

SUGAR RUSH

UNIVERSITY OF CALIFORNIA
LOS ANGELES

2018-2019

PROJECT OVERVIEW AND
TECHNICAL ADDENDUM



PROJECT OVERVIEW & TECHNICAL ADDENDUM



School Name

University of California, Los Angeles

Canoe Name

Sugar Rush

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COMPLIANCE CERTIFICATE



COMPLIANCE CERTIFICATE

School Name: University of California, Los Angeles

Canoe Name: Sugar Rush

The University of California, Los Angeles certifies that the following statements and information provided in this document are all valid.

1. The construction and finishing of the canoe has been performed in complete compliance with the Rules and Regulations of the National Competition.
2. The registered participants at the Conference/National Competition are qualified student members and National Student Members of ASCE, and they meet all eligibility requirements.
3. The canoe has been completely built within the current academic year of the competition.
4. The team acknowledges all Material Technical Data Sheets (MTDS) and Safety Data Sheets (SDS) have been read by the project management team.
5. The team acknowledges receipt of the Request for Information (RFI) Summary and that their entry complies with responses provided.

strength values reported in this table were obtained from 28-day testing	Densities (lb/ft ³) (brief)		Slump (inches)	Air Content	Strength (psi)		
	Wet (Plastic)	Oven-Dried			Compressive	Tensile	Composite Flexural
Structural Mix	70.1	64	1.25	2.8%	1830	460	2460
Finishing Mix	68.7	63	1.50	3.1%	1470	280	
Maximum Length	19 ft		Maximum Depth		13.5 in	Overall Weight	
Maximum Width	26 in		Average Thickness		3/8 in	180 lbs	

Member	ASCE National ID
Ada Chang	10491566
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Colin Burrowes	10893576
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Johnny Schmidt	10498395
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By signing below, I hereby confirm that the aforementioned information is valid.

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Date 3/5/2019



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HOW-TO



MOLD CONSTRUCTION

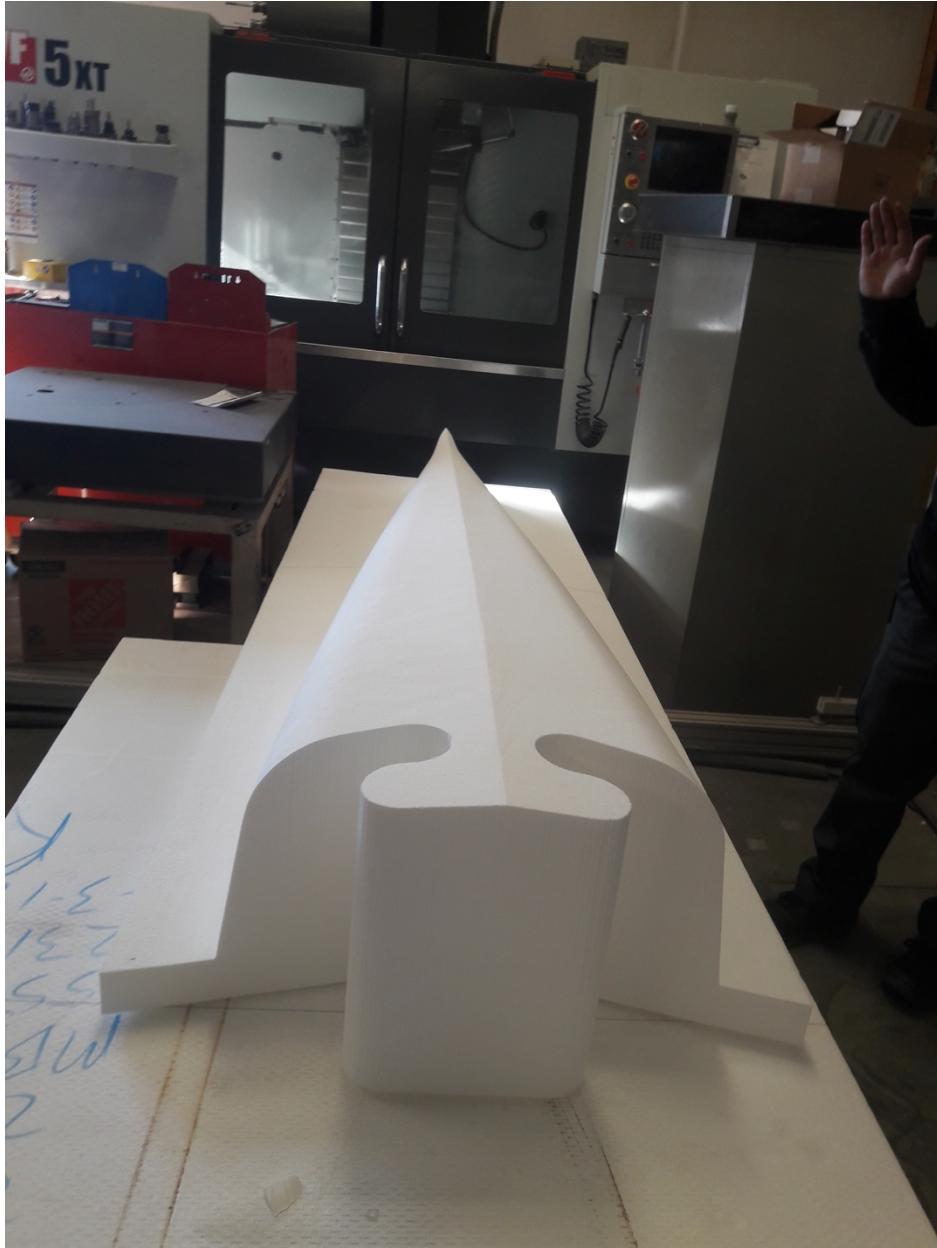


Image 1: Expanded polystyrene (EPS) mold being milled using a computer controlled process (CNC-milling).



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Image 2: Completed CNC-milled foam mold.



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Image 3: Hot-wire cut EPS foam tips glued to ends of the mold.



Image 4: Sanding tips of the mold to ensure smoothness.



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Image 5: Painting the mold to prevent reaction between the mold and epoxy.



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Image 6: Applying epoxy to provide a hard protective coat for the mold.



Image 7: Applying contact paper to ease demolding process.



Image 8: Sketching candies and donut for inlaid aesthetic details.



Image 9: Taping around the details to ensure clean lines for the aesthetic details.



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Image 10: Wooden blocks glued 1" away from the mold for quality assurances of gunwales.



Image 11: Set-up of the pre-tensioning system with tension in the cables along the gunwales of the canoe.



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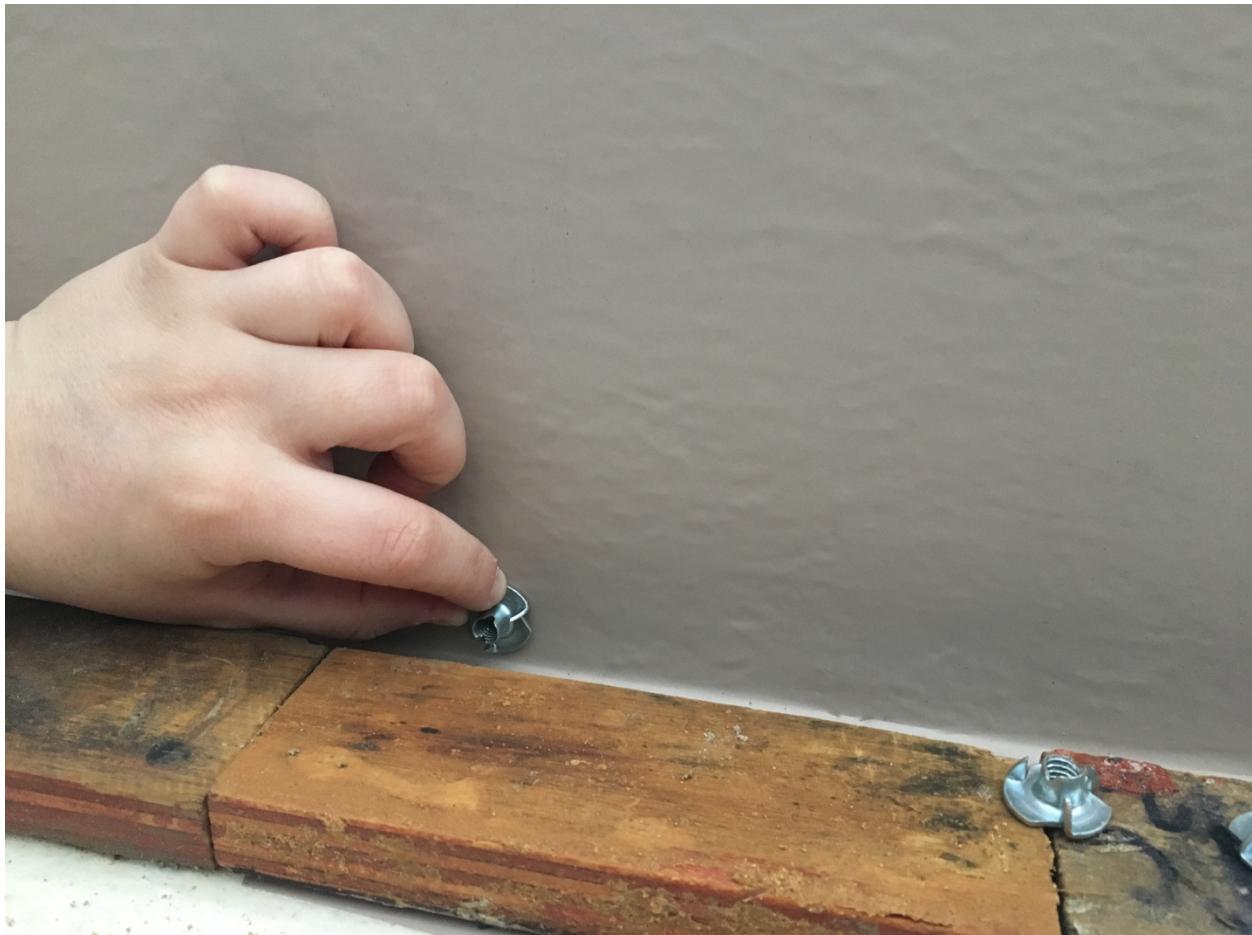


Image 12: Aligning spacers to hold the pre-tension cables in place along gunwales.



Image 13: Applying form oil to the mold to ensure ease in demolding.



CANOE CONSTRUCTION



Image 14: Preparing dry batches of concrete prior to casting day.



Image 15: Mixing the liquid materials into the dry batches of concrete.



Image 16: Casting the inlaid aesthetic details on innermost layer.



Image 17: Casting the first structural layer of the canoe.



Image 18: Casting the second structural layer over the first layer of reinforcement.



Image 19: Casting the third structural layer over the second layer of reinforcement.



Image 20: Casting around acrylic letter block-outs.



Image 21: Ensuring uniform concrete thickness with $\frac{1}{8}$ ", $\frac{1}{4}$ ", and $\frac{3}{8}$ " depth gauges for the first, second and third layers, respectively.



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Image 22: Removing the letter block-outs.



Image 23: Misting the canoe during the curing process.



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Image 24: Cutting pre-tensioning wires prior to demolding.



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Image 25: Demolding the canoe.



Image 26: Hot-wire cutting foam tip inserts, which aid in floatation.



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Image 27: Sanding and fitting foam into tips of canoe.



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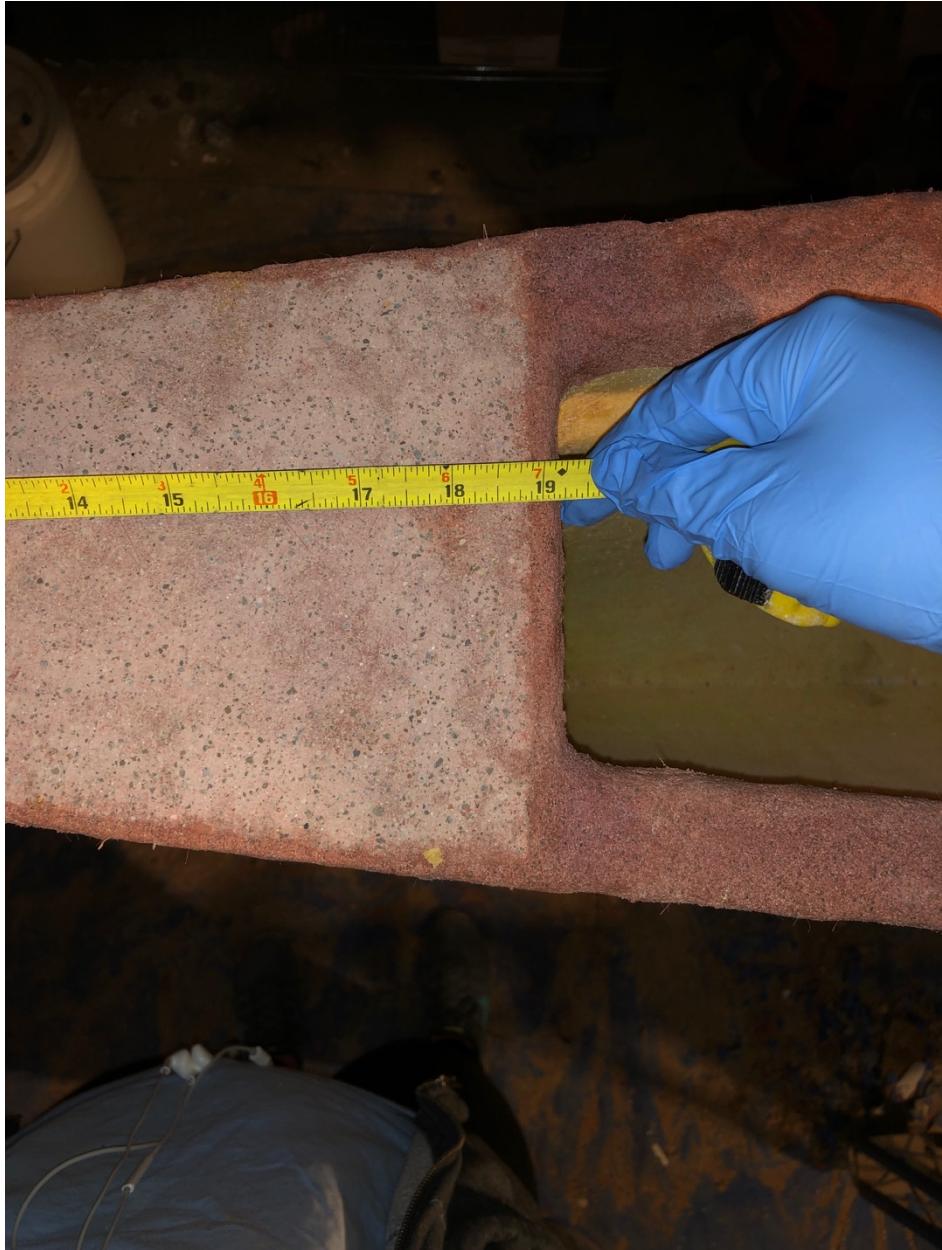


Image 28: Measuring casted foam tips to ensure compliance with rules and regulations.



Image 29: Creating pre-cast “sprinkles” for aesthetic details in letters.



Image 30: Filling in the letters of the canoe.



FINISHING TECHNIQUES

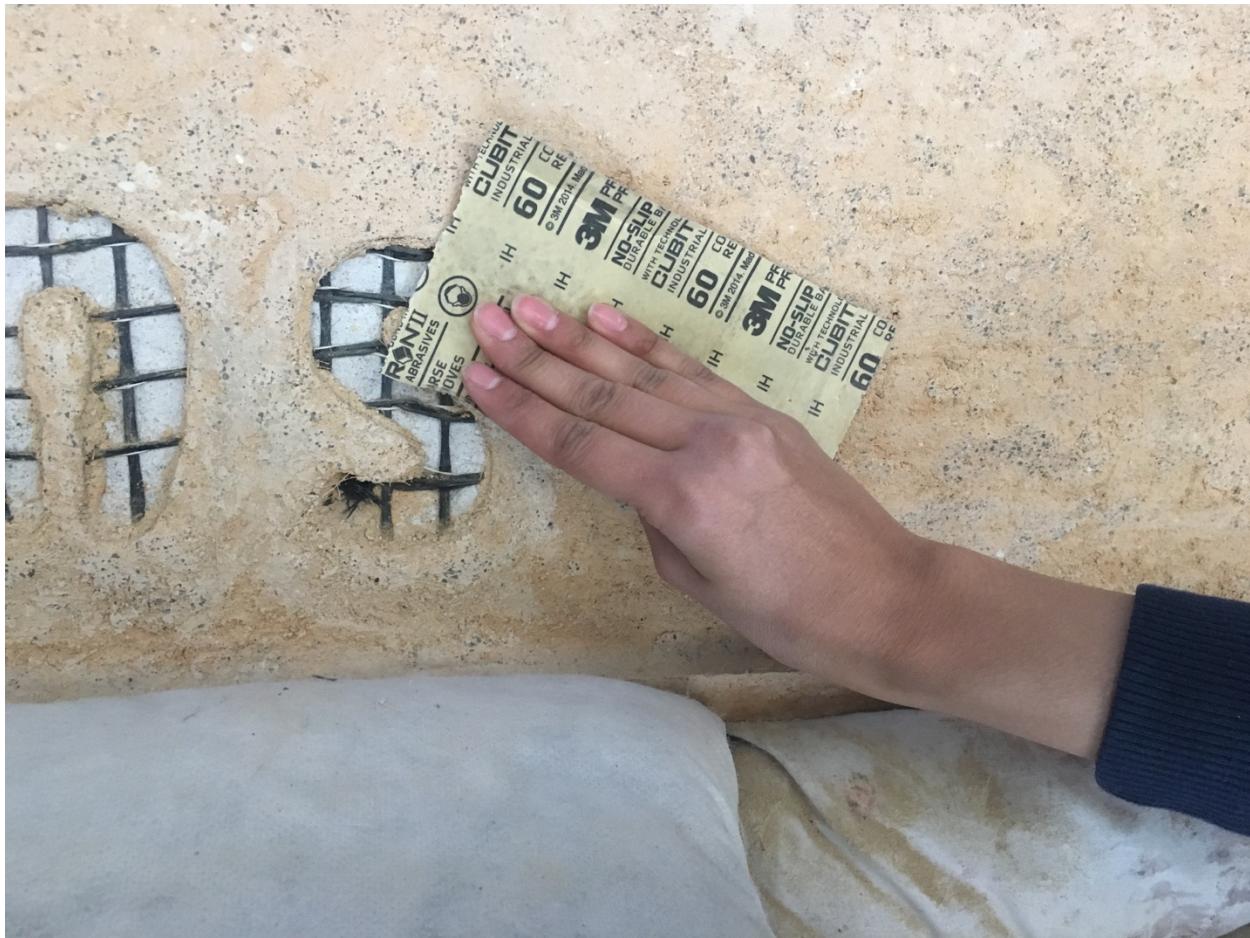


Image 31: Sanding the canoe exterior with low grit sandpaper.



Image 32: Power sanding the canoe to achieve desired shape and eliminate irregularities.



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Image 33: Removing dust and debris due to sanding using a vacuum and brush.



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Image 34: Locating blemishes and unevenness on the canoe's surface.



Image 35: Patching irregularities on interior and exterior of canoe's surface.



Image 36: Sanding interior of canoe for smoothness.



Image 37: Utilizing foam outlines for final tip aesthetic details.



Image 38: Casting final tip details over foam base.



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Image 39: Sanding the canoe with high grit sandpaper optimal smoothness.



Image 40: Applying sealant to the canoe.



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MATERIAL TECHNICAL DATA SHEETS (MTDS)



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ADVA 195

ADVA® 195

High-range water-reducing admixture

ASTM C494 Type A and F, and ASTM C1017 Type I

Product Description



- ADVA® 195 is a polycarboxlate-based high-range water-reducing admixture specifically formulated to meet the needs of the concrete industry. It is a low viscosity liquid, which has been formulated by the manufacturer for use as received.
- ADVA 195 is manufactured under closely controlled conditions to provide uniform, predictable performance and is formulated to comply with specifications for Chemical Admixtures for Concrete, ASTM Designation C494 as a Type A and F, and ASTM C1017 Type I admixture. ADVA 195 does not contain intentionally added calcium chloride. One gallon weighs approximately 8.8 lbs (1.1 kg/L).

Uses

ADVA 195 superplasticizer produces concrete with extremely workable characteristics referred to as high slump. It also allows concrete to be produced with very low water/cement ratios for high strength.

Product Advantages

- Highly efficient, producing high slump concrete at very low dosages
- Provides a combination of slump life with near neutral set time
- Consistent air entrainment
- Consistent performance across cement chemistries
- Concrete finishes easily without stickiness, spotty set or tearing

While ADVA 195 is ideal for use in any concrete where it is desired to minimize the water/cementitious ratio yet maintain workability, ADVA 195 is primarily intended for use in ready-mix concrete, but may also be used in other applications such as precast concrete and self-consolidating concrete.

Addition Rates

ADVA 195 superplasticizer addition rates can vary with type of application, but will normally range from 3 to 15 fl oz/100 lbs (195 to 980 mL/100 kg) of cementitious. In most instances, the addition of 3 to 6 fl oz/100 lbs (195 to 375 mL/100 kg) of cementitious will be sufficient. At a given water/cementitious ratio, the slump required for placement can be controlled by varying the addition rate. Should conditions require using more than the recommended addition rates, please consult your Grace representative.

ADVA 195 dosage requirements may also be affected by mix design, cementitious content and aggregate gradations. Please consult with your Grace Construction Products representative for more information and assistance.



Compatibility with Other Admixtures and Batch Sequencing

ADVA 195 is compatible with most Grace admixtures as long as they are added separately to the concrete mix. However, ADVA products are not recommended for use in concrete containing naphthalene-based admixtures including Daracem® 19 and Daracem 100, and melamine-based admixtures including Daracem ML 330 and Daracem 65. In general, it is recommended that ADVA 195 be added to the concrete mix near the end of the batch sequence for optimum performance. Different sequencing may be used if local testing shows better performance. Please see Grace Technical Bulletin TB-0110, *Admixture Dispenser Discharge Line Location and Sequencing for Concrete Batching Operations* for further recommendations. ADVA 195 should not come in contact with any other admixture before or during batching, even if diluted in mix water.

Pretesting of the concrete mix should be performed before use and as conditions and materials change in order to assure compatibility with other admixtures, and to optimize dosage rates, addition times in the batch sequencing and concrete performance. For concrete that requires air entrainment, the use of an ASTM C260 air-entraining agent (such as Daravair® or Darex® product lines) is recommended to provide suitable air void parameters for freeze-thaw resistance. Please consult your Grace representative for guidance.

Packaging & Handling

ADVA 195 is available in bulk, delivered by metered tank trucks, in 330 gal (1250 L) disposable totes, and in 55 gal (210 L) drums.

It will begin to freeze at approximately 32°F (0°C), but will return to full strength after thawing and thorough agitation. In storage, and for proper dispensing, ADVA 195 should be maintained at temperatures above 32°F (0°C).

Dispensing Equipment

A complete line of accurate, automatic dispensing equipment is available.

ADVA 195 ASTM C494 Type F High-Range Water Reducer Test Data

	US Units		Metric	
	Control	ADVA 195	Control	ADVA 195
Cement (pcy) (kg/m ³)	517	517	307	307
Coarse aggregate (pcy) (kg/m ³)	1944	1944	1153	1153
Fine aggregate (pcy) (kg/m ³)	1144	1214	679	720
Water (pcy) (kg/m ³)	235	204	396	344
w/cm	0.455	0.405	0.455	0.405
Slump (inches) (mm)	3.75	3.5	95	90
Plastic air (%)	5.5	5.4	5.5	5.4
Compressive strength				
1 day (psi) (MPa)	1860	2670	12.8	18.4
7 day (psi) (MPa)	4520	5530	31.2	38.1
28 day (psi) (MPa)	5440	6690	37.5	46.1
Initial set time (hr:min)	4:02	3:55	4:02	3:55
Length change 28 day (%)	-0.031	-0.028	-0.031	-0.028
Freeze-thaw resistance (RDME %)	92	98	92	98

www.graceconstruction.com

North American Customer Service: 1-877-4AD-MIX1 (1-877-423-6491)

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We hope the information here will be helpful. It is based on data and knowledge considered to be true and accurate and is offered for the users' consideration, investigation and verification, but we do not warrant the results to be obtained. Please read all statements, recommendations or suggestions in conjunction with our conditions of sale, which apply to all goods supplied by us. No statement, recommendation or suggestion is intended for any use which would infringe any patent or copyright. W. R. Grace & Co.-Conn., 62 Whittemore Avenue, Cambridge, MA 02140. In Canada, Grace Canada, Inc., 294 Clements Road, West, Ajax, Ontario, Canada L1S 3C6.

This product may be covered by patents or patents pending.
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GRACE



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BIDIRECTIONAL CARBON FIBER GRID REINFORCEMENT

CSS-BCG

Bidirectional Carbon Grid



®

DESCRIPTION

CSS-BCG is a bidirectional, high-strength, non-corrosive carbon grid designed to be field installed with CSS-CM cementitious matrix to create a fabric-reinforced cementitious matrix (FRCM) composite for structural reinforcement applications.

MATERIAL PROPERTIES

Grid Properties (in each direction)

Weight	3.9 oz./yd. ² (130 g/m ²)
Weight of fibers	2.4 oz./yd. ² (80 g/m ²)
Equivalent Dry Fabric Thickness	0.0017 in. (0.044 mm)
Ultimate Tensile Strength	9.5 kip/ft. (138 kN/m)
Ultimate Tensile Strain	1.5%
Axial Stiffness by width unit	633 kip/ft. (9,200 kN/m)
Area by width unit	0.0018 in. ² /in. (46 mm ² /m)
Color	Gray

Cured Composite Properties¹

Property	Design Value ²
Uncracked Tensile Modulus	3.8x10 ⁸ psi (2,600 GPa)
Cracked Tensile Modulus	9.0x10 ⁶ psi (62,200 MPa)
Ultimate Tensile Strain	1.2%
Tensile Strain at Transition Point	0.01%
Ultimate Tensile Strength	168,000 psi (1,160 MPa)
Tensile Stress at Transition Point	68,900 psi (475 MPa)
Lap Tensile Strength	194,000 psi, 6" lap (1,335 MPa, 15 cm)

1. When installed with CSS-CM cementitious matrix and 2 layers of CSS-BCG.

2. Average tensile strength minus one standard deviation per ACI 549. Modulus values are average.

PERFORMANCE FEATURES

- High strength
- Ambient Cure
- Non-corrosive
- Molds to fit various shapes
- Low aesthetic impact
- Compatible with many finish coatings

APPLICATIONS

Seismic Retrofit

- Shear strengthening
- Displacement/ductility
- Life safety

Load Rating Upgrade

- Increased live loads
- New equipment
- Change of use

Damage Repair

- Deterioration/corrosion
- Blast/vehicle impact

Defect Remediation

- Size/layout errors
- Low concrete strengths

Blast Mitigation

- Progressive collapse

STRUCTURES

- Buildings
- Bridges
- Parking garages
- Chimneys

- Piers/wharfs
- Tunnels
- Pipes

ELEMENTS

- | | |
|-----------|-------------|
| • Columns | • Walls |
| • Beams | • Piles |
| • Slabs | • Pier caps |

SUBSTRATES

- | | |
|------------|-----------|
| • Concrete | • Masonry |
|------------|-----------|

PACKAGING

Roll Size (Width x Length)	Model No.
77 in. (1.95 m) x 164 ft. (50 m)	CSS-BCG19550

Design

The number of layers, dimensions, and detailing of CSS-BCG shall be designed in accordance with ACI 549 or another recognized design guideline/code in order to meet the design performance specified for the application. Contact Simpson Strong-Tie for design and technical support.

Surface Preparation

Prepare surface and any exposed reinforcement per ICRI Guideline No. 310.1R. Concrete shall be prepared to achieve a minimum $\frac{1}{4}$ " (6 mm) amplitude (CSP-6-9 in accordance with ICRI Guideline No. 310.2R) by means of sand blasting, shot blasting, or water blasting. Application surfaces shall be clean, sound, and free of standing water at time of application. All dust, laitance, grease, curing compounds, and other foreign materials that may hinder the bond must be removed before installation. All corners to be covered with grid and matrix shall be rounded to a $\frac{3}{4}$ " (19 mm) minimum radius using a grinder. Wet the substrate for at least 24 hours to a saturated surface dry condition prior to FRCM application.

Application

CSS installation shall only be performed by contractors and personnel that have been properly trained by Simpson Strong-Tie. CSS-CM cementitious matrix can be pumped and projected with traditional shotcrete equipment or applied manually. If required, CSS-CM may be used to patch voids and defects no deeper than 2" (51 mm). Place $\frac{1}{4}$ "– $\frac{1}{2}$ " (6–13 mm) layer of CSS-CM cementitious matrix, then immediately set CSS-UBG grid into wet CSS-CM layer. Follow with additional layers of CSS-BCG, if required, set into $\frac{1}{4}$ "– $\frac{1}{2}$ " (6–13 mm) layers of CSS-CM. Finish with a final layer of CSS-CM at $\frac{1}{4}$ "– $\frac{1}{2}$ " (6–13 mm) thick and screed/trowel to desired finish. If a layer of matrix is allowed to cure with more layers to follow, the first layer must be cleaned with water pressure before the next matrix layer can be applied. See CSS-CM product data sheet for more detailed application and curing recommendations.

Matrix Working and Set Time

See product data sheet for the working time and set times of CSS-CM cementitious matrix.

Limitations

CSS installation shall take place only when the ambient and substrate temperatures are between 41°F (5°C) and 86°F (30°C). Installation shall be kept humid and protected against heat and wind for three to five days after application.

SAFETY PRECAUTIONS

Proper personal protection equipment (PPE) shall be worn at all times. Avoid contact with skin and eyes. Particulate masks, rubber gloves, safety glasses, and coverall suits are recommended. Refer to MSDS for full information.

FIRST AID

Skin: Wash fibers off skin with water and soap. If fibers are embedded in the skin, remove with tweezers. Discard clothing that may contain embedded fibers. **GET MEDICAL ATTENTION** if exposure results in adverse effects.

Eyes: Immediately flush with a continuous water stream for at least 20 minutes. Washing immediately after exposure is expected to be effective in preventing damage to the eyes. **GET MEDICAL ATTENTION**.

Inhalation: If there is inhalation exposure to the fibers of this product, remove source of exposure and move patient to fresh air. If the patient is not breathing, give artificial respiration. If there is breathing difficulty, give oxygen. **GET IMMEDIATE MEDICAL ATTENTION** for any respiratory problems.

Ingestion: Not expected to occur since ingestion is not a likely route of exposure for this product. If ingestion does occur, **DO NOT INDUCE VOMITING**. Give nothing by mouth if patient is unconscious. **GET IMMEDIATE MEDICAL ATTENTION**.

CLEAN-UP

Dispose of material in accordance with local regulations.

 SHELF LIFE

10 years from date of manufacture

STORAGE

Store material in a dry area with no exposure to moisture.

LIMITED WARRANTY

See www.strongtie.com for information.

IMPORTANT INFORMATION

It is the responsibility of each purchaser and user of each Product to determine the suitability of the Product for its intended use. Prior to using any Product, consult a qualified design professional for advice regarding the suitability and use of the Product, including whether the capacity of any structural building element may be impacted by a repair. As jobsite conditions vary greatly, a small-scale test patch is required to verify product suitability prior to full-scale application. The installer must read, understand, and follow all written instructions and warnings contained on the product label(s), Product Data Sheet(s), Material Safety Data Sheet(s) and the www.strongtie.com website prior to use. For industrial use only by qualified applicators. **KEEP OUT OF REACH OF CHILDREN!**

Proposition 65: Products named within this document contain materials listed by the state of California as known to cause cancer, birth defects, or reproductive harm.



PROJECT OVERVIEW & TECHNICAL ADDENDUM



CHROMIUM OXIDE GREEN PIGMENT

Product Code:	5376	Date: 07/13/2009
Commercial Name:	Chromium Oxide Green	Ref: 5376
Manufacturer:	Huntsman	Version: 001
Pigment Classes:	Pigment Green 17 / Color Index No. 77288	
CAS No:	1308-38-9	
EINECS No:		Page 1 of 1

Description

Chromium Oxide Green 5376 is a dark-shade high-tinting strength inorganic green pigment made by reducing alkali chromates obtained from chrome iron ore to chromic oxide under very high processing temperatures. This produces a pigment of high degree of durability, particle hardness and a spherical shape. Its primary use is in coatings, colorants, plastics, paper, adhesives, rubber, buffering and abrasive compounds and other specialty applications. In addition, it meets **ASTM C979-82** standards and therefore is suitable to color concrete, stucco or other cement-based products. Chromium Oxide Green 5376 is color-stable in processing temperatures up to 1000°C (1832°F). It is not of sufficient purity for use in packaging or articles that come in contact with food (21CFR) or for the direct coloration of food or cosmetics. It meets specifications: TT-C-306 and TT-P-347. All Chromium Oxide Greens are stable under exposure to sunlight and UV radiation and are alkali, chemical and weather resistant. Chromium Oxide Green 5376 is packaged in 55 pound (25 kilo) multiwall paper bags and shrink-wrapped onto pallets of 2200 pounds (1000 kilos). *Uses: Paint, plastics, rubber, colorants, powder coatings, adhesives, ink, vinyl, abrasives, polishes, concrete, stucco, and plaster.*

Composition/Typical Properties

Cr ₂ O ₃ content (%)	99+
Oil Absorption (g/100g)	15
Weight per Gallon (lbs)	43.3
Specific Gravity (g/cm ³)	5.2
Tap Density (g/ml)	1.2
325 Mesh Retention (%)	0.3
Water Soluble Salts (%)	<0.8
Moisture & Volatile (%)	0.1
Ignition Loss (%)	0.5
pH	6.0 – 7.0
Hegman Grind	<3.0
Particle Shape	Spheroidal
Predominant Particle Size (μm)	0.30

Typical Trace Metal Content in Parts Per Million (ppm)

Arsenic (As)	<0.5
Barium (Ba)	<1
Cadmium (Cd)	<1
Chromium (VI) (Cr) Soluble	<500
Lead (Pb)	<5
Mercury (Hg)	<0.2
Selenium (Se)	<0.5
Zinc (Zn)	<1

The values for typical contents and trace metals are provided as general information only. They are approximate values for reference and not specifications utilized in our standard QC procedures for color and consistency.



PROJECT OVERVIEW & TECHNICAL ADDENDUM



COBALT BLUE PIGMENT



DAVIS COLORS

Product Code:	418	Date: 01/19/2018
Commercial Name:	Cobalt Blue	Ref: 418
Manufacturer:	Rockwood Pigments/Davis Colors	Version: 001
Pigment Classes:	Pigment Blue 36 / Color Index No. 77343	
CAS No:	68167-11-1	
EINECS No:	269-072-0	Page 1 of 1

Description

Cobalt blue ($\text{Co}(\text{CrAl})_2\text{O}_4$) is a high-strength inorganic blue pigment manufactured by calcination of Cobalt, Chrome and Aluminum at processing temperatures above 1000°C. Cobalt blue 418 is ideally suited for the coloration of thermoplastics, thermosetting resins and surface coatings. In addition, it meets ASTM C979-82 standards and therefore is suitable for use in concrete and concrete products. No visible effect after 1 hour in 5% HCl (acid) solution or 1 hour in 1% NaOH (alkali) solution. Better than 8 on British Wool Scale for lightfastness and weatherability in Xenotest 150. Non-bleeding in: lacquer, aliphatic and aromatic solvents. Cobalt blue 418 is color-stable up to 1000°C (1832°F), non-migrating and offers maximum stability to: weathering, fading, chemical and solvent exposure, thermal degradation and oxidation. It is of sufficient purity for use in packaging or articles that come in contact with food (21CFR), but not suitable for the direct coloration of food or cosmetics. Cobalt blue 419 is packaged in (25 Kgs) 55 pound bag-in-box and shrink-wrapped onto pallets of (1000 Kgs) 2200 pounds (also available in smaller package sizes). *Uses: Paint, plastics, rubber, colorants, powder coatings, adhesives, ink, concrete, stucco, and plaster.*

Composition – Typical Properties

	Min/Max	Test Method
Co(CrAl) ₂ O ₄ content (%)	90-100%	
Oil Absorption (g/100g)	19.5	ISO787 - 5
Weight per Gallon (lbs)	37.47	
Specific Gravity (g/cm ³)	4.49	BS3483
Bulk Density – Tapped (g/ml)	1.06	ISO787 - 11
325 Mesh Retention (%)	0.01	
Water Soluble Salts (%)	0.4	
Ignition Loss (%)	0.5	
pH	8 – 9	ISO787-9
BET Surface Area (m ² /g)	5.9	ASM640
Hegman Grind	5.0	
Predominant Particle Size (μm)	1.3	ASM633

The values for typical contents and trace metals are provided as general information only. They are approximate values for reference and not specifications utilized in our standard QC procedures for color and consistency.



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CALVANIZED AIRCRAFT CABLE

Galvanized Aircraft Cable 1/16" (7X7)

PRODUCT SPECS

Weight	0.00500
Size	1/16"
Breaking Strength Lbs.	480
Type	7 x 7



PROJECT OVERVIEW & TECHNICAL ADDENDUM



K15 CLASS BUBBLES

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

		True Density (g/cc)		
	Product	Typical	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
iM Series	S60 0.200
	S60HS 0.200
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%
iM Series	S60 92%	90%
	S60HS 92%	90%
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

Product	Particle Size (microns, by volume) 3M QCM 193.0			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
iM Series	S60 15	30	55	65
	S60HS 12	29	48	60
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.

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.

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.

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PROJECT OVERVIEW & TECHNICAL ADDENDUM



MASTERAIR AE 90

MasterAir® AE 90

Air-Entraining Admixture

Formerly MB-AE 90*

Description

MasterAir AE 90 air-entraining admixture is for use in concrete mixtures. It meets the requirements of ASTM C 260, AASHTO M 154 and CRD-C 13.

Applications

Recommended for use in:

- Concrete exposed to cyclic freezing and thawing
- Production of high-quality normal or lightweight concrete (heavyweight concrete normally does not contain entrained air)

Features

- Ready-to-use in the proper concentration for rapid, accurate dispensing

Benefits

- Improved resistance to damage from cyclic freezing and thawing
- Improved resistance to scaling from deicing salts
- Improved plasticity and workability
- Reduced permeability – increased watertightness
- Reduced segregation and bleeding

Performance Characteristics

Concrete durability research has established that the best protection for concrete from the adverse effects of freezing and thawing cycles and deicing salts results from: proper air content in the hardened concrete, a suitable air-void system in terms of bubble size and spacing, and adequate concrete strength, assuming the use of sound aggregates and proper mixing, transporting, placing, consolidation, finishing and curing techniques. MasterAir AE 90 admixture can be used to obtain adequate freeze-thaw durability in a properly proportioned concrete mixture, if standard industry practices are followed.

Air Content Determination: The total air content of normal weight concrete should be measured in strict accordance with ASTM C 231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method" or ASTM C 173/C 173M, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method." The air content of lightweight concrete should only be determined using the Volumetric Method. The air content should be verified by calculating the gravimetric air content in accordance with ASTM C 138/C 138M, "Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete." If the total air content, as measured by the Pressure Method or Volumetric Method and as verified by the Gravimetric Method, deviates by more than 1.5%, the cause should be determined and corrected through equipment calibration or by whatever process is deemed necessary.

Guidelines for Use

Dosage: There is no standard dosage for MasterAir AE 90 admixture. The exact quantity of air-entraining admixture needed for a given air content of concrete varies because of differences in concrete-making materials and ambient conditions. Typical factors that might influence the amount of air entrained include: temperature, cementitious materials, sand gradation, sand-aggregate ratio, mixture proportions, slump, means of conveying and placement, consolidation and finishing technique. The amount of MasterAir AE 90 admixture used will depend upon the amount of entrained air required under actual job conditions. In a trial mixture, use 0.25 to 4 fl oz/cwt (16-260 mL/100 kg) of cementitious material. Measure the air content of the trial mixture, and, if needed, either increase or decrease the quantity of MasterAir AE 90 admixture to obtain the desired air content.

In mixtures containing water-reducing or set-control admixtures, the amount of MasterAir AE 90 admixture needed may be somewhat less than the amount required in plain concrete.

Due to possible changes in the factors that can affect the dosage of MasterAir AE 90 admixture, frequent air content checks should be made during the course of the work. Adjustments to the dosage should be based on the amount of entrained air required in the mixture at the point of placement.

If an unusually high or low dosage of MasterAir AE 90 admixture is required to obtain the desired air content, consult your local sales representative. In such cases, it may be necessary to determine that, in addition to a proper air content in the fresh concrete, a suitable air-void system is achieved in the hardened concrete.

Dispensing and Mixing: Add MasterAir AE 90 admixture to the concrete mixture using a dispenser designed for air-entraining admixtures, or add manually using a suitable measuring device that ensures accuracy within plus or minus 3% of the required amount.

For optimum, consistent performance, the air-entraining admixture should be dispensed on damp, fine aggregate. If the concrete mixture contains fine lightweight aggregate, field evaluations should be conducted to determine the best method to dispense the air-entraining admixture.

Precaution

In a 2005 publication from the Portland Cement Association (PCA R&D Serial No. 2789), it was reported that problematic air-void clustering that can potentially lead to above normal decreases in strength was found to coincide with late additions of water to air-entrained concretes. Late additions of water include the conventional practice of holding back water during batching for addition at the jobsite. Therefore, caution should be exercised with delayed additions of water to air-entrained concrete. Furthermore, an air content check should be performed after post-batching addition of any other materials to an air-entrained concrete mixture.

Product Notes

Corrosivity – Non-Chloride, Non-Corrosive: MasterAir AE 90 admixture will neither initiate nor promote corrosion of reinforcing and prestressing steel embedded in concrete, or of galvanized floor and roof systems. No calcium chloride or other chloride-based ingredients are used in the manufacture of this admixture.

Compatibility: MasterAir AE 90 admixture may be used in combination with any BASF admixture, unless stated otherwise on the data sheet for the other product. When used in conjunction with other admixtures, each admixture must be dispensed separately into the concrete mixture.

Storage and Handling

Storage Temperature: MasterAir AE 90 admixture should be stored and dispensed at 31 °F (-0.5 °C) or higher. Although freezing does not harm this product, precautions should be taken to protect it from freezing. If MasterAir AE 90 admixture freezes, thaw at 35 °F (2 °C) or above and completely reconstitute by mild mechanical agitation. Do not use pressurized air for agitation.

Shelf Life: MasterAir AE 90 admixture has a minimum shelf life of 18 months. Depending on storage conditions, the shelf life may be greater than stated. Please contact your local sales representative regarding suitability for use and dosage recommendations if the shelf life of MasterAir AE 90 admixture has been exceeded.

Safety: Chemical goggles and gloves are recommended when transferring or handling this material.

Packaging

MasterAir AE 90 admixture is supplied in 55 gal (208 L) drums, 275 gal (1040 L) totes and by bulk delivery.

Related Documents

Safety Data Sheets: MasterAir AE 90 admixture

Additional Information

For additional information on MasterAir AE 90 admixture, or its use in developing a concrete mixture with special performance characteristics, contact your local sales representative.

The Admixture Systems business of BASF's Construction Chemicals division is the leading provider of solutions that improve placement, pumping, finishing, appearance and performance characteristics of specialty concrete used in the ready-mixed, precast, manufactured concrete products, underground construction and paving markets. For over 100 years we have offered reliable products and innovative technologies, and through the Master Builders Solutions brand, we are connected globally with experts from many fields to provide sustainable solutions for the construction industry.

Limited Warranty Notice

BASF warrants this product to be free from manufacturing defects and to meet the technical properties on the current Technical Data Guide, if used as directed within shelf life. Satisfactory results depend not only on quality products but also upon many factors beyond our control. **BASF MAKES NO OTHER WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO ITS PRODUCTS.** The sole and exclusive remedy of Purchaser for any claim concerning this product, including but not limited to, claims alleging breach of warranty, negligence, strict liability or otherwise, is shipment to purchaser of product equal to the amount of product that fails to meet this warranty or refund of the original purchase price of product that fails to meet this warranty, at the sole option of BASF. Any claims concerning this product must be received in writing within one (1) year from the date of shipment and any claims not presented within that period are waived by Purchaser. **BASF WILL NOT BE RESPONSIBLE FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFITS) OR PUNITIVE DAMAGES OF ANY KIND.**

Purchaser must determine the suitability of the products for the intended use and assumes all risks and liabilities in connection therewith. This information and all further technical advice are based on BASF's present knowledge and experience. However, BASF assumes no liability for providing such information and advice including the extent to which such information and advice may relate to existing third party intellectual property rights, especially patent rights, nor shall any legal relationship be created by or arise from the provision of such information and advice. BASF reserves the right to make any changes according to technological progress or further developments. The Purchaser of the Product(s) must test the product(s) for suitability for the intended application and purpose before proceeding with a full application of the product(s). Performance of the product described herein should be verified by testing and carried out by qualified experts.

* MB-AE 90 became MasterAir AE 90 under the Master Builders Solutions brand, effective January 1, 2014.

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PROJECT OVERVIEW & TECHNICAL ADDENDUM



NEWCEM SLAG



LAFARGE Cement Test Report

CEMENT

Mill Test Report Number: SEA_NEWCEM_AUG

YEAR: 2016

MONTH: SEPTEMBER

PLANT: Seattle

CEMENT TYPE: Grade 100 NewCem

Reference Cement		
Fineness by Air Permeability (m ² /kg; ASTM C204)	414	
Fineness by 45 µm (No. 325) Sieve (% retain; ASTM C430)	2.3	
Compressive Strength (ASTM C109/C109 M)	psi	
7-day	4,681	
28-day	5,562	
Total Alkalies (Na ₂ O + 0.658 K ₂ O) (%, ASTM C114)	<u>Actual</u> 0.81	<u>Max Limit</u> 0.9

Slag			
Slag			
CHEMICAL ANALYSIS	Percent		
Silica Dioxide (SiO ₂ ; ASTM C114)	33.9		
Ferric Oxide (Fe ₂ O ₃ ; ASTM C114)	0.9		
Aluminum Oxide (Al ₂ O ₃ ; ASTM C114)	15.5		
Calcium Oxide (CaO; ASTM C114)	41.8		
Sulfur Trioxide (SO ₃ ; ASTM C114)	2.4		
Magnesium Oxide (MgO; ASTM C114)	4.8		
Potassium Oxide (K ₂ O; ASTM C114)	0.3		
Titanium Oxide (TiO ₂ ; ASTM C114)	0.6		
Loss on Ignition (L.O.I.; ASTM C114)	0.1		
Inorganic Process Addition	3		
Air Content of Mortar	Actual 4.6	Max Limit 12	
Sulfide Sulfur	Actual 0.66	Max Limit 2.5	
Sulfate Ion	Actual 0.8	Max Limit 4	
Autoclave expansion	Actual -0.010	Max Limit 0.5	

The ground granulated blast furnace slag complies with the current specification of the chemical physical requirement of ASTM C-989, AASHTO M-302 for grade 100 Ground Granulated Blast Furace Slag (GGBFS) and and CSA A3001 Slag.

Slag source is JFE Mineral Company in Kurashiki City, Japan. NewCem is ground and manufactured in Seattle, WA.

Certified by:



Daniel Waldron
Quality Control Laboratory Supervisor

September 15, 2016



PROJECT OVERVIEW & TECHNICAL ADDENDUM



NYCON-PVA RECS 100

NYCON-PVA RECS100

PVA (Polyvinyl Alcohol), Medium 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 RECS100 Physical Properties

Filament Diameter	20 Denier (100 Microns)
Fiber Length	0.5" (13 mm)
Specific Gravity	1.3
Tensile Strength	180 ksi (1200 MPa)
Flexural Strength	3600 ksi (25 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 RECS100 fiber products are 20 denier, monofilament PVA fibers for use in fiber reinforced concrete, stucco, shotcrete and precast. NYCON-PVA RECS100 is specifically designed for use in concrete products for the purpose of controlling plastic shrinkage, thermal cracking and improving abrasion resistance.

NYCON-PVA RECS100 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.

NYCON-PVA RECS100

PVA (Polyvinyl Alcohol), Medium 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 RECS100 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) water soluble 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, water soluble 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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PROJECT OVERVIEW & TECHNICAL ADDENDUM



NYCON-PVA RFS 400

NYCON-PVA RFS400

PVA (Polyvinyl Alcohol), Medium 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 RFS400 Physical Properties

Filament Diameter	40 Denier (200 Microns)
Fiber Length	0.75" (19 mm)
Specific Gravity	1.3
Tensile Strength	150 ksi (1000 MPa)
Flexural Strength	4200 ksi (29 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 RFS400 fiber products are 40 denier, monofilament PVA fibers for use in fiber reinforced concrete, stucco, shotcrete and precast. NYCON-PVA RFS400 is specifically designed for use in concrete products for the purpose of controlling plastic shrinkage, thermal cracking and improving abrasion resistance.

NYCON-PVA RFS400 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.

NYCON-PVA RFS400

PVA (Polyvinyl Alcohol), Medium 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 RFS400 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

(35) 1 lb (0.45 kg) paper beater bags per box, 700 lbs per pallet
(35) 1 lb (0.45 kg) water soluble bags per box, 700 lbs per pallet
(21) 40 lb (18 kg) paper bulk bags, 693 lbs per pallet

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).

Nycon reserves the right to change the properties of its products without notice. All sales of Nycon product(s) are subject to its current terms and conditions of sale which are available at www.nycon.com or by calling 800-456-9266.

Prior to each use of any Nycon product, the user must always read and follow the warnings and instructions on the product's most current Technical Data Sheet, product label and Material Safety Data Sheet which are available. Nothing contained in any Nycon materials relieves the user of the obligation to read and follow the warnings and instruction for each Nycon product as set forth in the current Product Data Sheet, product label and Material Safety Data Sheet prior to product use.

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.

NO OTHER WARRANTIES EXPRESS OR IMPLIED SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Nycon SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES. Nycon SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.

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PROJECT OVERVIEW & TECHNICAL ADDENDUM



PORAVER EXPANDED CLASS

TECHNICAL DATA SHEET

Lightweight aggregate according to DIN EN 13055-1

Poraver® expanded glass	BASIC GRANULAR SIZES					SPECIAL GRANULAR SIZES	
	0.1-0.3	0.25-0.5	0.5-1	1-2	2-4	0.04-0.125	0.5-1.25
Granular size in mm	0.1-0.3	0.25-0.5	0.5-1	1-2	2-4	0.04-0.125	0.5-1.25
Bulk density in kg/m ³	400 ± 60	340 ± 30	270 ± 30	230 ± 30	190 ± 20	530 ± 70	260 ± 30
Particle density in kg/m ³	950 ¹⁾ ± 150	700 ¹⁾ ± 80	500 ¹⁾ ± 80	400 ¹⁾ ± 60	320 ¹⁾ ± 40	1400 ²⁾ ± 300	490 ¹⁾ ± 80
Crushing resistance in N/mm ² according to DIN EN 13055-1 ³⁾	2.8	2.6	2.0	1.6	1.4	-	1.9
Oversize % by mass	≤ 10						
Undersize % by mass	≤ 15						
pH value	8 - 11						
Moisture content % by volume	< 0.2						
Moisture content % by mass	< 0.5						
Water absorption % by volume	33	15	9	7	4.5	-	10
Water absorption % by mass	35	21	18	19	14	-	20
Softening point	approx. 700°C						
Colour	creamy white						
Thermal conductivity W/(m·K)	-	-	-	-	0.07 ⁴⁾	-	-
CE according DIN EN 13055-1	•	•	•	•	•	-	•
Approval Z-3.42-1894	•	•	•	•	•	-	•
Approval Z-23.11-114	-	-	-	-	•	-	-

¹⁾ Apparent (relative) density according to EN 1097-6

²⁾ Density of filler according to EN 1097-7

³⁾ Values according to DIN V 18004 on request

⁴⁾ Calculated values DBt according to Approval Z-23.11-114 (Thermal insulating material, non combustible according to construction material class DIN 4102-A1)

The strength grades may vary within the tolerance range of bulk densities. The availability and delivery conditions for special grain sizes will be agreed on an individual basis.

CHEMICAL ANALYSIS

Constituent	Applied to the sample dried at 105°C	LOI free	Analysis method
Loss on ignition	0.3 %	-	DIN EN 1744-1
CaO	8.9 %	9.0 %	atomic emission spectrometric (AES)
SiO ₂	71.7 %	71.9 %	
Al ₂ O ₃	2.5 %	2.5 %	
TiO ₂	0.1 %	0.1 %	
Fe ₂ O ₃	0.4 %	0.4 %	
Mn ₂ O ₃	0 %	0 %	
MgO	2.1 %	2.1 %	
K ₂ O	0.8 %	0.8 %	
Na ₂ O	13.2 %	13.2 %	
SO ₃	0.1 %	0.1 %	coulometric
Cl	-	-	argentometric

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PROJECT OVERVIEW & TECHNICAL ADDENDUM



PORLAND TYPE I CEMENT

Product Data Sheet

Division 3 — Concrete
Division 4 — Masonry



PRODUCT NAME

- Lehigh White Portland Cement Types I, II, III and V
- Lehigh White Portland Cement—Type I Water Repellent Added
- Lehigh White PLC—Portland Limestone Cement Type IL(10), GUL or GU
- Lehigh White Masonry Cement, Types N and S

MANUFACTURER

Lehigh White Cement Company
7660 Imperial Way
Allentown, PA 18195
Phone: 610.366.4600
info@lehighwhitecement.com
www.lehighwhitecement.com



PRODUCT DESCRIPTION

Lehigh White Cement Company is the leading supplier of white cements in North America. We have been producing quality portland cements since 1897. For more than 100 years Lehigh has built a reputation for serving the construction industry with high performance products that encourage creativity and ensure longevity. This Product Data Sheet gives a brief overview of the types, specifications and some common uses of our cement. Depending on application, Lehigh White Cement products may be specified in Division 3 - Concrete or Division 4 - Masonry. For more info on our products visit us online @ www.lehighwhitecement.com.

SPECIFICATIONS

Portland Cements

Portland Cements are manufactured to meet ASTM C150 / AASHTO M85 and CSA A3001 specifications

PLC - Portland Limestone Cement

Portland Limestone Cements are manufactured to meet either the ASTM C595 and CSA A3001 or ASTM C1157 specifications.

Masonry Cements

Masonry Cements are manufactured to meet ASTM C91 and CSA A3002 specifications

APPLICATIONS

Lehigh White Portland Type I - Lehigh White Cements are regularly used to produce architectural concrete. General applications include cast-in-place or precast wall panels, floors, slabs, terrazzo, thin-set and tile grouts, cast stone, masonry units and mortars, stucco, swimming pools & spas, glass fiber reinforced concrete, ornamental statuary, floor tiles, concrete roof tiles, perimeter security, pavers and traffic safety items such as concrete median barriers, bridge parapets, pedestrian crosswalks, curbs and other delineators. White cement is often used to produce bright finishes, vibrant colors or ultra high performance concretes that look great and provide structural performance that make them ideal for resilient building applications.

Portland Type II and Type V - In addition to general use, Type II and Type V cements have moderate heat of hydration. Combined in mixes with low water-to-cement ratios and low permeability, Type II and Type V cements are less susceptible to the negative effects of higher than normal sulfate concentrations.

APPLICATIONS - Continued

Portland Type III - Type III portland cement is intended for use where high early strength or a finer grind is required. Type III portland cement is frequently used in precast and cold weather applications.

Portland Limestone Cement CSA A3001 GUL / ASTM C595 Type IL(10)

We intergrind approximately 10% limestone by weight as an ingredient in this blended cement which has similar strength & setting characteristics to our Type I cement. It is used in applications where Type I cement would be typical. It offers advantages in workability and sustainability.

PLC - Portland Limestone Cements ASTM 1157 Type GU - This cement conforms to the Standard Performance Specification for Hydraulic Cement for general construction. It is used where longer set times and workability are preferred characteristics. This specialty cement is most often used in cement rich mixtures such as pool plasters.

Lehigh White Masonry Cements Types N and S - Lehigh White Masonry Cements are combined with sand to produce either Type N or Type S Masonry Mortars per the ASTM C270 specification. They can also be used to produce interior plasters & exterior stucco. These cements are specially formulated for enhanced workability and water retention.

QUALITY

Lehigh White Portland, PLC and Masonry Cements are produced using carefully selected raw materials and rigid manufacturing standards to assure uniform whiteness and high performance. Count on our quality to stretch architectural boundaries through design, color and texture.

SUSTAINABILITY

Minerals used to produce white cement rank among the most abundant elements on earth. Besides having very low embodied energy and CO₂ emissions, portland cement concrete is resilient, durable & long lasting. Specify white cement for dynamic architectural & structural applications.

STORAGE

Portland cement must be kept dry in order to retain its quality. Protect packaged cement from moisture; store bulk cement weather-tight silos.

AVAILABILITY

Not every cement type is available in all markets. Lehigh White Cements are distributed throughout the United States and Canada.

SAFETY

Prior to using or handling cement products first read and understand Safety Data Sheets available at www.lehighwhitecement.com.

WARRANTY

Information and statements given are believed reliable, but are not to be construed as a warranty or representation for which the manufacturer assumes legal responsibility. No warranty, representation, or condition of any kind, expressed or implied (including no warranty of merchantability or fitness for a particular purpose) shall apply. Having no control over the use of cement, Lehigh will not guarantee finished work, nor shall Lehigh White Cement Company be liable for consequential damages.

For more product information or technical assistance:

www.lehighwhitecement.com

email: info@lehighwhitecement.com



PROJECT OVERVIEW & TECHNICAL ADDENDUM



SHORT STUFF SYNTHETIC PULP ESS5F

MINIFIBERS, INC.

TECHNICAL DATA SHEET SHORT STUFF™ SYNTHETIC PULP

Document No. SS-05
DCN 160502

Grade	ESS5F	ESS50F*	ESS2F	E380F	E505F*	E780F					
Average Fiber Length Expressed in millimeters (mm)	~0.1	~0.1	~0.6	~0.7	~0.9	~1.6					
Fiber Diameter Expressed in microns	5	5	5	15	15	25					
Surface Area (m²/gm) Measured by gas absorption	12	12	12	8	8	8					
Canadian Standard Freeness (cc)	-	-		670	680						
* Selected grades for improved dispersion in low shear aqueous systems.											
Melting Point	~135°C / ~275°F										
Moisture Content (%)	<2.0										
Specific Gravity (g/cm³)	0.96										
Bulking Value	Metric	1.04~1.10 litres/kg -- .91~.96 kgs/litre									
	English	0.1250~0.1319 gallons/lb -- 7.580~7.997 lbs/gallon									
Fiber Type	HDPE										
Chemical Formula	{CH ₂ - CH ₂ }										
CAS Number	9002-88-4										
Dispersibility	Dispersible in aqueous or solvent systems.										
Plasticity, Appearance, and Odor	Soft, flexible fibers, white and fluffy with no odor.										
Effects of Bleaches and Solvents	Swells in chlorinated hydrocarbons at room temperature. Soluble at 160 to 170 °F.										
Effects of Acids and Alkalies	Excellent resistance to acids and alkalis, with the exception of oxidizing agents.										
Resistance to Mildew, Aging, Sunlight, Abrasion	Not attacked by mildew; good resistance to aging, sunlight, and abrasion.										
Packaging	Packaged in multi-walled kraft bags.										

The above information is provided to describe typical values and does not constitute a product specification.



PROJECT OVERVIEW & TECHNICAL ADDENDUM



SIKA FLORSEAL WB-25

PRODUCT DATA SHEET

Edition 06.2018/v1

CSC Master Format™ 03 39 23.13

CHEMICAL COMPOUND MEMBRANE CONCRETE CURING

Sika® Florseal WB-18 & -25

WATER-BASED ACRYLIC CONCRETE CURE AND SEAL

Description Sika® Florseal WB-18 & -25 are a ready-to-use; water-based, clear, high gloss, non-yellowing, acrylic emulsion cure and seal. They are applied to new concrete substrates after the final finishing operations are completed to form a film that retains mix water allowing normal hydration. This film remains as a protective surface sealing treatment that greatly reduces dusting and increases stain resistance of the cured concrete. Product is available in two solids contents: Sika® Florseal WB-18 is an economical cure and seal that meets the moisture retention requirements of ASTM C309 Type 1, Class A. Sika® Florseal WB-25 is a premium grade, high build, cure and seal that meets the moisture retention requirements of ASTM C309 Type 1, Clear and the alkali resistance, acid resistance, adhesion-promoting qualities and UV light degradation properties of ASTM C1315 Type 1, Class A.

Where to Use

- For application on vertical, horizontal, smooth or textured, concrete substrates.
- Suitable for curing and sealing plain concrete and concrete surfaces treated with non-metallic, dry shake floor hardeners and topping courses.
- Suitable for interior or exterior concrete floors, pavements, sidewalks and structures. UV stable.
- Applications to existing concrete surfaces as economical, water clear, protective sealing treatments.
- Applications where solvent-based products cannot be used because of health and safety reasons.

Advantages

- Excellent moisture retention produces a durable concrete surface through optimum curing.
- Reduces dust on new and existing concrete substrates by forming a film that seals the surface.
- Protective sealer that resists some mild acids, alkalis and oils that may damage concrete.
- Increases stain resistance and cleanability by sealing the surface pores.
- Protects against damage from sudden rainfall.
- Easy application, one coat effectively cures and seals concrete surfaces. No additional burlap or polyethylene sheeting is required.
- Sika® Florseal WB 25 passes the adhesion requirements of ASTM C1315 Type 1, Class A standard that evaluates the compatibility of the sealer with common adhesives. Specifically, ceramic tile adhesives to the requirements of specification ANSI A136.1-1992 and vinyl tile adhesion to the Resilient Floor Covering Institute specification ADH-1.
- Meets the requirements of CFIA and USDA for use in food plants.
- Ministère des Transports du Québec acceptance.
- Product recognized by the British Columbia Ministry of Transportation(BC MoT).

Technical Data

Packaging	18.9 L (5 US gal.) pail and 208 L (55 US gal.) drum	
Colour	Water Clear	
Yield	Sika® Florseal WB-18	Sika® Florseal WB-25
Steel trowelled finished concrete	4.9 m ² /L (200 ft ² /US gal.)	7.4 m ² /L (300 ft ² /US gal.)
Float or broom finished concrete	2.5 m ² /L (100 ft ² /US gal.)	4.9 m ² /L (200 ft ² /US gal.)
(These figures do not allow for surface porosity, profile or wastage)		
Shelf Life	2 years in original unopened packaging. Protect from freezing.	
Properties at 20 °C (68 °F) and 50 % R.H.		
Drying Times	Touch-dry	45 min
	Light traffic	4 hrs
	Normal traffic	12 hrs
	Max. hardness	7 days
VOC Content	< 250 g/L	
<i>Product properties are typically averages, obtained under laboratory conditions. Reasonable variations can be expected on-site due to local factors, including environment, preparation, application, curing and test methods.</i>		

HOW TO USE

Application

Stir well prior to use, ensuring thorough agitation and distribution of any settled material throughout the liquid. Where necessary, use a paint straining mesh or fabric to collect any material which has formed a surface skin; the presence of which is a consequence of reaction during packaging and is not representative of any reduction in product quality. Apply by spray, brush, long nap roller, or lambs wool applicator. For best results, Sika Canada recommends a low-pressure garden-type sprayer with neoprene hoses. Apply uniformly to form a continuous film.

Curing New Concrete: Application should be made immediately following the final finishing operations as soon as the "sheen" of bleeding water on the surface has disappeared and slab can support the weight of an applicator.

Sealing New Concrete: For an excellent sealer and added protection to concrete cured with Sika® Florseal WB-18 & -25, apply a second coat after 28 days of curing. If not previously applied when curing concrete, apply two coats, second coat four hours after first coat. Area to be sealed must be cleaned and free of all foreign matter such as dirt, rubber marks, paint, etc. Apply product at 7.4 to 9.8 m²/L (300 to 400 ft²/US gal.) to dry surface.

Dustproofing / Sealing Aged Concrete: Defective mortar, open joints and spalling should be repaired. Surface must be structurally sound and free of foreign matter such as grease, oil, dirt, and incompatible sealers and coatings. Degrease and remove rubber tire marks followed by a thorough rinse with clean water. Apply product to dry surface at 7.4 to 9.8 m²/L (300 to 400 ft²/US gal.) depending upon the porosity. Second coat is necessary for maximum protection. Apply after 4 hours drying time at 7.4 to 14.7 m²/L (300 to 600 ft²/US gal.).

Coloured Concrete: New or existing concrete, best results are obtained with Sika® Florseal WB-18. Wait a minimum of 72 hours after concrete placement to apply sealer. Existing concrete (minimum 28 day old) surfaces can be sealed with either Sika® Florseal WB-18 or Sika® Florseal WB-25. Do not over apply sealer, use coverage rates list above under "Sealing New" or "Sealing Aged Concrete". Test samples are recommended to confirm an acceptable result.

Clean Up	Prior to drying; equipment can be cleaned with soap and water.
Care of Sprayer	When not in use, release air pressure from spray can, keep hose and nozzle elevated to drain away from tip.
Limitations	<ul style="list-style-type: none">▪ Note: Sika® Florseal WB-18 & -25 are designed as an initial curing and sealing treatment only, not as a long lasting traffic bearing coating. Maintaining the initial glossy appearance on smooth concrete surfaces may require periodic recoating in the heavy traffic areas.▪ Do not use Sika® Florseal WB-18 & -25 on floors treated with wax or on surface where a solvent-based cure and seal agent is still present.▪ Not recommended for sealing metallic aggregate hardened floors.▪ Protect from freezing.▪ Do not apply if concrete temperature is below 4 °C (40 °F).▪ Test panel applications should be made prior to general application on exposed aggregate, concrete block, stone, precast, coloured concrete, etc to determine acceptability.▪ Not suitable for continuous immersion in water or around pools and fountains.▪ May not provide bond for cementitious or other adhesives. Sika Canada recommends that a test trial be performed by the adhesive manufacturer or overlayer applicator prior to general application.▪ Do not dilute or alter the product in any way.▪ Use in well ventilated areas.
Health and Safety Information	For information and advice on the safe handling, storage and disposal of chemical products, users should refer to the most recent SAFETY DATA SHEET containing physical, ecological, toxicological and other safety-related data.

**KEEP OUT OF REACH OF CHILDREN
FOR INDUSTRIAL USE ONLY**

The Information, and in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions, within their shelflife. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any recommendations, or from any other advice offered. The information contained herein does not relieve the user of the products from testing them for the intended application and purpose. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request or may be downloaded from our website at: www.sika.ca

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Certified ISO 9001 (CERT-0102780)
Certified ISO 14001 (CERT-0102791)



PROJECT OVERVIEW & TECHNICAL ADDENDUM



STRUCTURAL FINE LIGHTWEIGHT AGGREGATE



CHJ Consultants

1355 E. Cooley Drive, Suite C, Colton, CA 92324 ♦ Phone (909) 824-7311 ♦ Fax (909) 503-1136

15345 Anacapa Road, Suite D, Victorville, CA 92392 ♦ Phone (760) 243-0506 ♦ Fax (760) 243-1225

77-564A Country Club Drive, Suite 122, Palm Desert, CA 92211 ♦ Phone (760) 772-8234 ♦ Fax (909) 503-1136

September 30, 2015

Trinity Industries, Inc.

Job No. 15053-5

11728 Highway 93

Boulder, Colorado 80303

Attention: Mr. Clint Chapman

Subject: ASTM C330 Compliance Testing
Frazier Park Structural Fine Lightweight Aggregate

Dear Mr. Chapman:

At your request, CHJ Consultants performed tests on the structural fine lightweight aggregate to verify conformance with ASTM Designation C330-14 "Standard Specification for Lightweight Aggregates for Structural Concrete". The structural fine aggregate is a fine-graded expanded shale/clay aggregate produced at your plant in Frazier Park, California. The material was tested at the CHJ laboratory in Colton, California. The material tested was delivered to CHJ by Trinity Industries. The results are as follows:

A. DELETERIOUS SUBSTANCES:

Test	Test Method	Test Result	C330 Requirement
Organic Impurities	C40	Lighter than Standard	Lighter than Standard
Staining	C641	Stain Index of 20	Stain Index of Less than 60 Percent
Loss on Ignition	C114	0.43 Percent	Less than 5 Percent



Client: Trinity Industries, Inc.
Material: Structural Lightweight Aggregate

Page No. 2
Job No. 15053-5

B. PHYSICAL TESTS:

Test	Test Method	Test Result	C330 Requirement
Clay Lumps	C142	0.0 Percent	Less than 2 Percent

Grading - Sieve Analysis (Test Method C136) Fine Aggregate		
Sieve Size	Percent Passing	C330 Requirement
3/8" (9.5 mm)	100	100
No. 4 (4.75 mm)	100	85-100
No. 8 (2.36 mm)	96	---
No. 16 (1.18 mm)	62	40-80
No. 50 (300 µm)	20	10-35
No. 100 (150 µm)	13	5-25

Grading - Sieve Analysis (Test Method C136)			
Test	Test Method	Test Result	C330 Requirement
Bulk Density Dry Loose Condition	C29	54.9 PCF	70 pcf Maximum
Bulk Density SSD Loose Condition	C29	58.9 PCF	No Requirement
Density Factor	ACI 211.2	1.83	No Requirement
Absorption	C127	21.1%	No Requirement



Client: Trinity Industries, Inc.
Material: Structural Lightweight Aggregate

Page No. 3
Job No. 15053-5

C. TESTS ON CONCRETE MADE WITH LIGHTWEIGHT AGGREGATE:

Concrete Mixture - Fine Lightweight Aggregate/Normal Weight Coarse Aggregate

Material	Weight (lbs.)	Specific Gravity	Absolute Volume
Cement - Type II	564	3.15	2.87
Water	300	1.00	4.81
1" Aggregate	1,253	2.65	7.58
Structural Fines	1,156	1.83	10.13
Admixtures:			
Air Entraining (fl. oz.)	0.8		
Water Reducer (fl. oz.)	28.2		
Slump (inches)	4.00		
Air Content (%)	6.00		1.62
Plastic Unit Weight (pcf)	119.0		27.00

* Batch proportions for ASTM C330 aggregate conformance testing only. Not intended for field use.

Test	Test Method	28-Day Test Result		C330 Requirement
Compressive Strength	C39	6,480		
		6,520		
		6,350		
Average		6,450		4,000 psi Minimum
Splitting Tensile	C496	545	505	
		475	490	
		505	485	
		490	545	
Average		505		330 psi Minimum



Client: Trinity Industries, Inc.
Material: Structural Lightweight Aggregate

Page No. 4
Job No. 15053-5

C. TESTS ON CONCRETE MADE WITH LIGHTWEIGHT AGGREGATE (Cont'd):
Concrete Mixture - Fine Lightweight Aggregate/Normal Weight Coarse Aggregate

Test	Test Method	Test Result	C330 Requirement
Oven Dry Density	C567 (Calculated per Section 9.1)	108.6	No Requirement
Approximate Equilibrium Density	C567 (Calculated per Section 9.2)	111.6	115.0 pcf Maximum
Drying Shrinkage	C330 (Section 8.4)	0.035%	0.070% Maximum
Popout Test	C151	No Popouts	No Popouts

D. RESISTANCE TO FREEZING AND THAWING TEST:

The resistance to freezing and thawing test was not performed. Trinity Industries can demonstrate necessary resistance to freezing and thawing performance.

E. CONFORMANCE:

The structural fine lightweight aggregate manufactured by Trinity Industries at Frazier Park, California, conforms to the requirements of **ASTM Designation: C330-14** "Standard Specification for Lightweight Aggregates for Structural Concrete".



Client: Trinity Industries, Inc.
Material: Structural Lightweight Aggregate

Page No. 5
Job No. 15053-5

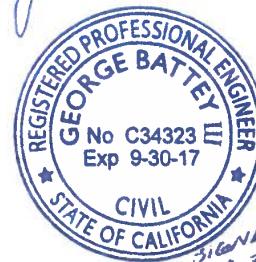
Thank you for the opportunity to provide materials testing services. If you should have any questions regarding this information, please do not hesitate to contact this firm at your convenience.

Respectfully submitted,

CHJ CONSULTANTS

Robert J. Johnson, P.E.
President

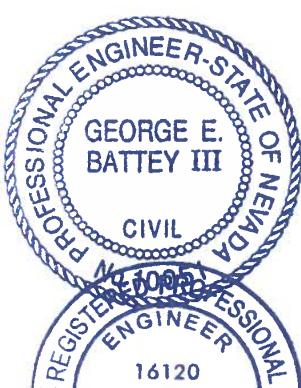
George Battey III
Consulting Engineer



California Registered Civil Engineer No. 34323
Registration Expires 09-30-2017



Arizona Registered Professional
(Civil) Engineer No. 29666
Registration Expires 12-31-2016



Nevada Professional Engineer No. 10051
Registration Expires 12-31-2016



Oregon Professional Engineer No. 16120
Registration Expires 12-31-2015

Distribution: Trinity Industries (4)
Clint Chapman - email (clint.chapman@trin.net)



PROJECT OVERVIEW & TECHNICAL ADDENDUM



STYROFAN 1186

Construction

Technical Data Sheet

Styrofan® 1186



Chemical Nature

Aqueous styrene-butadiene copolymer dispersion for use in concrete modification.

Properties

Typical Properties

Solids content	%	ca. 48
pH		ca. 10
Viscosity at 23 °C (Brookfield RVT, Spindle #1, at 20 rpm)	mPa s	ca. 38

Other properties of the dispersion

Surface Tension	dynes/cm	ca. 32
Specific Gravity	lbs/gal g/cm³	ca. 8.5 ca. 1.01
Bound Styrene	%	ca. 66
Average Particle Size	µm	ca. 0.2
Dispersion type		anionic
Coagulum (100 mesh)	Wt. %	< 0.1
Sensitivity to frost	cycles	ca. 2

Properties of the film

Glass transition temperature Tg (DSC)	°C	ca. 6
Mechanical strength*		
Tensile strength	psi N/mm²	ca. 600 ca. 4
Elongation at break	%	ca. 200
Appearance		slight yellow, transparent
Surface		tack-free

*This figure should be taken for comparison purposes only. All that can be obtained from it is an idea of the magnitude concerned

Applications

Fields of application

Styrofan® 1186 is used mainly for modifying concrete mixtures. The most notable applications are concrete for bridge deck and parking garage overlays. The addition of Styrofan® 1186 to conventional unmodified concrete mixtures reduces the amount of water required for the placement of the mix. The lower water typically results in a cured concrete with higher compressive strength. The polymer forms an elastic membrane throughout the matrix of the cured concrete, reducing the formation of voids and hairline cracks therein. Moreover, the resulting concrete mixture shows improved resistance to the penetration of oil, salts and aids in the adhesion of the new concrete to old. Flexural strength and abrasion resistance are also increased.

Styrofan® 1186 has been pre-qualified by the FHWA under FHWA RD-78-35.

Safety

General

The usual safety precautions when handling chemicals must be observed. These include the measures described in Federal, State and Local health and safety regulations, thorough ventilation of the workplace, good skin care and wearing of protective goggles.

Material Safety Data Sheet

All safety information is provided in the Material Safety Data Sheet for Styrofan® 1186.

Storage

Storage requirements for Styrofan® 1186 vary according to the method of shipment. Since indoor storage at a construction site usually is not feasible, a temporary covering must be provided for the storage container. Use of a white polyethylene film, a minimum of 4 mil thickness, is suggested for protection of the storage container from the elements. In hot weather, at temperatures over 85°F, the storage container should be covered with wet burlap, which will help to maintain the ideal temperature of the latex.

The ideal storage temperature range for Styrofan® 1186 is between 50°F – 85°F. However, slightly higher or lower temperatures will not affect the quality of the latex. At higher temperatures, surface skin formation may occur. This phenomenon is usually caused by the evaporation of water at the latex surface. To minimize this effect the latex temperature should not be allowed to exceed 105°F. While Styrofan® 1186 has been tested by the FHWA and shown to be freeze-thaw stable, it is recommended that the latex not be subjected to freezing conditions.

Important

The descriptions, designs, and data contained herein are presented for your guidance only. Because there are many factors under your control which may affect processing or application/use it is necessary for you to make appropriate tests to determine whether the product is suitable for your particular purpose prior to use. **NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE MADE REGARDING PRODUCTS DESCRIBED OR DESIGNS, OR INFORMATION SET FORTH, OR THAT THE PRODUCTS, DESIGNS, OR DATA MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, DATA OR DESIGNS PROVIDED BE PRESUMED TO BE A PART OF OUR TERMS AND CONDITIONS OF SALE.** Further, you expressly understand and agree that the descriptions, designs, and data furnished by BASF hereunder are given gratis and BASF assumes no obligation or liability for same or results obtained from use thereof, all such being given to you and accepted by you at your risk.

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BASF Corporation
Dispersions and Pigments
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Charlotte, North Carolina 28273
Phone: (800) 251 – 0612
Email: edtech_info@basf.com
www.bASF.us/dpsolutions



PROJECT OVERVIEW & TECHNICAL ADDENDUM



SYNTHETIC IRON OXIDE MEDIUM RED PIGMENT

Product Code:	1117	Date: 08/16/2001
Commercial Name:	Davis Colors™ Synthetic Iron Oxide Medium Red	Ref: 1117
Manufacturer:	Huntsman	Version: 001
Pigment Classes:	Pigment Red 101 / Color Index No. 77491	
CAS No:	1309-37-1	
EINECS No:		Page 1 of 1

Description

Davis Colors™ Red 1117 is a blend of medium and dark shade primary synthetic iron oxide reds (Fe_2O_3). It is designed for use in concrete, concrete products and mortar. It is manufactured in large batches on intensive grinding and blending equipment. Each batch is measured throughout the process and verified on spectrophotometer to certify its conformance with standards for tint strength and shade. It meets or exceeds ASTM C979-82 standards for pigments used in cement. Davis Colors™ Red 1117 is color-stable in processing temperatures below 1000°C (1832°F). It is of sufficient purity for use in packaging or articles that come in contact with food (21CFR), but not suitable for the direct coloration of pet food or cosmetics. All Davis Colors™ iron oxides are manufactured under strict QC and environmental controls for reliable and consistent quality, stable under exposure to sunlight and UV radiation and are alkali, chemical and weather resistant. Davis Colors™ Red 1117 is packaged in 50 pound multiwall paper bags and shrink-wrapped onto pallets of 2000 pounds and also available in Mix-Ready® disintegrating bags. *Uses: concrete, masonry, pavers, roof tile, brick, stone, stucco, plaster, low-gloss paint, plastics and rubber.*

Composition/Typical Properties

Fe_2O_3 content (%)	95 – 96
SiO_2 content (%)	<1
Oil Absorption (g/100g)	24
Weight per Gallon (lbs)	40
Specific Gravity (g/cm³)	4.8
Bulk Density (lbs/ft³)	25
325 Mesh Retention (%)	<0.2
Water Soluble Salts (%)	<0.5
Ignition Loss (%)	<2
Moisture content (%)	<1
pH	3 – 7
Particle Shape	Spherical
Predominant Particle Size (μm)	0.40

Typical Trace Metal Content in Parts Per Million (ppm)

Arsenic (As)	<10
Antimony (Sb)	<15
Cadmium (Cd)	<1
Chromium (III) (Cr)	<350
Copper (Cu)	<300
Lead (Pb)	<5
Mercury (Hg)	<1
Nickel (Ni)	<50
Selenium (Se)	<2

The values for typical contents and trace metals are provided as general information only. They are approximate values for reference and not specifications utilized in our standard QC procedures for color and consistency.



PROJECT OVERVIEW & TECHNICAL ADDENDUM



SYNTHETIC IRON OXIDE TAN PIGMENT



IRON OXIDE PIGMENTS FOR THE CONSTRUCTION INDUSTRY

CONCRETE COLORS • MORTAR COLORS • COLOR-FLO LIQUIDS • DISPENSING EQUIPMENT • READY MIX COLORS • DECORATIVE CONCRETE SYSTEMS

Divisions of Solomon Colors, Inc.

BRICKFORM

Legacy[®]
DECORATIVE
CONCRETE
SYSTEMS

www.solomoncolors.com

September 24, 2014

To Whom It May Concern:

This letter is to certify that all Iron Oxide, Chromium Oxide, Cobalt Mixed Metal Oxide and Titanium Dioxide Pigments supplied by Solomon Colors comply with all the requirements set forth by ASTM C979-10.

Please do not hesitate to contact me for any further assistance.

A handwritten signature in black ink, appearing to read "John C. Ciente".

John C Ciente
Technical Sales Manager
Solomon Colors

647.224.4461
jciente@solomoncolors.com

TECHNICAL SPECIFICATION DATA

BASIC USE: Solomon Colors, Inc., SGS, Concentrated Mortar Colors are pure mineral pigments designed to be used with all cementitious material whether it may be type N, S, M or O strength masonry cement or portland and lime mixtures. The pre-measured unit concept of SGS colors provides uniform color control with the cost saving flexibility of utilizing local masonry and/or portland and lime cements to achieve the proper strength and mix design for brick, block, stucco or stone unit construction. Since 18-20% of the visual surface of the average brick wall is mortar, the proper selection and use of an appropriate mortar color will dramatically enhance the visual impact and beauty of the masonry wall.

COMPOSITION & MATERIALS: SGS colors are products of pure natural and/or synthetic iron oxides which are finely milled (95 - 99% minus 325 mesh particle size) and blended under strict quality control procedures producing uniform and consistently strong tinting strength for maximum coloring power. Each SGS color exceeds the requirements set forth by ASTM C-979 "Pigments For Integrally Colored Concrete." SGS colors are inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, lime proof, non-bleeding natural and synthetic iron oxides free of deleterious fillers and extenders.

SPECIFICATION PROCEDURES: As detailed in the table, select the proper ASTM C-270 masonry mix design of Type N, S, M or O compressive strength for the masonry unit construction. Then, depending upon the masonry mix design, select the appropriate SGS color and specify the number of units to be added to the mortar mix.

PACKAGING: All SGS Concentrated Mortar Colors are packaged in sealed unit bags. The "A" Series contains 6, "H" Series 12 and "X" Series 18 color

unit bags per case. Each case contains enough color to lay approximately 900 ("A"), 1800 ("H") and 2700 ("X") standard size bricks respectively, using a 3/8" (9.5 mm) mortar joint. Each unit bag is clearly identified with color name, number, weight, plus complete mixing instructions.

COLOR RANGE: SGS offers a wide color spectrum with A, H and X Series Mortar Colors. This offers precise color tones that are needed to complement or accentuate the broad range of color shades found in brick, stone or colored block. Our Color Laboratory is available at no charge to match existing colored mortar, develop special color tones or to provide expert color assistance to solve your individual color needs.

MIXING PROCEDURES: Mortar shall be mixed in a power mixer for a minimum of five (5) minutes or until a uniform color is obtained. Any change in proportioning the amount of color to cement and/or the type of cement, sand or water content can result in a variation of color tone in the finished work. DO NOT load the mixer beyond its recommended capacity. Overloading will reduce mixing efficiency. Request SGS Spec-Data Masonry Mortar 04060 data sheets for complete mixing instructions.

AVAILABILITY: SGS colors are readily available from stocks carried by an extensive network of building material dealers throughout the United States and Canada. Solomon Colors Inc. dealers are also backed by reliable 24-hour factory services in processing and shipping of orders. Solomon Colors Inc. has local sales representatives covering each state within the continental United States. For names of local dealers, distributors and sales representatives, contact Solomon Colors Inc. office in Springfield, IL at (217) 522-3112 or (800) 624-0261.

COST: Retail costs for SGS colors are established by stocking or distributing building material dealers. Costs are influenced by the individual color and color shade desired.

LIMIT OF WARRANTY & LIABILITY: Solomon Colors, Inc. warrants their product conforms to the description and standards stated on the product packaging and specific product literature. If properly mixed and applied, Solomon Colors Inc. warrants the Concentrated Mortar Color to be uniform, lime proof and sunfast. The exclusive remedy of the user or buyer and the limit of liability of this company shall be the purchase price paid by the user or buyer for the quantity of the SGS product involved.

MASONRY CLEANING: In the event cleaning is required to remove masonry stains and efflorescence, the cleaning operation should be undertaken after the colored mortar has sufficiently cured, generally 7-14 days after the masonry installation. Avoid using hydrochloric (muriatic) acid. Use a commercially prepared "proprietary masonry cleaner" following the directions for the weakest solution recommended by the manufacturer. Request SGS Spec Data Masonry Mortar 04060 data sheets for complete cleaning instructions.

SAMPLES: Color pigment samples are available for constructing job site mock-up panels. Contact your local Solomon Colors, Inc. building materials dealer, or Solomon Colors direct at: (217) 522-3112 or (800) 624-0261.

SGS MORTAR COLOR KIT & CATALOG: Samples of our standard mortar colors are available in convenient mortar color channels. Each channel is an actual representation of the color units mixed with either light gray prepared masonry cement or equivalent portland and lime mix plus a light tan builders sand and water. The shown Mortar Color Kit and Architectural Products Binder contains complete specification and technical information covering the complete line of SGS mortar and cement colors. Available upon request.



Mortar Color Kit

Architectural Products Binder

SGS **SOLOMON**
COLORS, INC.

World Headquarters

4050 Color Plant Road
Springfield, IL 62702
Phone: 800-624-0261
Fax: 217-522-3145



West Coast Facility:

360 S Lilac Ave.
Rialto, CA 92376
Toll Free: 866-747-2656
Fax: 909-874-9444

BM100 06-12



PROJECT OVERVIEW & TECHNICAL ADDENDUM



SYNTHETIC IRON OXIDE YELLOW PIGMENT

Product Code:	569	Date: 08/16/2001
Commercial Name:	Davis Colors™ Synthetic Iron Oxide Light Yellow	Ref: 569
Manufacturer:	Huntsman	Version: 001
Pigment Classes:	Pigment Yellow 42 / Color Index No. 77492	
CAS No:	51274-00-1	
EINECS No:		Page 1 of 1

Description

Davis Colors™ Yellow 569 is a blend of extra light-shade primary synthetic iron oxide yellow pigments (FeOOH). It is designed for use in concrete, concrete products and mortar. It is manufactured in large batches on intensive grinding and blending equipment. Each batch is measured throughout the process and verified on spectrophotometer to certify its conformance with standards for tint strength and shade. It meets or exceeds **ASTM C979-82** standards for pigments used in cement. Davis Colors™ 569 is color-stable in processing temperatures below 180°C (365°F). It is of sufficient purity for use in packaging or articles that come in contact with food (21CFR), but not suitable for the direct coloration of pet food or cosmetics. All Davis Colors™ iron oxides are manufactured under strict QC and environmental controls for reliable and consistent quality, stable under exposure to sunlight and UV radiation and are alkali, chemical and weather resistant. Davis Colors™ Yellow 569 is packaged in 50 pound multiwall paper bags and shrink-wrapped onto pallets of 2000 pounds and also available in Mix-Ready® disintegrating bags and True-Tone™ Mortar Color Boxes. *Uses: concrete, mortar, low-gloss paint, plastics, rubber, stucco and plaster.*

Composition/Typical Properties

Fe ₂ O ₃ content (%)	85 – 87
SiO ₂ content (%)	<1
Oil Absorption (g/100g)	48
Weight per Gallon (lbs)	34.2
Specific Gravity (g/cm ³)	4.1
325 Mesh Retention (%)	0.3
Water Soluble Salts (%)	<1
Ignition Loss (%)	12
Moisture content (%)	<1
pH	3 – 7
Particle Shape	Needle
Predominant Particle Size (μm)	0.48

Typical Trace Metal Content in Parts Per Million (ppm)

Arsenic (As)	<10
Antimony (Sb)	<10
Cadmium (Cd)	<1
Chromium (III) (Cr)	<150
Copper (Cu)	<200
Lead (Pb)	<1
Mercury (Hg)	<1
Nickel (Ni)	<2
Selenium (Se)	<1

The values for typical contents and trace metals are provided as general information only. They are approximate values for reference and not specifications utilized in our standard QC procedures for color and consistency.



PROJECT OVERVIEW & TECHNICAL ADDENDUM



T-NUT SPACERS

T-Nut Spacers

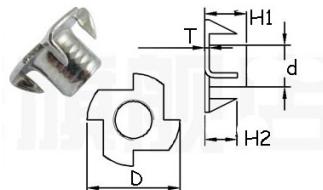
Specification:

Product Name	T Nut
Design	4 Prong, Full Thread
Full Thread	5/16"-18
Height	10mm/ 3/8"
Total Diameter	21.5mm/0.85"
Base Plate Thickness	1.5mm/0.06"
Material	Carbon Steel, Zinc Plated
Color	Blue
Total Weight	270g
Package Content	50Pcs(+/-2%) x T Nut



Description:

- The t nuts are barrel shaped fasteners with internal threading and are used when a flush surface is needed.
- The tee nut has a flat base with prong projections running parallel to the barrel. These prong nuts can be used in hard or soft wood as well as plastic or particle board. When installed, the tee nut sits flush with the fastened material.
- Used as Fastener parts, for all kinds of household appliances, office equipment, toys, appliances, furniture, electric bicycle, skating shoes, sports equipment, electronic instrument, machinery manufacturing industry.
- Our Store also has other kinds T nut such as M4, M5, M6, M8, M10,1/4 inch-20, 3/8 inch-16, 3/16 inch-24, 5/16 inch-18,if you want please contact our service.



Unit	D	d	T	H1	H2
mm	21.5	9.5	1.5	10	7.5
Inch	0.85	0.37	0.06	0.39	0.3



PROJECT OVERVIEW & TECHNICAL ADDENDUM



VCAS WHITE POZZOLANS



VCAS™ White Pozzolans

Custom-engineered, high performance, pozzolanic mineral additives
for use in white cement, mortar, and concrete products

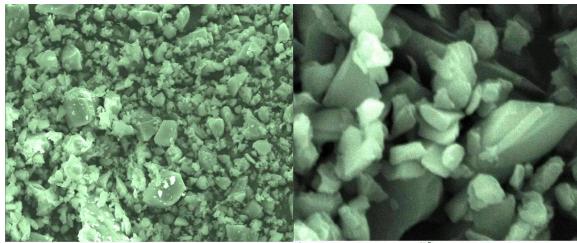
www.vitrominerals.com

Product Description

VCAS™ (vitreous calcium aluminosilicate) pozzolans are new custom-engineered, high performance supplementary cementing materials for use in white Portland cement, mortar, and concrete products.

After primary sizing and drying, the feedstock is finely ground and processed through high efficiency classifiers to produce a fine bright white powder with quality assured physical properties. The consistent chemical composition and tightly controlled particle size distribution result in highly reactive and superior quality pozzolans for concrete applications.

Currently, the VCAS™ patented technology produces white pozzolans in three grades, **VCAS-140**, **VCAS-160** and **VCAS-Ultra200**, engineered with fineness tailored for the demands of the applications as described in this technical summary.



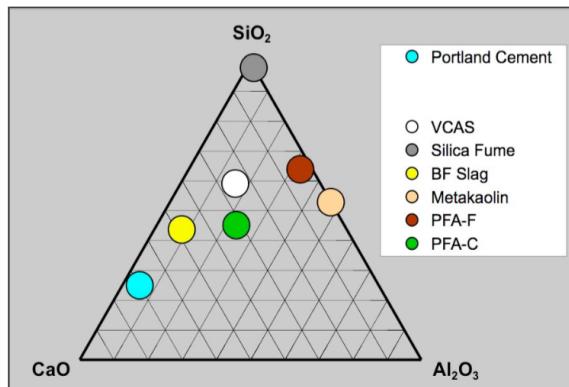
Unlike silica fume, coal fly ash, ground granulated blast furnace slag, and other by-products, VCAS™ White Pozzolans are free of iron, manganese, and other undesirable color-inducing impurities, making them ideally suited for all applications using white cement and in decorative and pigmented concrete.

VCAS™ pozzolans are value-added supplementary cementing materials that exhibit pozzolanic activity comparable to silica fume and metakaolin when tested in accordance with ASTM C618 and ASTM C1240. VCAS™ pozzolans react with calcium hydroxide produced during the hydration of Portland cement to form additional cementitious compounds such as calcium silicate and aluminosilicate hydrates. Pozzolans are widely used in cement and concrete technology to increase concrete strength, density, and resistance to chemical attack as well as control efflorescence.

Chemical Composition of VCAS™ Pozzolans

Silica, SiO ₂	50–55%	Titania, TiO ₂	< 1%
Alumina, Al ₂ O ₃	15–20%	Phosphorus oxide, P ₂ O ₅	< 0.1%
Iron oxide, Fe ₂ O ₃	< 1%	Manganese oxide, MnO	< 0.01%
Calcia, CaO	20–25%	Boron oxide, B ₂ O ₃	0–6%
Magnesia, MgO	< 1%	Sulphur oxide, SO ₃	< 0.1%
Sodium oxide, Na ₂ O	< 1%	Chloride, Cl	< 0.01%
Potassium oxide, K ₂ O	< 0.2%	Loss on ignition, LOI	< 0.5%

Chemically, VCAS™ pozzolans are comprised largely of oxides of silicon, aluminum and calcium with no deleterious impurities. The CaO-SiO₂-Al₂O₃ proportions, the low alkali metal content, and the amorphous structure are ideal for a pozzolanic additive in hydraulic concrete. The low iron content makes them particularly well suited for applications using white cement, such as mortars, stuccos, terrazzo, artificial stone, and cast-in-place or precast concrete products.



Ternary diagram (CaO-SiO₂-Al₂O₃) for the composition of VCAS™ pozzolans relative to Portland cement and the common pozzolans.

VCAS™ pozzolans have superior powder handling compared with silica fume and metakaolin. Tight process control provides consistent product quality and physical properties.

Physical Properties of VCAS™ Pozzolans

	VCAS-140	VCAS-160	VCAS-Ultra200
Specific Gravity	2.6	2.6	2.6
Bulk Density, Loose lb/ft ³	50-55	45-50	40-45
Passing No. 325 Mesh, %	95	98	>99
Pozzolanic Strength Index, % control	104	110	122
Brightness, %	82-85	82-85	87-90
Melting Point, °C	1200	1200	1200
Hardness, Mohs	5.5	5.5	5.5

New high brightness,
high fineness grade

Vitro Minerals

95 Pinnacle Drive, Jackson, TN 38301 Phone: 678-729-9333 Fax: 678-750-0105

Benefits of VCAS™ Pozzolans

Fresh Concrete:

- Improved workability
- Reduction in water requirements
- Ease of dispersability
- Reduction in superplasticizer
- Reduction in bleeding
- Reduction in aggregate segregation

Hardened Concrete:

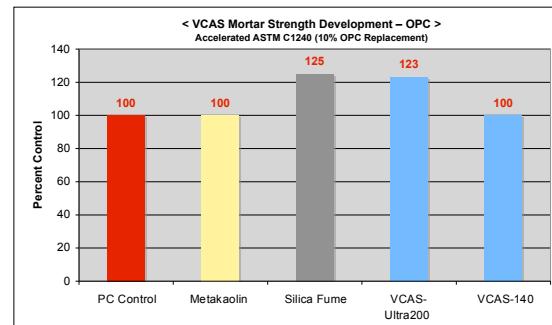
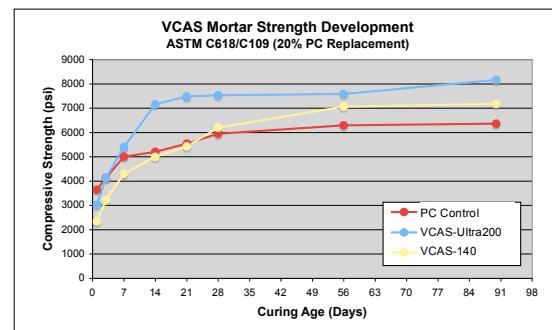
- Increased compressive strength
- Decreased permeability
- Increased durability

Added Value:

- Mix-color neutrality and brightness
- Improved retention of mold detail
- Sustainability

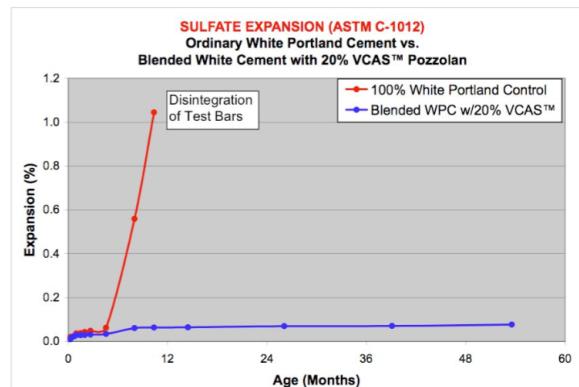
High Performance

VCAS™ White Pozzolans meet the technical requirements of ASTM C618 for use as supplementary cementitious materials in concrete. Blended pozzolanic cements produced with VCAS pozzolans also comfortably exceed the requirements of ASTM C1157: Standard Performance Specification for Hydraulic Cement. Typical strength curves at 20% cement replacement are shown below. VCAS-Ultra200™ exceeds the control in 3-5 days, making it an excellent choice for high performance applications where high early strength and excellent color are required. VCAS-Ultra200™ also meets the accelerated pozzolanic activity index, ASR control, and sulfate resistance requirements of ASTM C1240 for silica fume. Coupled with low water demand, reduced efflorescence, and improved chloride resistance, VCAS™ pozzolans are extremely cost effective.



Enhanced Durability

VCAS™ pozzolans provide white Portland cement with superior resistance to sulfate attack (ASTM C1012). The graph below shows the excellent dimensional stability of a white cement mortar with 20% VCAS replacement after over 4 years of exposure. Under these harsh test conditions, the 100% white cement control mortar disintegrated in less than 200 days. VCAS is also very effective at controlling expansion due to the alkali-silica reaction (AASHTO TP-110) and reducing chloride ion penetration (ASTM C1202).



Comparison with Other Pozzolans

VCAS™ pozzolans are excellent high reactivity materials for use with white cement to produce durable, high performance architectural concrete structures and reflective highway barriers.

Pozzolan	% Replacement	Reactivity	Color	Water Demand	Environmental
VCAS-140™	10-30	Mod	White	Reduction	Positive
VCAS-Ultra200™	10-30	High	White	Reduction	Positive
Silica fume	5-8	High	Dark grey	Large increase	Positive
Metakaolin	5-8	High	Cream/pink	Large increase	Negative
Blastfurnace slag	25-50	Mod	Buff	Neutral	Positive
Fly ash	10-30	Low	Dark	Reduction	Positive

Environmental, Health & Safety

VCAS™ pozzolans have an important role to play in sustainable construction by increasing service life and reducing the net greenhouse gas emissions (GHG) for a cubic yard of concrete.

VCAS™ pozzolans are non-toxic, contain no crystalline silica, and are classed as a nuisance dust, in common with other common fine particulate industrial minerals.

Product Availability

VCAS™ pozzolans are sold in 50 lb bags. Contact Vitro for the availability of 1-ton super-sacks and bulk tanker trucks in your area.

Disclaimer: The statements in this bulletin are based on data which is believed to be reliable, and is offered in good faith to be applied accordingly to the user's best judgment. Since operating conditions at customer's sites are beyond our control, Vitro Minerals will not assume responsibility for the accuracy of this data, or liability which may result from the use of its products. Likewise, no patent liability is assumed for use of Vitro Mineral products in any manner which could or would infringe on patent rights of others.