.1	
7	Fe ₂ O ₃	0.4	0.4	
8	Mn ₂ O ₃	0	0	
9	MgO	2.1	2.1	
10	K ₂ O	0.8	0.8	
11	Na ₂ O	13.2	13.2	
12	SO ₃	0.1	0.1	coulometric
13	Cl	–	–	argentometric
14	Remaining	– 0.1	– 0.1	–
15	Total 1, 3–14	100.0	100.0	–
16	Na ₂ O equivalent	13.7	–	calculated from 10+11

The analysis was conducted on a sample ground and dried to a granular size of < 0.125 mm.



3M™ Glass Bubbles

K Series, S Series and iM Series

Introduction

3M™ Glass Bubbles are engineered hollow glass microspheres that are alternatives to conventional fillers and additives such as silicas, calcium carbonate, talc, clay, etc., for many demanding applications. These low-density particles are used in a wide range of industries to reduce part weight, lower costs and enhance product properties.

The unique spherical shape of 3M glass bubbles offers a number of important benefits, including: higher filler loading, lower viscosity/improved flow and reduced shrinkage and warpage. It also helps the 3M glass bubbles blend readily into compounds and makes them adaptable to a variety of production processes including spraying, casting and molding.

The chemically stable soda-lime-borosilicate glass composition of 3M glass bubbles provides excellent water resistance to create more stable emulsions. They are also non-combustible and non-porous, so they do not absorb resin. And, their low alkalinity gives 3M glass bubbles compatibility with most resins, stable viscosity and long shelf life.

3M Glass Bubbles K Series, S Series and iM Series are specially formulated for a high strength-to-weight ratio. This allows greater survivability under many demanding processing conditions, such as injection molding. They also produce stable voids, which results in low thermal conductivity and a low dielectric constant. 3M glass bubbles are available in a variety of sizes and grades to help you meet your product and processing requirements.

Typical Properties

Not for specification purposes

Isostatic Crush Strength

	Product	Test Pressure (psi)	Target Fractional Survival	Minimum Fractional Survival
K Series	K1	250	90%	80%
	K15	300	90%	80%
	K20	500	90%	80%
	K25	750	90%	80%
	K37	3,000	90%	80%
	K46	6,000	90%	80%
S Series	S15	300	90%	80%
	S22	400	90%	80%
	S32	2,000	90%	80%
	S35	3,000	90%	80%
	S38	4,000	90%	80%
	S38HS	5,500	90%	80%
	S60	10,000	90%	80%
	S60HS	18,000	90%	90%
iM Series	iM16K	16,000	90%	90%
	iM30K	28,000	90%	90%

True Density

	Product	Typical	True Density (g/cc)	
			Minimum	Maximum
K Series	K1	0.125	0.10	0.14
	K15	0.15	0.13	0.17
	K20	0.20	0.18	0.22
	K25	0.25	0.23	0.27
	K37	0.37	0.34	0.40
	K46	0.46	0.43	0.49
S Series	S15	0.15	0.13	0.17
	S22	0.22	0.19	0.25
	S32	0.32	0.29	0.35
	S35	0.35	0.32	0.38
	S38	0.38	0.35	0.41
	S38HS	0.38	0.35	0.41
	S60	0.60	0.57	0.63
	S60HS	0.60	0.57	0.63
iM Series	iM16K	0.46	0.43	0.49
	iM30K	0.60	0.57	0.63

Typical Properties

Chemical Resistance

In general, the chemical properties of 3M™ Glass Bubbles resemble those of a soda-lime-borosilicate glass.

Thermal Conductivity

	Product	Calculated Thermal Conductivity (W-m-1-K-1) at 70°F (21°C)
K Series	K1	0.047
	K15	0.055
	K20	0.070
	K25	0.085
	K37	0.124
	K46	0.153
S Series	S15	0.055
	S22	0.076
	S32	0.108
	S35	0.117
	S38	0.127
	S38HS	0.127
	S60	0.200
	S60HS	0.200
iM Series	iM16K	0.153
	iM30K	0.200

Conductivity increases with temperature and product density. The thermal conductivity of a composite will depend on the matrix material and volume loading of 3M glass bubbles.

Thermal Stability

Appreciable changes in bubble properties may occur above 1112°F (600°C) depending on temperature and duration of exposure.

Flotation

	Product	Floaters (% by bulk volume)	
		Typical	Minimum
K Series	K1	96%	90%
	K15	96%	90%
	K20	96%	90%
	K25	96%	90%
	K37	94%	90%
	K46	92%	90%
S Series	S15	96%	90%
	S22	96%	90%
	S32	94%	90%
	S35	96%	90%
	S38	94%	90%
	S38HS	96%	90%
	S60	92%	90%
	S60HS	92%	90%
iM Series	iM16K	96%	90%
	iM30K	92%	90%

Packing Factor (Ratio of bulk density to true particle density)

Averages about 60%.

Oil Absorption

0.2–0.6 g oil/cc of 3M glass bubbles, per ASTM D281-84.

Volatile Content

Maximum of 0.5 percent by weight.

Alkalinity

Maximum of 0.5 milliequivalents per gram

pH

Because 3M glass bubbles are a dry powder, pH is not defined. The pH effect will be determined by the alkalinity as indicated above.

When 3M glass bubbles are mixed with deionized water at 5% volume loading, the resulting pH of the slurry is typically 9.1 to 9.9, as measured by a pH meter.

Dielectric Constant

K Series: 1.2 to 1.7 @ 100 MHz, based on theoretical calculations.

S Series: 1.2 to 2.0 @ 100 MHz, based on theoretical calculations.

iM Series: 1.2 to 1.7 @ 100 MHz, based on theoretical calculations

The dielectric constant of a composite will depend on the matrix material and volume loading of 3M glass bubbles.

Particle Size

		Particle Size (microns, by volume) 3M QCM 193.0			
	Product	Distribution			Effective Top Size
		10th%	50th%	90th%	
K Series	K1	30	65	115	120
	K15	30	60	105	115
	K20	30	60	90	105
	K25	25	55	90	105
	K37	20	45	80	85
	K46	15	40	70	80
S Series	S15	25	55	90	95
	S22	20	35	65	75
	S32	20	40	70	80
	S35	20	40	65	80
	S38	15	40	75	85
	S38HS	19	44	70	85
	S60	15	30	55	65
	S60HS	12	29	48	60
iM Series	iM16K	12	20	30	40
	iM30K	8.6	15.3	23.6	26.7

Particle Size (continued)

Hard Particles (3M QCM 93.4.3)

No hard particles (e.g. glass slag, flow agent, etc.) greater than U.S. number 40 (420 microns) standard sieve will exist.

Oversize Particles (3M QCM 93.4.4)

For *K1*, *K15*, *K20* and *K25* glass bubbles:

Using a 10 gram sample on a U.S. number 80 standard sieve (177 microns), a maximum of five (5) percent by weight glass bubbles will be retained on the sieve.

For *K37* and *K46* glass bubbles:

Using a 10 gram sample on U.S. number 100 standard sieve (149 microns), a maximum of one (1) percent by weight glass bubbles will be retained on the sieve.

For *S15*, *S32*, *S35*, *S38*, *S38HS*, *S60*, *S60HS*, *iM16K* and *iM30K* glass bubbles:

Using a 10 gram sample on a U.S. number 140 standard sieve (105 microns), a maximum of three (3) percent by weight glass bubbles will be retained on the sieve.

For *S22* glass bubbles:

Using a 10 gram sample on a U.S. number 200 standard sieve (74 microns), a maximum of five (5) percent by weight glass bubbles will be retained on the sieve.

Appearance (3M QCM 22.85)

White to the unaided eye.

Flow (3M QCM 22.83)

3M™ Glass Bubbles remain free flowing for at least one year from the date of shipment if stored in the original, unopened container in the minimum storage conditions of an unheated warehouse.

Labeling

3M glass bubbles will be packaged in suitable containers to help prevent damage during normal handling and shipping. Each container will be labeled with:

1. Name of manufacturer
2. Type of 3M glass bubbles
3. Lot number
4. Quantity in pounds

Storage and Handling

To help ensure ease of storage and handling while maintaining free flowing properties, 3M™ Glass Bubbles have been made from a chemically stable glass and are packaged in a heavy-duty polyethylene bag within a cardboard container.

Minimum storage conditions should be unopened cartons in an unheated warehouse.

Under high humidity conditions with an ambient temperature cycling over a wide range, moisture can be drawn into the bag as the temperature drops and the air contracts. The result may be moisture condensation within the bag. Extended exposure to these conditions may result in “caking” of the 3M glass bubbles to various degrees. To minimize the potential for “caking” and prolong the storage life, the following suggestions are made:

1. Carefully re-tie open bags after use.
2. If the polyethylene bag is punctured during shipping or handling, use this bag as soon as possible, patch the hole, or insert the contents into an undamaged bag.
3. During humid summer months, store in the driest, coolest space available.
4. If good storage conditions are unavailable, carry a minimum inventory, and process on a first in/first out basis.

Dusting problems that may occur while handling and processing can be minimized by the following procedures:

1. For eye protection wear chemical safety goggles. For respiratory system protection wear an appropriate NIOSH/MSHA approved respirator. (For additional information about personal protective equipment, refer to Material Safety Data Sheet.)
2. Use appropriate ventilation in the work area.
3. Pneumatic conveyor systems have been used successfully to transport 3M glass bubbles without dusting from shipping containers to batch mixing equipment. Static eliminators should be used to help prevent static charges.

Diaphragm pumps have been used to successfully convey 3M glass bubbles. Vendors should be consulted for specific recommendations.

3M glass bubble breakage may occur if the product is improperly processed. To minimize breakage, avoid high shear processes such as high speed Cowles Dissolvers, point contact shear such as gear pumps or 3-roll mills, and processing pressures above the strength test pressure for each product.

Health and Safety Information

For product Health and Safety Information, refer to product label and Material Safety Data Sheet (MSDS) before using product.

Packaging Information

Small Box (10 Cubic ft.)

A single corrugated box with a plastic liner. All boxes are banded together and to the wooden pallet. 4 boxes per pallet.

Each box inside diameter is 22 in. × 19 in. × 39 in.

Pallet size is 42 in. × 48 in.

Large Box (50 Cubic ft.)*

A single corrugated box with a plastic liner. Top enclosed with interlocking double cover banded. Bottom is normal box closure, entire box banded to wooden pallet.

Each box inside diameter is 48 in. × 42 in. × 44 in. Overall load size is 48³/₄ in. × 42³/₄ in. × 50 in. including pallet.

Pallet size is 42 in. × 48 in.

*S60 and S60HS large boxes are 38 cubic ft.

Resources

3M™ Glass Bubbles are supported by global sales, technical and customer service resources, with fully-staffed technical service laboratories in the U.S., Europe, Japan, Latin America and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

For additional technical information on 3M glass bubbles in the United States, call 3M Advanced Materials Division, **800-367-8905**. For other 3M global offices, and information on additional 3M products, visit our website at: **www.3M.com/engineeredadditives**.

Box Weights

	Product	Small Box	Large Box*	Truckload Large Box* 44 Pallets
K Series	K1	40 lb.	210 lb.	9,240 lb.
	K15	50 lb.	265 lb.	11,660 lb.
	K20	60 lb.	350 lb.	15,400 lb.
	K25	80 lb.	430 lb.	18,920 lb.
	K37	100 lb.	660 lb.	29,040 lb.
	K46	125 lb.	815 lb.	35,860 lb.
S Series	S15	50 lb.	265 lb.	11,660 lb.
	S22	60 lb.	385 lb.	16,940 lb.
	S32	100 lb.	525 lb.	23,100 lb.
	S35	100 lb.	630 lb.	27,720 lb.
	S38	100 lb.	680 lb.	29,920 lb.
	S38HS	100 lb.	680 lb.	29,920 lb.
	S60	125 lb.	850 lb.	37,400 lb.
	S60HS	125 lb.	850 lb.	37,400 lb.
iM Series	iM16K	99 lb.	800 lb.	—
	iM30K	125 lb.	850 lb.	37,400 lb.

*Box weights may vary due to manufacturing tolerances on each product.

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NYCON-PVA RECS15

PVA (Polyvinyl Alcohol), Small Denier, Superior Bond

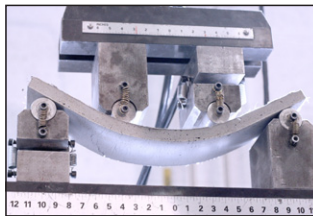


ULTRA-HIGH PERFORMANCE FIBERS

PVA fibers are unique in their ability to create a fully-engaged molecular bond with mortar and concrete that is **300% greater** than other fibers.

NYCON-PVA RECS15 Physical Properties

Filament Diameter	8 Denier (38 Microns)
Fiber Length	0.375" (8mm)
Specific Gravity	1.3
Tensile Strength	240 ksi (1600 MPa)
Flexural Strength	5700 ksi (40 GPa)
Melting Point	435° F (225° C)
Color	White
Water Absorption	<1% by Weight
Alkali Resistance	Excellent
Concrete Surface	Not Fuzzy
Corrosion Resistance	Excellent



Description

NYCON-PVA RECS15 fiber products are 8 denier, monofilament PVA fibers for use in fiber reinforced concrete, stucco and precast. NYCON-PVA RECS15 is specifically designed for use in concrete products for the purpose of controlling plastic shrinkage, thermal cracking and improving abrasion resistance. When NYCON-PVA RECS15 is used at high doses it can dramatically improve flexural characteristics of concrete products.

NYCON-PVA RECS15 meets the requirements of ASTM C-1116, Section 4.1.3 and AC-32 at 1.0 lb (0.45 kg) per CY.

Applications

NYCON-PVA utilizes the mixing activity to disperse the fibers into the mix. NYCON-PVA acts with a molecular bond in the concrete with a multi-dimensional fiber network. NYCON-PVA does not affect curing process chemically.

NYCON-PVA can be used in all types of concrete. Synthetic fibers help the concrete at early ages, which is especially beneficial where stripping time and handling is important.

800-456-9266

www.nycon.com

sales@nycon.com

NYCON-PVA RECS15

PVA (Polyvinyl Alcohol), Small Denier, Superior Bond



Advantages/Benefits

- Molecular bond with the concrete
- Reduces the formation of plastic shrinkage cracking in concrete.
- Provides multi-dimensional reinforcement.
- Improves impact, shatter and abrasion resistance of concrete.
- Enhances durability and toughness of concrete.
- Excellent, "no fuzz" finishability

Mixing

NYCON-PVA RECS15 can be added directly to the mixing system during or after the batching of the ingredients and mixed at high speed for a minimum of five minutes. Additional mixing does not adversely affect the distribution or overall performance of NYCON-PVA. The addition of NYCON-PVA at the normal or high dosage rate does not require any mix design or application changes. A water reducer or super-plasticizer is recommended in concrete products where improved workability and finishability are desired.

Tooling & Finishing

Fiber reinforced concrete can be finished by most finishing techniques. NYCON-PVA does not affect the finishing characteristics of concrete. NYCON-PVA can be used in power/hand troweled concrete, colored and broom finished concrete.

NYCON-PVA can be pumped and placed using conventional equipment. Hand screeds can be used, but vibratory and laser screeds are recommended to provide added compaction and bury surface fibers.

Packaging

(30) 1 lb (0.45 kg) paper beater bags per box, 600 lbs per pallet
(30) 1 lb (0.45 kg) Melt-Away® bags per box, 600 lbs per pallet
(21) 40 lb (18 kg) paper bulk bags, 840 lbs per pallet

NYCON-PVA Fibers are packaged in pre-measured 1 lb (0.45kg) degradable "toss-in" paper beater bags, Nycon Melt-Away® Bags or bulk bags.

Storage and Shelf Life

NYCON-PVA should be stored in dry warehouse. Protect product from the rain.

KEEP CONTAINER TIGHTLY CLOSED • KEEP OUT OF REACH OF CHILDREN • NOT FOR INTERNAL CONSUMPTION • FOR INDUSTRIAL USE ONLY

All information provided by Nycon Corporation concerning Nycon products, including but not limited to, any recommendations and advice relating to the application and use of Nycon products, is given in good faith based on Nycon's current experience and knowledge of its products when properly stored, handled and applied under normal conditions in accordance with Nycon's instructions. In practice, the differences in materials, substrates, storage and handling conditions, actual site conditions and other factors outside of Nycon's control are such that Nycon assumes no liability for the provision of such information, advice, recommendations or instructions related to its products, nor shall any legal relationship be created by or arise from the provision of such information, advice, recommendations or instructions related to its products. The user of the Nycon product(s) must test the product(s) for suitability for the intended application and purpose before proceeding with the full application of the product(s).

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Nycon warrants this product for one year from date of shipment to be free from manufacturing defects and to meet the technical properties on the current Product Data Sheet if used as directed within shelf life. User determines suitability of product for intended use and assumes all risks. Buyer's sole remedy shall be limited to the purchase price or replacement of product exclusive of labor or cost of labor.

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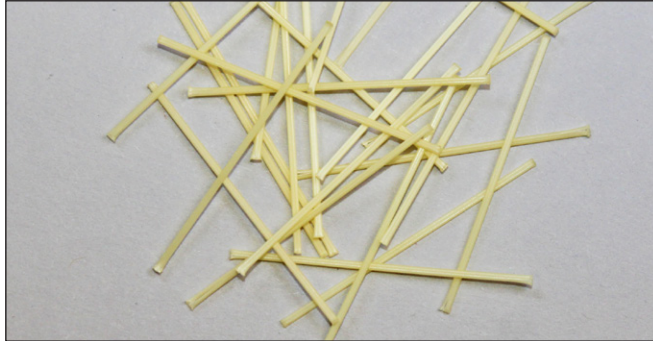
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NYCON-PVA RF4000

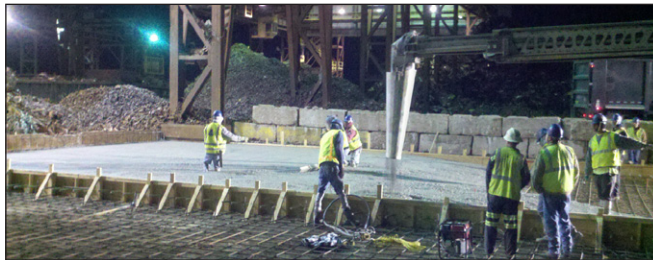
PVA (Polyvinyl Alcohol), Large Denier Macro, Superior Bond



ULTRA-HIGH PERFORMANCE FIBERS

PVA fibers are unique in their ability to create a fully-engaged molecular bond with mortar and concrete that is **300% greater** than other fibers.

Nycon-PVA RF4000 is a component of the Nycon TUFF-SLAB™ blend.



NYCON-PVA RF4000 Physical Properties

Filament Diameter	130 Denier (660 Microns)
Fiber Length	1.25" (30 mm)
Specific Gravity	1.3
Tensile Strength	120 ksi (800 MPa)
Flexural Strength	3300 ksi (23 GPa)
Melting Point	435° F (225° C)
Color	Yellow
Water Absorption	<1% by Weight
Alkali Resistance	Excellent
Concrete Surface	Not Fuzzy
Corrosion Resistance	Excellent



Description

NYCON-PVA RF4000 fiber products are 130 denier, monofilament PVA fibers for use in fiber reinforced concrete, shotcrete, TUFF-SLAB™ and precast. NYCON-PVA RF4000 is specifically designed for use in concrete products for the purpose of controlling plastic shrinkage, thermal cracking and improving abrasion resistance.

NYCON-PVA RF4000 meets the requirements of ASTM C-1116, Section 4.1.3 and AC-32 at 1.0 lb (0.45 kg) per CY.

Applications

NYCON-PVA utilizes the mixing activity to disperse the fibers into the mix. NYCON-PVA acts with a molecular bond in the concrete with a multi-dimensional fiber network. NYCON-PVA does not affect curing process chemically.

NYCON-PVA can be used in all types of concrete. NYCON-PVA RF4000 at 6 lb (2.7 kg) per CY is the macro fiber and NYCON-PVA RSC15 at 3 lbs (1.35 kg) per CY is the micro fiber used together in Nycon's TUFF-SLAB™ product.

800-456-9266

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NYCON-PVA RF4000

PVA (Polyvinyl Alcohol), Large Denier Macro, Superior Bond



Advantages/Benefits

- Molecular bond with the concrete
- Reduces the formation of plastic shrinkage cracking in concrete.
- Provides multi-dimensional reinforcement.
- Improves impact, shatter and abrasion resistance of concrete.
- Enhances durability and toughness of concrete.
- Excellent, "no fuzz" finishability

Mixing

NYCON-PVA RF4000 can be added directly to the mixing system during or after the batching of the ingredients and mixed at high speed for a minimum of five minutes. Additional mixing does not adversely affect the distribution or overall performance of NYCON-PVA. The addition of NYCON-PVA at the normal or high dosage rate does not require any mix design or application changes. A water reducer or super-plasticizer is recommended in concrete products where improved workability and finishability are desired.

Tooling & Finishing

Fiber reinforced concrete can be finished by most finishing techniques. NYCON-PVA does not affect the finishing characteristics of concrete. NYCON-PVA can be used in power/hand troweled concrete, colored and broom finished concrete.

NYCON-PVA can be pumped and placed using conventional equipment. Hand screeds can be used, but vibratory and laser screeds are recommended to provide added compaction and bury surface fibers.

Packaging

(30) 1 lb (0.45 kg) paper beater bags per box, 600 lbs per pallet
(30) 1 lb (0.45 kg) Melt-Away® bags per box, 600 lbs per pallet
(21) 22 lb (10 kg) paper bulk bags, 462 lbs per pallet

Storage and Shelf Life

NYCON products should be stored in dry warehouse. Protect product from the rain.

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XYCRYLIC ADMIX

03900 | PATCHING & RESURFACING

Concrete Restoration

Description

XYCRYLIC ADMIX is a water-based, high solids, polymer dispersion specifically designed for fortifying Portland cement compositions. This liquid is milky-white in color and improves curing qualities, enhances bond, imparts excellent water and weather resistance, and reduces shrinkage cracking. Xycrylic Admix is also used to fortify Xypex Patch'n Plug.

Recommended for:

- Patching and Concrete Repairs
- Resurfacing Floor Underlayments
- Terrazzo Flooring
- Spray and Fill Coats
- Highway and Bridge Deck Repair

Advantages

- Hardens and toughens cement mortars for improved durability
- Enhances adhesion capabilities to a wide variety of surfaces
- Increases resistance to many industrial chemicals
- Eliminates water curing

Durability and Strength

Cement mortars modified with Xycrylic Admix are hard, tough and durable. Compared with unmodified mortars, Xycrylic modified mortars have far superior flexural, adhesive and impact strengths as well as excellent abrasion resistance. They are especially useful where thin sections are desirable and where excessive vibration and heavy traffic is encountered.

Adhesion

Xycrylic Admix modified mortars have excellent adhesion to a variety of surfaces such as concrete, masonry, brick, wood, metals and others.

Resistance Properties

Cement mortars modified with Xycrylic Admix are resistant to many industrial chemicals as well as ultraviolet light and heat. Mortars containing Xycrylic Admix dry to a uniform color.

Packaging

Xycrylic Admix is available in 1 U.S. gallon (3.79 litre) bottles and 5 U.S. gallon (18.95 litre) pails.

Storage

Keep Xycrylic Admix from freezing.

Mixing

Xycrylic Admix may be used full strength or diluted with clean water depending on application requirements.

Test Data

Physical Strength of Cement Mortars					
ASTM Standard Test Method	Mixing Liquid				
	Full Strength	1:1 Water	1:2 Water	No Xycrylic	
C-190-85 Tensile Strength	610 4.2	440 3.0	375 2.6	235 1.6	psi MPa
C-109-88 Compressive Strength	5700 39.3	4530 31.2	3830 26.4	2390 16.5	psi MPa
C-348-86 Flexural Strength	1570 10.8	1130 7.8	960 6.6	610 4.2	psi MPa
Shear Bond Adhesion	640 4.4	360 2.5	260 1.8	45 0.31	psi MPa

NOTE 1: Strength properties are based on cement mortar prepared as 3 parts sand to 1 part cement by volume.

NOTE 2: Strengths are based on a 28 day air-cure. Wet cure strengths may be less.

Application Procedures

Xycrylic Admix may be used full strength or diluted with clean water depending on application requirements.

For Use With Cement Mortar

1. Thoroughly premix sand and cement (1 part cement to 2 parts sand).
2. Blend Xycrylic Admix with water according to strength, bonding and resistance requirements.
3. Add the Xycrylic mixing liquid (whether full strength or diluted with water) to the sand and cement.

4. Mix thoroughly until desired workable consistency is reached. Always withhold some Xycrylic mixing liquid so that the mortar will not be too fluid and so that mixing liquid can be carefully gauged near end of mixing cycle (2 - 4 minutes).

For Use With Patch'n Plug

1. Blend Xycrylic Admix with clean water (1 part Xycrylic to 1 part water by volume).
2. Add Xycrylic mixing liquid to the Patch'n Plug powder at a rate of 1 part liquid to 3.5 parts Patch'n Plug.
3. Mix to a stiff putty consistency. Do not mix more than can be used in three minutes.

Curing

For optimum physical properties, cement mortars modified with Xycrylic Admix should be air-cured at ambient temperature and relative humidity.

Technical Services

For more instructions, alternative application methods, or information concerning the compatibility of the Xypex treatment with other products or technologies, contact the Technical Services Department of Xypex Chemical Corporation or your local Xypex representative.

Safe Handling Information

Xycrylic Admix is alkaline and has a slight ammoniacal odor. This product may be a mild to moderate skin and eye irritant. In addition, many of the components of the cementitious products that are used in conjunction with the Xycrylic Admix may also possess significant skin and eye irritation potential. Directions for treating these problems are clearly detailed on all Xypex pails and packaging. The Manufacturer also maintains comprehensive and up-to-date Material Safety Data Sheets on all its products. Each sheet contains health and safety information for the protection of workers and customers. The Manufacturer recommends you contact Xypex Chemical Corporation or your local Xypex representative to obtain copies of Material Safety Data Sheets prior to product storage or use.

Warranty

The Manufacturer warrants that the products manufactured by it shall be free from material defects and will be consistent with its normal high quality. Should any of the products be proven defective, the liability to the Manufacturer shall be limited to replacement of the product

ex factory. The Manufacturer makes no warranty as to merchantability or fitness for a particular purpose and this warranty is in lieu of all other warranties expressed or implied. The user shall determine the suitability of the product for his intended use and assume all risks and liability in connection therewith.



13731 Mayfield Place, Richmond, BC, Canada V6V 2G9 Toll-free: 1.800.961.4477
Tel: 604.273.5265 Fax: 604.270.0451 E-mail: info@xypex.com Web: www.xypex.com
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February 11, 2016

Michigan Technological University
Civil Engineering
Concrete Canoe Senior Captain
ASCE | SPE

Attention: Philip A. Doederlein

Subject: Xypex Xycrylic Admixture in Regards to ASTM C1438

Dear Philip,

In regards to your request for information regarding Xypex Xycrylic Admixtures status in regards to the ASTM C1438 Standard Specification for Latex and Powder Polymer Modifiers in Hydraulic Cement Concrete and Mortar I comment as follows.

Xypex Xycrylic Admixture is a high solids liquid latex polymer admixture that is utilized as a polymer modifier for Portland cement systems. Xypex has utilized this material for several years in several of its products and thus Xypex is familiar with Xycrylic's performance characteristics. Given the above and our review of the ASTM C1438 test regime and requirements it is Xypex's expectation and opinion that Xypex Xycrylic would pass the C1438 test regime if the testing were to be done.

I trust that this satisfies your questions and concerns in this matter.

Please let me know if I can be of further help.

Best regards,

XYPEX CHEMICAL CORPORATION



Jim Caruth, P.Eng.
Technical Services Manager

Description

Glenium 3030 NS ready-to-use full-range water-reducing admixture is a patented new generation of admixture based on polycarboxylate chemistry. Glenium 3030 NS admixture is very effective in producing concretes with different levels of workability including applications that require the use of Rheodynamic® Self-Consolidating Concrete (SCC). Glenium 3030 NS admixture meets ASTM C 494/C 494M requirements for Type A, water-reducing, and Type F, high-range water-reducing, admixtures.

Applications

Recommended for use in:

- Concrete where high flowability, high-early and ultimate strengths and increased durability are needed
- Self-consolidating concrete
- Concrete where normal, mid-range, or high-range water-reduction is desired
- Concrete where normal setting times are required
- 4x4™ Concrete for fast track construction
- Pervious Concrete
- Self-consolidating grout

GLENIUM® 3030 NS

Full-Range Water-Reducing Admixture

Features

- Reduced water content for a given slump
- Dosage flexibility for normal, mid and high-range water reduction
- Produces cohesive and non-segregating concrete mixture
- Increased compressive strength and flexural strength performance at all ages
- Providing faster setting times and strength development
- Enhanced finishability and pumpability

Benefits

- Providing economic benefits to the entire construction team through higher productivity and reduced variable costs

Performance Characteristics

Mixture Data: 600 lb/yd³ of Type I cement (360 kg/m³); slump, 8.5-9.25 in. (210-235 mm); non-air-entrained concrete; dosage rate adjusted to obtain 25-30% water reduction.

Setting Time

Mixture	Initial Set (h:min)	Difference (h:min)
Plain	4:24	–
Conventional Superplasticizer	6:00	+ 1.36
Glenium 3030 NS admixture	5:00	+0.36

Compressive Strength

Mixture	1 day		7 days	
	psi	MPa	psi	MPa
Plain	1700	12	4040	28
Conventional Superplasticizer	3460	24	6380	44
Glenium 3030 NS admixture	4120	28	7580	52

Slump Retention - in. (mm)

Mixture	Minutes		
	15	30	45
Plain	8.5 (215)	8.5 (215)	7.5 (200)
Conventional Superplasticizer	8.5 (215)	4.25 (110)	3.5 (90)
Glenium 3030 NS admixture	9.25 (235)	9.25 (235)	8.25 (210)

Product Data: GLENIUM® 3030 NS

Rate of Hardening: Glenium 3030 NS admixture is formulated to produce normal setting characteristics throughout its recommended dosage range. Setting time of concrete is influenced by the chemical and physical composition of the basic ingredients of the concrete, temperature of the concrete and ambient conditions. Trial mixtures should be made with actual job materials to determine the dosage required for a specified setting time and a given strength requirement.

Guidelines for Use

Dosage: Glenium 3030 NS admixture has a recommended dosage range of up to 3 fl oz/cwt (195 mL/100 kg) for Type A applications, 3-6 fl oz/cwt (195-390 mL/100 kg) for mid-range use and up to 18 fl oz/cwt (1,170 mL/100 kg) for Type F applications. The dosage range is applicable to most concrete mixtures using typical concrete ingredients. However, variations in job conditions and concrete materials, such as silica fume, may require dosages outside the recommended range. In such cases, contact your local BASF Construction Chemicals representative.

Mixing: Glenium 3030 NS admixture can be batched with the initial mixing water or as a delayed addition. However, optimum water reduction is generally obtained with a delayed addition.

Product Notes

Corrosivity – Non-Chloride, Non-Corrosive: Glenium 3030 NS admixture will neither initiate nor promote corrosion of reinforcing steel embedded in concrete, prestressed concrete or of galvanized steel floor and roof systems. Neither calcium chloride nor other chloride-based ingredients are used in the manufacture of Glenium 3030 NS admixture.

Compatibility: Glenium 3030 NS admixture is compatible with most admixtures used in the production of quality concrete, including normal, mid-range and high-range water-reducing admixtures, air-entrainers, accelerators, retarders, extended set control admixtures, corrosion inhibitors, and shrinkage reducers.

Do not use Glenium 3030 NS admixture with admixtures containing beta-naphthalene-sulfonate. Erratic behaviors in slump, slump flow, and pumpability may be experienced.

For directions on the proper evaluation of Glenium 3030 NS admixture in specific applications, contact your BASF Construction Chemicals representative.

Storage and Handling

Storage Temperature: If Glenium 3030 NS admixture freezes, thaw at 45 °F (7 °C) or above and completely reconstitute by mild mechanical agitation. **Do not use pressurized air for agitation.**

Shelf Life: Glenium 3030 NS admixture has a minimum shelf life of 12 months. Depending on storage conditions, the shelf life may be greater than stated. Please contact your BASF Construction Chemicals representative regarding suitability for use and dosage recommendations if the shelf life of Glenium 3030 NS admixture has been exceeded.

Packaging

Glenium 3030 NS admixture is supplied in 55 gal (208 L) drums, 275 gal (1040 L) totes and by bulk delivery.

Related Documents

Material Safety Data Sheets: Glenium 3030 NS admixture.

Additional Information

For additional information on Glenium 3030 NS admixture or its use in developing concrete mixes with special performance characteristics, contact your BASF Construction Chemicals representative.

The Admixture Systems business of BASF Construction Chemicals is a leading provider of innovative admixtures for specialty concrete used in the ready-mixed, precast, manufactured concrete products, underground construction and paving markets throughout the North American region. The Company's respected Master Builders brand products are used to improve the placing, pumping, finishing, appearance and performance characteristics of concrete.

BASF Construction Chemicals
Admixture Systems

www.masterbuilders.com

United States 23700 Chagrin Boulevard, Cleveland, Ohio 44122-5544 • Tel: 800 628-9990 • Fax: 216 839-8821
Canada 1800 Clark Boulevard, Brampton, Ontario L6T 4M7 • Tel: 800 387-5862 • Fax: 905 792-0651

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**Master
Builders**

Basalt Volcanic Composites

Features & Benefits

What are Basalt Fibers?

They are **Pultruded** fibers made from volcanic rock melted in high heat furnaces. Pultrusion is a manufacturing process for producing continuous lengths of FRP (fiber reinforced polymer) structural shapes. Raw materials include a liquid resin mixture (containing resin, fillers and specialized additives) and reinforcing fibers. The process involves pulling these raw materials (rather than pushing as is the case in extrusion) through a heated forming die using a continuous pulling device.

Basalt FRP is a Composite Rebar (BCR)

Basalt rebar is made as a continuous spiral formed by winding fibers into a highly durable compound. These fibers form a strong composite offering a wide range of applications for construction. Basalt rebars are resistant to corrosion and aggressive chemical liquids and are extremely light (4 times lighter than steel), producing considerably longer life expectancy in construction.

The Main Uses of Basalt Products are

Textile applications for fire protection :

Basalt does not melt nor shrink in flame and when not mechanically stressed, keeps its geometric integrity.

Basalt is exceptionally suited to block fire. Basalt products resist open flame. A fabric made of Basalt, with a Bunsen burner pointed at it (1100 - 1200°C) becomes red hot as a metal fabric would. This can last for hours. For reference, an E-glass fabric of the same surface density gets pierced by the same flame in a matter of seconds.

High Temperature Insulation (HTI) :

Basalt fibers, at present, exhibit a resistance to temperature superior to E glass fibers in the range -260° to +560°C. A perfect high temperature insulation material chopped Basalt fibers and non-woven Basalt needled mats find their place in the construction of auto and motorcycle exhaust mufflers and ovens. They are also used as the heat insulation of gas turbines, including nuclear plant locations, as basalt is known to resist degradation caused by radiation, unlike synthesized materials such as glasses. Basalt is also functional to very low temperatures (down to - 260°C). Other useful applications are insulation of liquid nitrogen tanks and pipes, and cryogenics.

continued on page 2 >>



Top Ten Reasons to use Basalt Fibers

1. Stronger than fiberglass in tensile strength
2. Non-respirable, inert and safe to work with
3. 18% better elastic modulus
4. UV immune
5. Non-conductive
6. Will not harbor bacterial or microbial growth
7. Better impact resistance, does not shatter like carbon fibers
8. Ten times better electrical insulator than fiberglass
9. Very resistant to aggressive liquids, acids and alkalies
10. Has great sound attenuation properties

Oh yes! There are more reasons...cont. pg 4 >>

The Main Uses of Basalt Products *continued*

As reinforcement in composite materials :

The great mechanical properties of Basalt (strength & rigidity), easy wetting of the filament surface and recyclability make them particularly suitable for composites applications.

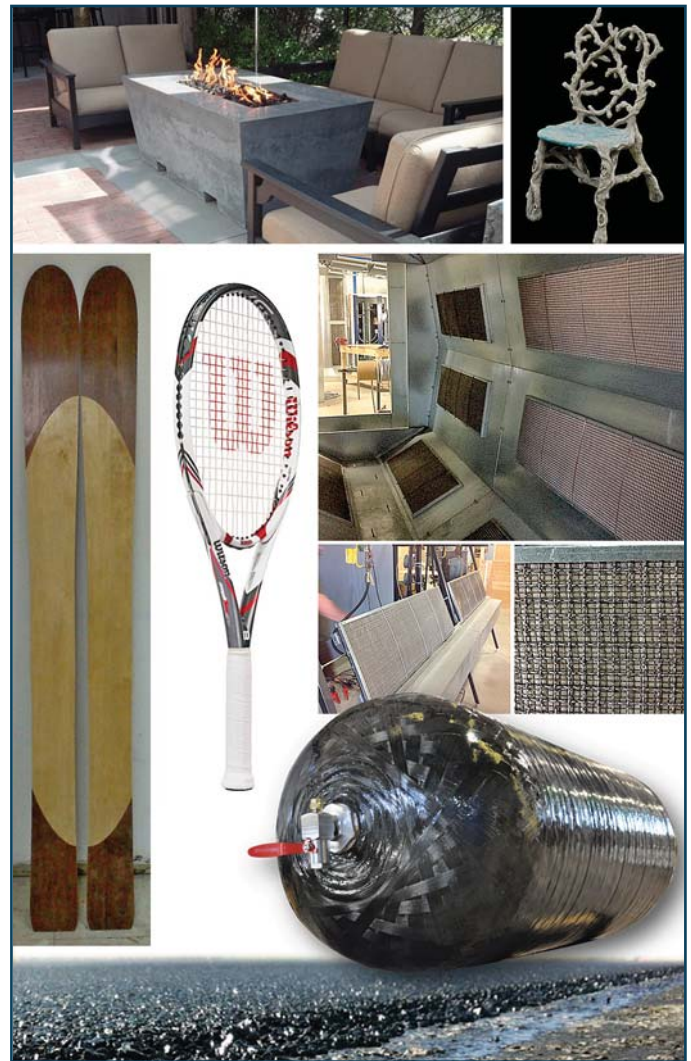
UV resistance, better acid resistance, better alkaline resistance and very low water absorption of Basalt fibers ensure excellent weatherability for outdoor Basalt fiber reinforced composites.

Higher thermal insulation and equally high electrical resistivity of Basalt fibers also allow making reinforced composites with good dielectric properties and better heat diffusion. Basalt is ten times better electrical insulator than fiberglass.

Basalt fiber reinforced injection molded parts have a better surface finish. This allows direct utility as an automotive interior decorative component.

Basalt continuous fibers have a melting temperature higher than that of the flame, which allows separation of the composite constitutions by fire at the recycling stage (e.g. in automotive industry). There is no disposal issue at the recycling stage after separation, being a natural product.

*For more Basalt Product Uses
go to www.basalt.guru*



NEW! – Bio-Mid & Basalt Fabric

Smarter Building Systems is proud to announce the next generation of fibers made from renewable materials using Basalt fibers and a cellulose fiber Bio-Mid, made from certified sustainable wood. Bio-Mid and Basalt volcanic rock fibers are compatible with most common resin systems.

These fibers have unique advantages to traditional natural fibers – they offer the same lightweight and sustainable advantages, but with a substantial increase in thermal resistance, fiber uniformity, and fiber alignment. Results are a much higher in-plane loading and higher fiber content in laminates.

Breaking strengths are higher than most E-glass yarns of similar weight. 100% renewable content.

Cellulose is the world's most abundant renewable material, and basalt mines contain many millions of cubic yards of volcanic rock.

No fertilizers, pesticides or extraordinary irrigation are required to produce these fibers. They do not compete or displace lands suitable for food crops. All this makes for a much lower carbon footprint in stark contrast to traditional natural or man-made synthetic or petroleum based fibers that often generate thousands of tons of CO₂ due to post harvesting and mining processes.

Manufacturing with a conscience, with technology that can create superior performance, while remaining earth-friendly.

Fabrics are available in standard 40-inch (1 meter) widths and can be supplied in other widths ranging from 30-80 inches (76 cm up to 2 meters). Combined as a unique hybrid, the Bio-Mid/Basalt fibers are particularly useful as the different properties are advantageous.

*Phone (401) 481 8422 or email Nick
today for more Information.*

Selection of Basalt Products



BASALT PRODUCTS: Weaves, Weights, Dimensions, etc.

UNI-DIRECTIONAL FABRIC

Plain: 200 grams/m²; 300 grams/m²; 13 micron roving

Black: 200 grams/m²; Black 13 micron roving

MULTI-DIRECTIONAL FABRIC

Bi-Axial: 450 grams/m²; fiber angles +45°, - 45°; 13 micron roving.

Bi-Axial: 450 grams/m²; fiber angles 0°, 90°; 13 micron roving.

Bi-Axial: 650 grams/m²; fiber angles 0°, 90°; 13 micron roving.

Tri-Axial: 980 grams/m²; fiber angles 0°, +45°, - 45°; 13 micron roving.

Quad-Axial: 680 grams/m²; fiber angles 0°, 90°, +45°, -45°; 13 micron roving.

PLAIN WEAVE FABRIC

15x15: 108 grams/m²; 9 micron fibers. 65 grams/m²; 13 micron fibers.

180 grams/m²; 13 micron fibers. 200 grams/m²; 9 micron fibers.

7.2x7.2 : 220 grams/m²; 19 micron fibers.

5x5: 325 grams/m². 11 micron fibers.

5x3.5: 400 grams/m²; 11 micron fibers.

5x3: 650 grams/m²; 13 micron fibers.

TWILL WEAVE FABRIC

8x7: 200 grams/m². 9 micron fibers.

5x5: 350 grams/m². 13 micron fibers.

6x6: 900 grams/m². 13 micron fibers.

SATIN WEAVE FABRIC: 220 grams/m². 300 grams/m². 9 micron fibers.

COATED FABRIC: Aluminum Coated one side – 200 grams/m².

220 grams/m². 650 grams/m².

SURFACE VEIL (WET-LAID NON-WOVENS): 30 grams/m². 40 grams/m².

WOVEN TAPE: 25mm. 50mm. 75mm. 100mm. 135mm.

Heavy weight 25mm x 2mm thick.

TWILL WOVEN TAPE: 50mm. Plain or Aluminum coated one side

BI-AXIAL BRAIDED SLEEVING: Diameter 5 cm. 7 cm. 10 cm. 15 cm.

CHOPPED STRAND MAT: 200 grams/m². 350 grams/m².

CHOPPED FIBER: Length 3mm. 6mm. 9mm. 12mm. 18mm. 24mm.

30mm. 36mm. 50mm. 63mm. 90mm.

CONTINUOUS ROVING: 9 micron/136 tex. 13 micron/800 tex.

13 micron/1200 tex. 16 micron/2400 tex. 16 micron/4800 tex.

3-PLY ROPE: 3 plies of 6400 tex 16 micron roving, total tex 19,200

GUN ROVING: 15 micron/2400 tex

REBAR: Diameter 4mm. 6mm. 8mm. 10mm. 12mm. 25mm.

MESH: Plain or Resin Coated. Window size 5mm x 5mm. 10mm x 10mm.

25mm x 25mm. 50mm x 50mm.

NEEDLE FELT MAT: Thickness 6mm. 8mm. 12mm. 25mm.

RIGID BOARD: Thickness 6mm. 12mm. 18mm.

More Reasons to use Basalt Fibers!

- Much higher heat and extreme cold – cryogenics are made with basalt and so are fire curtains
- Much better pricing than S-glass, Kevlar and carbon fiber
- A beautiful golden color
- Supple – many weights and weaves available. Plain, satin, coated.
- Many times lighter than steel and yet 2-3 times stronger than steel
- Will not corrode
- Does not interfere with RF signals
- Ballistic impact properties
- Made from rock the concrete basalt products expand and contract at the same rate unlike others
- Great for making tool molds as basalt takes heat and does not conduct and does not move
- Basalt sleeves with no seams come in many sizes – used as spark plug covers for example
- Basalt boards with a fire retardant resin are a perfect backer with fire and insulation properties
- Basalt twine rope acts like a flexible rebar – a ten pound box of over a thousand feet!

Industries Currently Testing Basalt

Cryogenics
Prosthetics
Filament Winding
Thermoplastics
Mold (Tool) Making
Asphalt
Ballistics
Bridge Wraps
Manholes

What Application do you have that needs Better Performance at a Better Price?

Comparative Technical Characteristics of Filament Made from E-Glass, Basalt and Silica

Properties	SI Units	Basalt Filaments	Fiberglass	Silica Filament
Thermal				
Maximum application temperature	(°C)	650°	600°	1100°
Sustained operating temperature	(°C)	600°	480°	1000°
Minimum operating temperature	(°C)	-260°	-60°	-170°
Thermal conductivity	(W/m K)	0.031-0.038	0.034-0.04	0.035-0.04
Melting temperature	(°C)	1450°	1120°	1550°
Vitrification conductivity	(°C)	1050°	600°	1300°-1670°
Glow loss	(%)	1.91	0.32	1.75
Thermal expansion coefficient	(ppm/ °C)	8.0°	5.4°	0.05°
Physical/Mechanical				
Density	(g/cm3)	2.75	2.6	2.15
Filament diameter	(microns)	9-23	9-13	9-15
Tensile strength	(M Pa)	4840	3450	4750
Compression	(psi)	550,000	440,000	510,000
Elastic modulus	(G Pa)	89	77	66
Linear expansion coefficient	(x10 /K)	5.5	5	0.5
Elongation at break	(%)	3.15	4.7	1.2
Absorption of humidity (65%RAH)	(%)	<0.1	<0.1	<0.1
Stability at tension (20 C°)	(%)	100	100	100
Stability at tension (200 C°)	(%)	95	92	94
Stability at tension (400 C°)	(%)	82	52	80
Acoustics				
Sound absorption coefficient	(%)	0.9-0.99	0.8-0.93	0.85-0.95
Electrical				
Specific volume resistance	(ohm.m)	1*10×12	1*10×11	1*10×11
Loss angle tangent frequency	(1 MHz)	0.005	0.0047	0.0049
Relative dielectric permeability	(1 MHz)	2.2	2.3	2.3
Chemical Resistance				
% weight loss after 3 hrs boiling in:				
H2O	(%)	0.2	0.7	0.05
2n NaOH (Sodium Hydroxide)	(%)	5.0	6.0	5.0
2n HCl (Hydrochloric acid)	(%)	2.2	38.9	15.7
Price Comparison		\$	\$	\$\$\$\$

Basalt Sample Packs Order Online

A wide assortment of our products are available in **Sample Packages** to allow you a chance to physically feel and see them before deciding on future purchases. Order online at www.smarter-building-systems.com/basalt-sample-packs/.

We can also put together **Custom Sample Packs**.
Phone (401) 481 8422 or email Nick today
for more Information and Technical Data.

Basalt Woven Fabric can be supplied with the following coating on one or both sides

COATING TYPE	PURPOSE
Thermoblocker	Intumescent barrier
Flock	Skin contact barrier
Silicon	Splatter protection
Acrylic	Splatter protection
PUR or EVA	Fatigue resistance



Dow Building Solutions

Manufacturer's Insulation Fact Sheet

Extruded Polystyrene Foam Home Insulation Products

This fact sheet contains important information about STYROFOAM™ brand insulation, BLUECOR™ brand Underlayment and DOW High Performance Underlayment insulation. These products, available from Dow Building Solutions, are made of extruded polystyrene foam insulation and are clearly identified by the DOW Diamond Logo.

Aged R-Value (Measured at 75° Mean Temperature)

Product Thickness (nominal inches)	0.38	1/4	3/8	1/2	0.55	5/8	3/4	0.78	1	1 1/2	2	2 1/2	3
STYROFOAM™ Brand Square Edge Insulation	–	–	–	–	2.8*	–	3.8	4.0*	5.0	7.5	10.0	–	–
STYROFOAM™ Brand Tongue & Groove Insulation	–	–	–	–	–	–	3.8	–	5.0	7.5	10.0	–	–
STYROFOAM™ Brand Residential Sheathing	–	–	–	3.0	–	–	4.0	–	5.0	–	–	–	–
STYROFOAM™ Brand Residing Board	–	–	–	2.8	–	–	–	–	–	–	–	–	–
STYROFOAM™ UTILITYFIT™ PSI 15	–	–	–	–	–	–	–	–	5.0	7.5	10.0	–	–
STYROFOAM™ DURAMATE™ Plus Brand Insulation	2.0	–	–	3.0	–	–	–	–	–	–	–	–	–
STYROFOAM™ WALLMATE™ Brand Insulation	–	–	–	–	–	–	–	–	–	7.5	10.0	–	–
STYROFOAM™ PERIMATE™ Brand Insulation	–	–	–	–	–	–	–	–	–	7.0	10.0 ¹	–	–
STYROFOAM™ STUCCOMATE™ Brand Insulation	–	–	–	–	–	–	–	–	5.0	–	–	–	–
STYROFOAM™ Scoreboard Brand Insulation	–	–	–	–	–	–	3.8	–	5.0	7.5	10.0	12.5	15
STYROFOAM™ BLUEGUARD™ Brand Insulation	–	–	–	–	–	–	–	–	5.0	7.5	10.0	–	–
BLUECOR™ Brand Underlayment	–	1.0	–	–	–	–	–	–	–	–	–	–	–
DOW™ High Performance Underlayment	–	1.0	1.5	–	–	–	–	–	–	–	–	–	–

¹ Nominal 2" thickness. * Available in Florida only

Board Coverage Area

Standard Size (feet) sizes vary by product	2 x 8	4 x 8	4 x 9	4 x 50
Coverage per board (sq. ft.)	16	32	36	200

READ THIS BEFORE YOU BUY

The chart shows the R-value of this insulation. R means resistance to heat flow. The higher the R-value, the greater the insulating power. Compare insulation R-values before you buy.

There are other factors to consider. The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you'll save on fuel.

To get the marked R-value, it is essential that this insulation be installed properly.

NOTICE: No freedom from any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. Dow assumes no obligation or liability for the information in this document. NO WARRANTIES ARE GIVEN; EXCEPT FOR LIMITED PERFORMANCE WARRANTIES SPECIFICALLY PROVIDED BY DOW. ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

NOTICE: Changes to the International Residential Code require the installation of a weather-resistive barrier (WRB) within most exterior wall assemblies in residential construction. The following Dow insulated sheathing products qualify as a WRB when installed according to the installation instructions developed for "installation of foam sheathing as a weather-resistive barrier": STYROFOAM™ DURAMATE™ Brand Plus, STYROFOAM™ Brand Residential Sheathing, STYROFOAM™ Brand Tongue and Groove, STYROFOAM™ Brand Square Edge, STYROFOAM™ Brand Residing Board, DOW™ High Performance Underlayment, THERMAX™ Sheathing, TUFF-R™ and Super TUFF-R™ and therefore do not require the use of a building paper or a housewrap as a WRB. When a WRB is not needed, these Dow foam sheathings may be installed according to standard installation instructions for foam sheathing from Dow. Be sure products and installation instructions meet code requirements for your particular location. Note: WEATHERMATE™ and WEATHERMATE™ Plus housewraps have already qualified as weather-resistive alternatives to the prescribed felt (see Evaluation Reports NER-593 and NER-640 for approved alternative).

COMBUSTIBLE: Protect from high heat sources. Local building codes may require a protective or thermal barrier. For more information, consult MSDS, call Dow at 1-866-583-BLUE (2583) or contact your local building inspector. In an emergency, call 1-989-636-4400.

Building and/or construction practices unrelated to building materials could greatly affect moisture and the potential for mold formation. No material supplier including Dow can give assurance that mold will not develop in any specific system.

a proud partner of



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Dow Building Solutions

Manufacturer's Insulation Fact Sheet

Polyisocyanurate Foam Home Insulation Products

This fact sheet contains important information about DOW Polyisocyanurate insulation. These products, available from Dow Building Solutions, are clearly identified by the DOW Diamond Logo.

Product R-Value

Product Thickness (nominal inches)	0.38	0.5	0.59	0.625	0.75	1.0	1.25	1.5	1.55	1.75	2.0
THERMAX™ Sheathing	–	3.3	–	–	5.0	6.5	–	9.8	10.1	–	13.0
Reflective system R-Value with 3/4" vertical air space	–	6.1	–	6.9	7.8	9.3	–	12.6	–	–	15.8
THERMAX™ White Finish	–	3.3	–	–	5.0	6.5	–	9.8	10.1 [†]	–	13.0
TUFF-R™	–	3.3	–	4.1 ^{††}	5.0	6.5	–	9.8	–	–	–
Reflective system R-Value with 3/4" vertical air space	–	6.1	–	6.9	7.8	9.3	–	12.6	–	–	–
TUFF-R™ C	–	–	–	–	–	–	–	9.8	–	–	13.0
Reflective system R-Value with 3/4" vertical air space	–	–	–	–	–	–	–	12.6 ^{†††}	–	–	15.8
Super TUFF-R™	2.0	3.3	–	4.1 ^{††}	5.0	6.5	–	9.8	–	–	–
STURDY-R™	–	2.5	3.0	–	4.0	5.0	–	–	–	–	–
QUIK-R™	–	–	3.0	–	4.0	5.0	–	–	–	–	–

[†] Only 1.55" THERMAX™ White Finish standard offering. All other sizes available under non-standard business rules.

^{††} Available under non-standard business rules.

^{†††} Reflective System R-value is the sum of the product R-value plus additional R-value calculated when the aluminum foil surface is installed next to a non-ventilated 3/4" air space (R-value = 2.8). All values from the ASHRAE Fundamentals Handbook.

Board Coverage Area

Standard Size (feet) sizes vary by product	4x8	4x9	4x10	4x12
Coverage per board (sq. ft.)	32	36	40	48

READ THIS BEFORE YOU BUY

The chart shows the R-value of this insulation. R means resistance to heat flow. The higher the R-value, the greater the insulating power. Compare insulation R-values before you buy.

There are other factors to consider. The amount of insulation you need depends mainly on the climate you live in. Also, your fuel savings from insulation will depend upon the climate, the type and size of your house, amount of insulation already in your house, and your fuel use patterns and family size. If you buy too much insulation, it will cost you more than what you'll save on fuel.

To get the marked R-value, it is essential that this insulation be installed properly.

NOTICE: No freedom from any patent owned by Dow or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other government enactments. Dow assumes no obligation or liability for the information in this document. NO WARRANTIES ARE GIVEN; EXCEPT FOR LIMITED PERFORMANCE WARRANTIES SPECIFICALLY PROVIDED BY DOW. ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

NOTICE: Changes to the International Residential Code require the installation of a weather-resistive barrier (WRB) within most exterior wall assemblies in residential construction. The following Dow insulated sheathing products qualify as a WRB when installed according to the installation instructions developed for "installation of foam sheathing as a weather-resistive barrier": STYROFOAM™ DURAMATE™ Brand Plus, STYROFOAM™ Brand Residential Sheathing, STYROFOAM™ Brand Tongue and Groove, STYROFOAM™ Brand Square Edge, STYROFOAM™ Brand Residing Board, DOW™ High Performance Underlayment, THERMAX™ Sheathing, TUFF-R™ and Super TUFF-R™ and therefore do not require the use of a building paper or a housewrap as a WRB. When a WRB is not needed, these Dow foam sheathings may be installed according to standard installation instructions for foam sheathing from Dow. Be sure products and installation instructions meet code requirements for your particular location. Note: WEATHERMATE™ and WEATHERMATE™ Plus housewraps have already qualified as weather-resistive alternatives to the prescribed felt (see Evaluation Reports NER-593 and NER-640 for approved alternative).

THERMAX Products

COMBUSTIBLE: THERMAX products should be used only in strict accordance with product application instructions. THERMAX products, when used in a building containing combustible materials, may contribute to the spread of fire. For more information, consult MSDS and/or call Dow at 1-866-583-BLUE (2583). In an emergency, call 1-989-636-4400.

Dow Polyisocyanurate Insulation Other than THERMAX™ Products

COMBUSTIBLE: Protect from high heat sources. Local building codes may require a protective or thermal barrier. For more information, consult MSDS, call Dow at 1-866-583-BLUE (2583) or contact your local building inspector. In an emergency, call 1-989-636-4400.

Building and/or construction practices unrelated to building materials could greatly affect moisture and the potential for mold formation. No material supplier including Dow can give assurance that mold will not develop in any specific system.

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Form No. 179-07335-1008MCK
McKAY197618



ChemMasters

SPECIALTY CONSTRUCTION PRODUCTS

CRYSTAL CLEAR-A

LOW VOC, SOLVENT-BASED
HIGHEST GLOSS SEALER & CURING
COMPOUND FOR CONCRETE

P R O D U C T

D A T A

DESCRIPTION

Crystal Clear-A is premium quality, super high gloss, non yellowing, curing and sealing compound. Crystal Clear-A is a state-of-the-art proprietary formulation which creates the highest gloss possible on concrete.

Crystal Clear-A is a solvent based product which meets the VOC requirements of the Ozone Transport Commission, in effect as of Jan. 1st, 2005.

Crystal Clear-A coats concrete with a chemically bonded siliconized acrylic film that deepens the color and enhances the look of pigmented or decorative concrete. Crystal Clear-A completely resists discoloration from ultraviolet light exposure. It keeps its high gloss finish much longer than standard concrete sealers. Crystal Clear-A will retard efflorescence while resisting oil, grease and food stains. Crystal Clear-A eliminates concrete dusting, while protecting concrete against salt and water penetration.

USES

Use on exterior plain, colored, textured or exposed aggregate concrete to

- Cure freshly poured concrete where superior curing efficiency is required
- Seal, harden and dustproof existing concrete, particularly architectural or residential concrete exposed to freeze-thaw or Ultra Violet light.
- Enhance the color and and gloss of pigmented or stamped concrete

ADVANTAGES

- Crystal Clear-A is much tougher than acrylic sealers. The high gloss created by Crystal Clear lasts up to 70% longer.
- Crystal Clear-A completely resists discoloration from ultraviolet light exposure.

- Complies with the VOC standards for concrete sealers in the following states: California, Delaware, New Jersey, New York, Oregon, Pennsylvania, Virginia, Washington and other area that require the VOC limits on curing & sealing compounds to be less than 350 grams per liter
- Crystal Clear-A cures concrete to ASTM C1315 standards to minimize cracking and increase the strength of concrete.
- Protects surfaces against deicing chemicals, fertilizers, salts, grease, oil, alkalies, mild acids and detergents.

TECHNICAL DATA

Crystal Clear-A has been tested for gloss retention and non yellowing against standard concrete sealers with the following results.

Gloss Retention

After 1,000 hours QUV exposure

(All panels begin with 95 gloss rating)

	Gloss	Percent Original
Crystal Clear-A	89.8	95%
Moisture Cure Urethane	79.1	83%
Pure Acrylic	73.6	77%
Styrene Acrylic	55.4	58%

Yellowing Index

After 1,000 hours QUV exposure

Equivalent to approx 10 years of Florida sunlight

(All panels begin with 0 yellow rating)

	Yellowing
Crystal Clear-A	0.00
Moisture Cure Urethane	3.00
Pure Acrylic	4.77
Styrene Acrylic	9.48

(Visable yellowing begins at 3.00)



ChemMasters

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Revised March 2006

- ASTM C-1315, Type I , Class A & B,
- ASTM C-309, Type I, Class A & B,
- USDA approved, when cured, for incidental contact

V.O.C. content	350 gr/L
Moisture retention (ASTM C-156)	0.035 gms/cm ²
Flash point	over 0°F (-18°C)
Drying time@70°F (21°C) and 50% RH	
Tack free	2 hours
Light foot traffic	8 hours
Maximum hardness	7 days

PACKAGING

Crystal Clear-A is available in 5 gallon (18.9 liter) metal pails and 55 gallon (208 liter) drums.

ESTIMATING GUIDE

Coverage is dependent upon surface texture and porosity. These are guidelines only

	Ft. ² /gal	M ² /L
Curing	300	7
Sealing Concrete		
First Coat	350	8
Second coat	450	11

DIRECTIONS

MIXING: Do not dilute. Crystal Clear-A is packaged ready to use and requires no mixing.

APPLICATION: Always test application in a small area to verify appearance. In cold temperatures (below 50°F), warm material to room temperature to ease application. In hot weather avoid applying in direct sunlight or in windy conditions. In hot weather, apply Crystal Clear-A early in the morning.

Because Crystal Clear-A dries very quickly, a low pressure, spray application is recommended. A pump up sprayer equipped with a slit-type orifice rated between 0.5 - 1.0 gallons per minute is recommended. If spraying, hold spray tip 6-8 inches from the surface and apply a continuous film leaving no pinholes or gaps. The optimum spray pattern is an 8-12 inch fan. When using a hand pressurized sprayer it is important to maintain as high an air pressure as possible to aid in spraying. Do not allow material to puddle. If roller application is necessary, regularly dip the

roller in a solvent like xylene or Polyseal Solvent to keep the roller from drying. If the roller dries out, cob-webbing or stringiness will result.

CURING: Apply Crystal Clear-A after all bleed water has dissipated and application will not mar the surface. For maximum gloss and protection, apply a second sealer coat after curing process is completed (minimum 28 days later).

SEALING: When sealing older concrete, clean concrete thoroughly removing any dirt, dust, paints, oil, grease or other contaminants that prevent adhesion. Allow the surface to dry before application of Crystal Clear-A. For best protection and highest gloss, apply two thin coats of Crystal Clear-A. Allow first coat to dry tack free before application of second coat.

CLEANUP

Clean tools immediately after use with Polyseal Solvent™ or xylene.

STORAGE

Store tightly sealed containers in cool, dry area away from direct sunlight and sources of heat. Shelf life is one year from date of manufacture.

LIMITATIONS

- Strong organic solvents, xylene, toluene, lacquer thinner, will lift Crystal Clear-A. Gasoline, hydraulic fluids, peanut oil and cooking oils soften and lift Crystal Clear if spills are not removed quickly.
- Do not apply to joints or channels scheduled to receive elastomeric caulks.
- Do not use if ambient or surface temperature is below 40°F (4°C). For best results, condition material to a minimum of 50°F (10°C) prior to application.
- Quality curing or sealing compounds and floor treatments darken or highlight the subtle color variations naturally present in concrete. When the difference in shading caused by absorptive deviation or finishing techniques is objectionable, consult ChemMasters technical staff prior to concrete placement for recommendations.

CAUTION

FLAMMABLE LIQUID: Keep away from heat or open flames. Use with adequate ventilation. May cause skin, eye and respiratory tract irritation. Do not take internally.

This Product is Formulated and Labeled for Industrial and Commercial Use Only

FOR BEST RESULTS AND SAFEST USAGE, USER IS SPECIFICALLY DIRECTED TO CONSULT THE CURRENT MATERIAL SAFETY DATA SHEET AND PACKAGE LABEL FOR THIS PRODUCT

We warrant our products to meet our published specifications and to be free from defects in materials and workmanship to the acceptable quality levels defined in these specifications. If acceptable quality levels are not specified, the acceptable quality levels will be those normally supplied by us for the product. We make no guarantee of the results to be obtained from the use of our products. The determination as to the adaptability of any of our products to the specific needs of the Buyer is solely Buyer's prerogative and responsibility. We are glad to offer suggestions on the use of our products. Nevertheless, there are no warranties given except such expresses warranties offered in connection with the sale of a particular product. Our liability shall be limited to replacement of, or refund of an amount not to exceed the purchase price attributed to, the goods as to which such claim is made. Our selection of one of these alternatives shall be Buyer's exclusive remedy. IN NO CASE SHALL WE BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES, EVEN IF WE HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, GUARANTEES, CO-CONDITIONS AND REPRESENTATIONS, EITHER EXPRESSED OR IMPLIED, WHETHER ARISING UNDER ANY STATUTE, COMMON LAW, USAGE OR TRADE, COURSE OF DEALING OR OTHERWISE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.



1. Product Name

Direct Colors Concrete Pigments

2. Manufacturer

Direct Colors, Inc. (DCI)
430 East 10th Street
Shawnee, OK 74801
(877) 255-2656
(405) 275-6657
Fax: (405) 275-2815
E-mail: info@directcolors.com
www.directcolors.com

3. Product Description

BASIC USE

Direct Colors Concrete Pigment, also known as Integral Color, is designed to color concrete, stucco, plaster, mortar, grout, overlay and other cementitious materials. Integral Colors have been used in thousands of different commercial and residential applications to create beautiful and unique surfaces.

DCI Concrete, Inc. (DCI) concrete pigments can be used to add color to concrete floors, countertops, cultured and architectural stone, statuary and an assortment of other garden decor items.

DCI Concrete pigments are also used to tint concrete sealers and liquid release agents to over 30 translucent colors for use in both indoor and outdoor flooring applications. Additionally, DCI acetone-based concrete dyes, made with concrete pigments, can be applied to existing concrete surfaces for even, consistent coloration and are especially valuable for floors that cannot be acid stained or colored by any other means.

COMPOSITION & MATERIALS

Direct Colors Pigments are made from metal oxides of iron, chromium, cobalt or titanium. They are man-made, synthetic, inorganic pigments that are tested to and meet ASTM C979 standards. They do not contain carbon black, or other materials that may be unstable or non-lightfast in many cementitious applications.

SIZES

Direct Colors Concrete Pigments are available in 1 lb (0.5 kg), 5 lb (2 kg), 10 lb (4.5 kg), 20 lb (9 kg),



1835 Pigment in Stamped Concrete (Photo Courtesy of Decocrete)

50 lb (23 kg), 500 lb (227 kg) and 2000 lb (907 kg) quantities. Custom batch quantities are also available.

COLOR

Direct Colors Concrete Pigments deliver superior uniformity in color, strength and lightfastness and are available in over 100 colors. See Tables 1 and 2. Accurate traceability is provided by use of batch identification codes. View visual color representations online at www.directcolors.com.

BENEFITS

- High quality pigments at an affordable price
- Wide range and variety of colors available
- Superior customer service and technical support
- Free freight in the lower 48 states

ACCESSORIES

- Concrete sealers
- Multipurpose wax
- Concrete dyes
- DCI overlays
- Liquid Colored Antique
- Decorative aggregates
- Stamps and stencils

LIMITATIONS

- Direct Colors, Inc., color charts for integral color/concrete pigments are intended to match what can generally be expected from a final color as closely as possible. However, the color and condition of preexisting concrete will affect the final result of the new concrete color, so color samples are approximations only

- Efflorescence, a naturally occurring deposit found on the surface of concrete, is more noticeable on dark colors because of its whitish appearance. Although it will eventually cease, there is no known method to achieve 100% prevention. Efflorescence can quickly be removed by acid washing, but over time, natural weathering will achieve the same effect. See "Reducing Efflorescence" under "Installation" for techniques to help reduce the occurrence of efflorescence

4. Technical Data

APPLICABLE STANDARDS

ASTM International (ASTM) - ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete

APPROVALS

Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR 1910.1200

PHYSICAL/CHEMICAL PROPERTIES

- Lightfast
- Alkali and weather resistant
- UV stable
- Non-hazardous
- Color consistent
- Chemically inert
- Insoluble in water
- Inorganic
- Synthetic
- Specific gravity - Heavier than water
- Evaporation rate - None
- Reddish-brown appearance
- Odorless

Direct Colors, Inc.

TABLE 1 INTEGRAL COLOR CHART, GRAY CEMENT BASE, TO ASTM C979

Color mixture	Brick Red	Sun Dried Tomato	Merlot	Evening Shadow	Terra Cotta
Pigment type	1835	1835	126	126	560
Pound rating	4 lb	1 lb	3 lb	1 lb	5 lb
Color mixture	Majestic Sunrise	Dawn	Earthen Red	Desert Rouge	Desert Vista
Pigment type	1830	1830	1115	1115	560
Pound rating	4 lb	1 lb	3 lb	1 lb	3 lb
Color mixture	Navajo	Uplands	Caramel	San Juan	Frontier Buff
Pigment type	543	543	543	543	533
Pound rating	5 lb	3 lb	2 lb	1 lb	1 lb
Color mixture	Burnished Copper	Sandstone	Canyon Brown	Santa Fe Tan	Smokestack
Pigment type	553	553	553	533	230
Pound rating	4 lb	1 lb	5 lb	3 lb	5 lb
Color mixture	Weathered Tin	Deep Bronze	Milk Chocolate	Rattan	Golden Buff
Pigment type	230	680	680	609	609
Pound rating	1 lb	3 lb	1 lb	4 lb	2 lb
Color mixture	Cocoa Brown	Walnut	Petrified Wood	Mint Green	Briar Buff
Pigment type	653	649	649	5376	500
Pound rating	3 lb	4 lb	2 lb	3 lb	3 lb
Color mixture	Taupe	Pecan	Maple	Rocky Crag	Wildwood Buff
Pigment type	653	627	627	623	500
Pound rating	1 lb	3 lb	1 lb	3 lb	2 lb
Color mixture	Wheat Buff	Winterfield Buff	Mocha	Tarnished Brass	Sunray
Pigment type	500	1198	623	1311	1311
Pound rating	1 lb	1 lb	1 lb	3 lb	1 lb
Color mixture	Venetian Red	Umber	Slate Blue	Prussian Blue	Sapphire
Pigment type	1880	1880	5151	5151	15.3
Pound rating	5 lb	3 lb	1 lb	3 lb	5 lb
Color mixture	Midnight Blue	Mint Green	Forest Green		
Pigment type	15.3	5376	5376		
Pound rating	5 lb	3 lb	5 lb		

TABLE 2 INTEGRAL COLOR CHART, WHITE CEMENT BASE, TO ASTM C979

Color mixture	Cayenne	Blush	Sequoia	Plum	Fire Rose
Pigment type	1830	1830	126	126	1115
Pound rating	3 lb	1 lb	3 lb	1 lb	3 lb
Color mixture	Morning Mist	Dusty Rose	Wildflower	Terran	Peach
Pigment type	1115	1835	1835	553	553
Pound rating	1 lb	3 lb	1 lb	3 lb	1 lb
Color mixture	Autumn	Leaf Fall	Pumpkin	Sun Dust	October Bronze
Pigment type	560	560	543	543	533
Pound rating	3 lb	1 lb	3 lb	1 lb	3 lb
Color mixture	Sunwashed Clay	New Bark	Everland Buff	Cake Buff	Beachfront Buff
Pigment type	533	623	623	609	609
Pound rating	1 lb	3 lb	1 lb	3 lb	1 lb
Color mixture	Canyon Wall	Cinnamon	Espresso	Pebble	Camel
Pigment type	627	627	653	653	500
Pound rating	3 lb	1 lb	3 lb	1 lb	3 lb
Color mixture	Sunset Tan	Tawny	Cream Beige	Café	Cottage Brown
Pigment type	500	1198	1198	649	649
Pound rating	1 lb	3 lb	1 lb	3 lb	1 lb
Color mixture	Malayan Buff	Lotus Pond	Crème Mint	Hunter Green	Vineyard
Pigment type	1311	5376	5376	5376	1880
Pound rating	1 lb	3 lb	1 lb	5 lb	5 lb
Color mixture	Vineyard	Mauve	Tea Rose	Prairie Blue	Skye Blue
Pigment type	1880	1880	1880	5151	5151
Pound rating	5 lb	3 lb	1 lb	1 lb	3 lb
Color mixture	Electric Blue	Ultramarine	Hunter Green		
Pigment type	15.3	15.3	5376		
Pound rating	3 lb	5 lb	5 lb		

29	14
Mint Green 5376 - 3 lb.	San Juan 543 - 1 lb.
75	20
Venetian Red 1880 - 5 lb.	Smokestack 230 - 5 lb.

Colors cast in Gray Cement

FIRE PERFORMANCE

Direct Colors Concrete Pigments are non-flammable, noncombustible and nonexplosive.

5. Installation

PREPARATORY WORK

Store materials in an area protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

Verify that site conditions are acceptable for installation. Do not proceed with installation until unacceptable conditions are corrected.

61	64
Beachfront Buff 609 - 1 lb.	Espresso 653 - 3 lb.
42	72
Cayenne 1830 - 3 lb.	Malayan Buff 1311 - 1 lb.

Colors cast in White Cement



METHODS

Mixing

Color charts and codes are based on pounds of pigment per 94 lb (43 kg) of cement material, including Portland cement, silica fume, fly ash and lime. Sand and aggregates are not used in this ratio. The maximum level of pigment to cement is 10% by weight. Using less than 1% pigment can result in a washed-out appearance. Blue pigments should be mixed dry with any cement-based material to ensure even color distribution.

When an exact color match is required, complete a test pour, mixing the exact ingredients and ratios that will be used onsite. When custom blends are made for countertops, ready mixes, overlays, curbing, mortar, grouts and other concrete based products, the colors hold true within an acceptable range to most users, especially when the mixture has been adjusted to meet the specific needs of the mix and the project application.

Truck Pours

For a standard mix, the simplest method to convert the values on the color chart to a specific pour is to multiply the poundage on the chart by 5 to determine how much pigment per yard is needed. Consistency with the pigment per yard ratio is critical in achieving matching pours. The water level and mix ratios in each load are critical as well. It is essential to know how much concrete is in the truck, not just how much will be poured.



Stamped walkway colored with 230 and 1830 Concrete Pigments (Photo Courtesy of Mark Douglass)



Swim-up pool bar countertop colored with 1311 Concrete Pigment, English Red Acid Stain and Coffee Brown Deco Gel (Photo Courtesy of Susan Turfle)

Dispense the pigment in the back of the truck, using the hose to clean the fins and ensuring that no loose pigment remains to cause streaking. Spinning the mix for 10 - 15 minutes is generally sufficient to properly disperse the pigment. Place and work the concrete as normal.

As the concrete sets, the color will appear to fade. This is caused by the concrete dispensing powder on the surface and will be resolved by sealing this in the same way as a decorative concrete would be sealed. Once sealed, the color should be stable and considerably darker than at first appearance pre-seal.

Color Calculator

Color calculators and measurement examples are available at www.directcolors.com to measure required pigment per yard and per custom batch of concrete.

PRECAUTIONS

Safety

- To avoid inhaling dust and contact with face and eyes, wear full face mask, eye protection and rubber gloves
- Avoid contact with inorganic acids
- Wash with soap and water after exposure. Chronic overexposure can cause slight skin irritation

Performance

- For optimal results, use the same brand of cement, aggregates and sand, as well as the same cement to pigment ratio, until project completion

- In order to avoid undesired discoloration, do not use calcium chloride as a set accelerator
- Difference in slump may produce a noticeable difference in color between batches
- Use local exhaust or baghouse for ventilation
- If material is released or spilled, scoop or vacuum the floor and wash with water
- To avoid color variation, be consistent in all stages of the batching, mixing, forming/ placing and hardening of concrete

Reducing Efflorescence

- Ensure that the aggregate-cement ratio is sufficient to enable the cement paste to completely fill the voids between the aggregate particles after compaction
- To minimize air voids that remain after complete cement hydration, add to the concrete mix only the minimum amount of water needed to achieve required workability
- Select sands and aggregates for the mix design carefully, as appropriate particle size and shape can help to improve mechanical compaction, effectively squeezing air voids and allowing them to be replaced with the cement paste
- There is some evidence that certain cement additives and chemical admixtures can help to inhibit efflorescence. Consult Direct Colors, Inc., for more information



Stamped concrete colored with Direct Colors Concrete Pigment dispersed in Antique Release and Tinted Sealer (Photo Courtesy of Decocrete)

8. Maintenance

None required.

9. Technical Services

Technical assistance, including more detailed information, product literature, test results, project lists, assistance in preparing project specifications and arrangements for application supervision, is available by contacting Direct Colors, Inc. For questions or custom solutions, call (877)-255-2656 or email info@directcolors.com.

10. Filing Systems

- SmartBuilding Index
- MANU-SPEC®
- Additional product information is available from the manufacturer upon request.

- Ensure concrete cures sufficiently to achieve not only strength, durability and reduced cracking, but surfaces that are as dense as possible to limit the concrete's ability to absorb water
- A variety of concrete coatings, including water and solvent based concrete sealers offered by Direct Colors, are available for application to the surface, blocking pores and forming an impermeable barrier at the concrete's exposed surface. This prevents

the movement of water to the surface, restricting the migration of efflorescence forming compounds. Consult Direct Colors, Inc., for more information.

BUILDING CODES

Installation and waste disposal must comply with the requirements of all applicable local, state and federal code jurisdictions.

6. Availability & Cost

AVAILABILITY

Products can be purchased at www.directcolors.com, or by calling (877) 255-2656. Products are also available from certified distributors. Contact the manufacturer or check online at www.directcolors.com for local availability information.

COST

Current pricing is available online at www.directcolors.com.

7. Warranty

The conditions of use and application of concrete pigment products are beyond the control of Direct Colors, Inc. Direct Colors makes no warranty regarding workmanship and other variables that do not involve the performance of pigments. Buyer's sole remedy shall be the purchase price paid by the user or buyer for the quantity of the Direct Colors product involved. For details, consult Direct Colors, Inc.



Close-up of stamped concrete walkway as shown above (Photo Courtesy of Decocrete)



Vinyl Tape

471 • 4712 (Linered)

Technical Data

February, 2011

Product Description

3M™ Vinyl Tape 471 and 4712 are a conformable colored (9 colors plus transparent) tapes made from vinyl backing with rubber adhesive. They are ideal for many lane and safety markings, color coding, abrasion protection, masking, sealing, splicing and other general purpose applications.

3M vinyl tape 4712 is a linered version of 3M vinyl tape 471 that may be used for die cutting or large area applications.

Product Construction

Product	Adhesive	Color	Standard Roll Length
3M™ Vinyl Tape 471	Rubber	Yellow, white, red, black, brown, green, orange, purple, blue and transparent	36 yds. (33 m)
3M™ Vinyl Tape 4712	Rubber	Yellow, white, red, black, brown, green, orange, purple, blue and transparent	36 yds. (33 m)

Typical Physical Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

ASTM Test Method

Properties for all colors except transparent:

Adhesion to Steel:	23 oz./in. width (25 N/100 mm)	D-3330
Tensile Strength at Break:	14 lbs./in. width (270 N/100 mm)	D-3759
Elongation at Break:	130%	D-3759
Backing Thickness:	4.1 mils (0.10 mm)	D-3652
Total Tape Thickness:	5.2 mils (0.14 mm)	D-3652
Liner Thickness: (3M™ Vinyl Tape 4712)	2.5 mils (0.6 mils)	D-3652
Temperature Use Range:	40° to 170°F (4° to 77°C)	
Low Leachable Halogen and Sulfur:	Passes	MIL-STD-2041D(SH)

Properties for transparent:

Adhesion to Steel:	26 oz./in. width (28 N/100 mm)	D-3330
Tensile Strength at Break:	14 lbs./in. width (270 N/100 mm)	D-3759
Elongation at Break:	150%	D-3759
Backing Thickness:	4.1 mils (0.10 mm)	D-3652
Total Tape Thickness:	5.2 mils (0.14 mm)	D-3652
Liner Thickness: (3M™ Vinyl Tape 4712)	2.5 mils (0.6 mils)	D-3652
Temperature Use Range:	40° to 170°F (4° to 77°C)	

3M™ Vinyl Tape

471 • 4712 (Linered)

Features

- Pigmented backings maintain their vivid colors even when exposed to heavy abrasion.
- Can be sold to Commercial Item Description A-A-1689 Type I & II
- Conformability and dead stretch properties are ideal for taping, wrapping or sealing many curved, convex, or irregular surfaces.
- Rubber adhesive provides good adhesion to many surfaces for easier application and excellent holding strength.
- Sharp colors for color coding or marking systems, draw attention and help enhance plant safety.
- Clean removal from many surfaces which helps reduce clean-up and labor costs.
- Abrasion resistant and longer potential application life.
- Good solvent resistance for application protection and longer product life.
- 3M™ Vinyl Tape 4712 can be printed using the thermal printing process.

Application Ideas

- Excellent for many lane and safety marking applications. When used with an applicator like the M-77 dispenser, 3M™ Vinyl Tape 471 can be quickly applied to define storage and safety areas. The fact that 3M tape 471 is quickly and cleanly removed in most cases makes it a faster, more versatile and less costly option than painting. Using tape for lane marking instead of painting also eliminates the need to ventilate paint solvents from an open area.
- Because they have low leachable halogens and sulfur, 3M™ Vinyl Tapes 471 and 4712 can be used in corrosion sensitive applications like the nuclear and stainless steel industries.
- 3M tape 4712 is great for die cuts and large area masking.
- Printed 3M tape 4712 can extend the range of 3M tape 471 for color coding by allowing multiple colors or identification on one tape.
- 3M tapes 471 and 4712 stretch to seal canisters and other storage containers that require a tight seal.
- Vivid colors of the tapes make them ideal for color, coding and decorating.

Application Techniques

- Best results are attained when applied to a clean, dry surface at temperatures between 60° to 85°F (16° to 27°C).

Note: While 3M tapes 471 and 4712 resist many common solvents, they should not be exposed to ketones, chlorinated hydrocarbons and esters found in lacquer thinner, degreasers, paint strippers, etc., which may cause the backing to swell or curl.

3M™ Vinyl Tape

471 • 4712 (Linered)

Storage	Store under normal conditions of 60° to 80°F (16° to 27°C) and 40 to 60% R.H. in the original carton.
Shelf Life	To obtain best performance, use this product within 18 months from date of manufacture.
Technical Information	The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.
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