NON-SHRINKING CEMENT MORTAR & GROUT

EVALUATION REPORT

Report 74-5

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VERMONT DEPARTMENT OF HIGHWAYS

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ABSTRACT

Tests on samples of grouts and grouting aids were conducted to determine their characteristics as non-shrinking cement mortars. The samples were submitted by their manufacturers and prepared according to the recommendations that accompanied them. Results of the investigation generally confirmed the claims made for the products. However, each formulation exhibited its own peculiar characteristics and the choice of grout should be determined by the application for which it is to be used.

INTRODUCTION

The 1976 Vermont Standard Specifications for Highway and Bridge Construction require the addition of aluminum powder to mortar mixtures in order to effect the properties of a non-shrinking cement mortar. It further states that "Upon request, the Department will furnish a list of products or additives that are considered satisfactory to use for non-shrinking cement mortar in lieu of that specified." "Products not on the Department's approved list, that meet the specifications, shall be certified by a Type A Certification in accordance with Subsection 700.02."

Non-shrink grout can be made with expanding agents of aluminum powder, granulated iron in combination with an oxidizing material, gas forming agents, or sulphoaluminate cement. The aluminum powder reacts with hydroxides in fresh cement paste to produce hydrogen gas. The iron filings expand in volume as they are converted to iron oxide and the expansive cements expand chemically by formation of hydrated calcium sulphoaluminates.

The purpose of this investigation is to acquire several commerical non-shrinking grout and mortar products, and evaluate and compare them to aluminum powder mixtures, as well as to each other. Although there is no standard specification for non-shrinking cement mortar in either AASHTO or ASTM, other applicable testing procedures were followed.

MATERIALS

Commercial Products:

Sika Chemical Corporation

- Intracrete
- Intraplast-N
- Kemox-G
- Kemox-PG

Grace Construction Products

- Darex In-Pakt
- Vibro-Foil
- Vibro-Foil Ready Mix

Sauereisen Cement Company

- Sauereisen F-100

Master Builders

- Masterflow 713 Grout
- Embeco 153 Grout

U. S. Bronze Powder

- "Venus Multi-Leaf Aluminum No. 195"

U. S. Grout Corporation

- Five Star Grout

U. S. M. Corporation

- Upcon

Reynolds Metals Company

- 3-XD Aluminum Powder
- 1-511 Atomized Powder

Sonneborn Building Products

- "Sonogrout"

W. R. Meadows, Inc.

- "V-3 Grout"

Cement:

Type I - Glens Falls Portland Cement Company
Glens Falls, New York

Sand:

Standard Sand ASTM Designation C-109

PROCEDURES & DATA

The objectives of this investigation were to establish volume changes prior to and following initial set, setting time, absorption, and compressive strength. Specimens were further examined for discoloration and excessive cracking.

I. Batching & Mixing:

Each product was mixed in a Reynolds two-speed, paddle-type mixer, having a bowl capacity of twelve quarts. The procedures and mix design weights followed manufacturers recommendations. Listed are the mix design weights (in grams) and the specified mixing sequence.

PRODUCT NAME	DESIGN WEIGHT (gm)				MIXING SEQUENCE
	GROUT	WATER	CEMENT	SAND	
Intracrete	32	1200	3200	3200	(a) add water to mixer (b) while mixing, add cement and sand; mix thoroughly (c) add admixture and mix for one additional minute
Intraplast-N	32	1120	3200	3200	(a) add water to mixer (b) add all dry materials and mix thoroughly
Kemox-G	2400	870	2256	2400	(a) add and mix all dry materials in mixer (b) slowly add water and mix thoroughly
Kemox-PG	2350	330	--	--	(a) add dry material to mixer (b) slowly add water, while mixing, and mix thoroughly
Darex In-Pakt	4517	870	--	--	(a) add dry material to mixer (b) add water and mix for three minutes

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PRODUCT NAME	DESIGN WEIGHT (gm)				MIXING SEQUENCE	
	GROUT	WATER	CEMENT	SAND		
Vibro-Foil	2000	910	2000	2000	(a) (b)	add dry materials to mixer while mixing slowly, add water; mix thoroughly
Vibro-Foil Ready Mix	6750	990	--	--	(a) (b)	add dry materials to mixer while mixing slowly, add water; mix thoroughly
Sauereisen F-100	5096	968	--	--	(a) (b)	place grout in mixer while mixing slowly add water and mix for five minutes
*3-XD Aluminum Powder	11.7	1120	3200	3200	(a) (b)	add all dry materials to mixer and mix thoroughly add water while mixing and blend thoroughly
*1-511 Atomized Powder	11.7	1120	3200	3200	(a) (b)	add all dry materials to mixer and mix thoroughly add water while mixing and blend thoroughly
Masterflow 713	6000	996	--	--	(a) (b)	add dry material to mixer add water and mix for three minutes
Embeco 153	7000	1085	--	--	(a) (b)	add dry material to mixer add water and mix for three minutes
Five Star	2000	336	--	--	(a) (b)	add dry material to mixer add water and mix for three minutes
Upcon	4000	832	--	--	(a) (b)	add dry material to mixer add water and mix for three minutes
Sonogrout	7000	1316	--	--	(a) (b)	add dry material to mixer add water and mix thoroughly

*1-511 Atomized Powder and 3-XD Aluminum Powder were blended to a mixture of one part powder to fifty parts cement. If the aluminum powder is not blended, it tends to "float" in the mixer and does not disperse throughout the mix. The weights used were that of the blended mixture.

PRODUCT NAME	DESIGN WEIGHT (gm)				MIXING SEQUENCE	
	GROUT	WATER	CEMENT	SAND		
*Venus Multi-Leaf Aluminum No. 195	11.7	1120	3200	3200	(a)	add all dry material to mixer and blend
					(b)	add water while mixing and blend thoroughly
V-3 Grout	6000	1155	--	--	(a)	add two-thirds of water to dry material and mix for a short period
					(b)	add remaining water and mix for three minutes

*Venus Multi-Leaf Aluminum No. 195 was blended to a mixture of one part powder to fifty parts cement. If the aluminum powder is not blended it tends to "float" in the mixer and does not disperse throughout the mixture.

II. Volume Change:

(a) Prior to Initial Set:

A test to measure volume change of the specimens prior to initial set was devised, as no Standard Method was available for guidance. A thin metal plate cut to fit the 2" square cube was placed on the surface of the freshly mixed grout. The volume change was monitored by using a ring stand and dial indicator.

(b) Following Initial Set:

Specimens for determining length change after initial set were cast in standard autoclave molds (1" x 1" x 11"). The apparatus and method conformed in detail to Standard Method of Test for Length Change of Cement Mortar & Concrete (AASHO Designation T 160-70).

III. Time of Set:

For this report, the initial time of set was determined by using the Standard Method of Test for Time of Set of Hydraulic Cement by Gillmore Needles (AASHO Designation T 154-65).

IV. Absorption:

The test procedures for absorption followed Tentative Method of Test for Specific Gravity, Absorption, and Voids in Hardened Concrete (ASTM Designation C 642-69T), except that 2" cubes of grout were used as a convenience.

V. Compressive Strength:

Specimens used for compressive strength determinations were molded, cured, and tested according to the procedures outlined in Standard Method

of Test for Compressive Strength of Hydraulic Cement Mortars - using 2" Cube Specimens (AASHTO Designation T 106-64). Each product was evaluated for compressive strength in both the restrained and unrestrained condition. The restrained specimens were covered with a glass plate weighted with a thirty pound concrete block. This restraint was removed after twenty-four hours, upon which all specimens were stored according to standard procedures. Compressive strength tests were conducted at ages of twenty-four hours, three days, seven days, and twenty-eight days.

RESULTS

This testing program revealed a wide range of results between products. Although the manufacturers recommendations concerning mixing were faithfully adhered to, the test results often varied from their advertised claims.

Following are summaries of test information for each product investigated. In some cases, an insufficient sample quantity was submitted, resulting in the omission of some of the desired information.

PRODUCT INFORMATION

Name: Intracrete (Admixture)

Manufacturer: Sika Chemical Corporation

Type: Expansion by Nitrogen gas generation

Test Results

1. Volume Change
   a. Prior to Initial Set +7.30 %
   b. Following Initial Set +0.13 %
2. Time of Initial Set 15 hrs. 40 min.
3. Absorption 9.5 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	———	———
b. at 3 days	4643	5443
c. at 7 days	6106	4362
d. at 28 days	6681	3206

Remarks:

Extensively tested. Delayed setting time. Full expansion prior to initial set. May be used with grout containing sand, but this will reduce expansion. Not to be used with grout containing fly ash. Must be used in confined area. Cubes of this material leached and fused together during storage in water. Subsequent tests did not duplicate this phenomenon. No reason is given at present. Shelf life - three to six months.

PRODUCT INFORMATION

Name: Intraplast-N (Admixture)

Manufacturer: Sika Chemical Corporation

Type: Non-Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set _____ %
   b. Following Initial Set +0.02 %
2. Time of Initial Set 7 hrs. 30 min.
3. Absorption 10.4 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	1093	1212
b. at 3 days	4981	3956
c. at 7 days	5518	4543
d. at 28 days	6575	4800

Remarks:

High absorption. Shelf life - three to six months.

PRODUCT INFORMATION

Name: Kemox-G (Admixture)

Manufacturer: Sika Chemical Corporation

Type: Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set -0.30 %
   b. Following Initial Set +0.14 %
2. Time of Initial Set 4 hrs. 30 min.
3. Absorption 6.1 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	4856	4962
b. at 3 days	8813	8018
c. at 7 days	9261	9118
d. at 28 days	11312	10624

Remarks:

High Compressive Strength - Metallic particles result in stains and rust spots. Not to be used in exposed areas. Some shrinkage or subsidence prior to initial set.

PRODUCT INFORMATION

Name: Kemox-PG (Pre-mixed)

Manufacturer: Sika Chemical Corporation

Type: Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set _____ %
   b. Following Initial Set _____ %
2. Time of Initial Set _____ hrs. _____ min.
3. Absorption 7.5 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	3987	3993
b. at 3 days	5193	7793
c. at 7 days	6656	8818
d. at 28 days	11093	10056

Remarks:

High Compressive Strength. Metallic particles result in stains and rust spots. Not to be used in exposed areas. Sample submitted was insufficient to complete all desired tests.

PRODUCT INFORMATION

Name: Darex In-Pakt (Pre-mixed)

Manufacturer: Grace Construction Products

Type: Non-Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set +4.00 %
   b. Following Initial Set +0.19 %
2. Time of Initial Set _____ hrs. _____ min.
3. Absorption _____ %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	_____	_____
b. at 3 days	3763	3332
c. at 7 days	5450	3794
d. at 28 days	_____	_____

Remarks:

Sample submitted was insufficient to complete all desired tests.

PRODUCT INFORMATION

Name: Vibro-Foil (Admixture)

Manufacturer: Grace Construction Products

Type: Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set -0.48 %
   b. Following Initial Set +0.04 %
2. Time of Initial Set 1 hrs. 10 min.
3. Absorption 6.0 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	5537	5656
b. at 3 days	10374	9968
c. at 7 days	12125	10543
d. at 28 days	12937	13124

Remarks:

High Compressive Strength. Quick setting. Metallic particles result in stains and rust spots. Not to be used in exposed areas. Some shrinkage or subsidence prior to initial set.

PRODUCT INFORMATION

Name: Vibro-Foil Ready Mix (Pre-mixed)

Manufacturer: Grace Construction Products

Type: Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set -0.40 %
   b. Following Initial Set +0.05 %
2. Time of Initial Set ____ hrs. 50 min.
3. Absorption 6.2 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	5403	4906
b. at 3 days	8993	9081
c. at 7 days	10343	9433
d. at 28 days	11531	11562

Remarks:

High Compressive Strength. Quick setting. Metallic particles result in stains and rust spots. Not to be used in exposed areas. Some shrinkage prior to initial set.

PRODUCT INFORMATION

Name: Sauereisen F-100 (Pre-mixed)

Manufacturer: Sauereisen Cement Company

Type: Non-Ferrous, Non-Organic

Test Results

1. Volume Change
   a. Prior to Initial Set +0.13 %
   b. Following Initial Set +0.15 %
2. Time of Initial Set 2 hrs. 50 min.
3. Absorption 9.5 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	3743	4087
b. at 3 days	6106	6306
c. at 7 days	6537	7225
d. at 28 days	7937	8624

Remarks:

Meets all requirements. No additional materials may be added. Should be used and cured at 70° F.

PRODUCT INFORMATION

Name: 3-XD Aluminum Powder (Admixture)

Manufacturer: Reynolds Metals Company

Type: Aluminum Powder

Test Results

1. Volume Change
   a. Prior to Initial Set +4.60%
   b. Following Initial Set +0.02%
2. Time of Initial Set 3 hrs. 55 min.
3. Absorption 9.2 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	4006	3693
b. at 3 days	5574	4699
c. at 7 days	6549	5218
d. at 28 days	7068	5067

Remarks:

A Leafing Flake Aluminum powder. This additive meets all requirements.

PRODUCT INFORMATION

Name: 1-511 Atomized Powder (Admixture)

Manufacturer: Reynolds Metals Company

Type: Aluminum Powder

Test Results

1. Volume Change
   a. Prior to Initial Set -0.50 %
   b. Following Initial Set +0.02 %
2. Time of Initial Set 3 hrs. 05 min.
3. Absorption 9.8 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	4468	3699
b. at 3 days	6212	4837
c. at 7 days	6743	5712
d. at 28 days	8512	7324

Remarks:

A Granular Aluminum Powder. This material does not meet requirements, due to non-expansion. Several re-tests revealed similar results.

PRODUCT INFORMATION

Name: Masterflow 713 Grout (Pre-mixed)

Manufacturer: Master Builders

Type: Non-Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set _____ %
   b. Following Initial Set +0.05 %
2. Time of Initial Set _____ hrs. 40 min.
3. Absorption 4.7 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	2793	2949
b. at 3 days	4368	4131
c. at 7 days	5362	5056
d. at 28 days	6781	5656

Remarks:

Quick setting, non-metallic grout. Low absorption.

PRODUCT INFORMATION

Name: Embeco 153 Grout (Pre-mixed)

Manufacturer: Master Builders

Type: Ferrous

Test Results

1. Volume Change
   a. Prior to Initial Set -0.26 %
   b. Following Initial Set +0.05 %
2. Time of Initial Set 1 hrs. 15 min.
3. Absorption 10.2 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	4406	4393
b. at 3 days	8224	7900
c. at 7 days	9843	9575
d. at 28 days	12625	11062

Remarks:

High Compressive Strength. Metallic particles result in stains and rust spots. Not to be used in exposed areas. Shrinkage or subsidence prior to initial set.

PRODUCT INFORMATION

Name: Five Star Grout

Manufacturer: U. S. Grout Corporation

Type: Non-Ferrous, Pre-mixed

Test Results

1. Volume Change
   a. Prior to Initial Set 0 %
   b. Following Initial Set 0 %
2. Time of Initial Set 2 hrs. 30 min.
3. Absorption 8.2 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	3375	3351
b. at 3 days	7632	7194
c. at 7 days	9282	8563
d. at 28 days	10751	9782

Remarks:

Unrestrained specimens showed slight expansion. Good Compressive Strengths.

PRODUCT INFORMATION

Name: Upcon (Pre-mixed)

Manufacturer: U. S. M. Corporation

Type: Organic

Test Results

1. Volume Change
   a. Prior to Initial Set 0 %
   b. Following Initial Set +0.11 %
2. Time of Initial Set _____ hrs. _____ min.
3. Absorption 11.5 %
4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	2856	2981
b. at 3 days	4369	5494
c. at 7 days	5318	6112
d. at 28 days		

Remarks:

No expansion or contraction prior to set. Good strength at seven days. High absorption. Insufficient sample to complete twenty-eight day compressive tests.

PRODUCT INFORMATION

Name: Sonogrout (Pre-mixed)

Manufacturer: Sonneborn Building Products

Type: Non-Ferrous

Test Results:

1. Volume Change

   a. Prior to Initial Set 0 %

   b. Following Initial Set +0.16 %

2. Time of Initial Set 2 hrs. 50 min.

3. Absorption 13.8 %

4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	2075	2113
b. at 3 days	4088	4176
c. at 7 days	5613	5382
d. at 28 days	8062	7407

Remarks: No expansion or contraction prior to set. No additional materials may be added.

PRODUCT INFORMATION

Name: Venus Multi-Leaf Aluminum No. 195 (admixture)

Manufacturer: U. S. Bronze Powder

Type: Aluminum Powder

Test Results:

1. Volume Change

   a. Prior to Initial Set +12.5 %

   b. Following Initial Set +0.02%

2. Time of Initial Set 3 hrs. 20 min.

3. Absorption 10.0 %

4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	3468	5193
b. at 3 days	7357	7076
c. at 7 days	7100	7675
d. at 28 days	10094	9282

Remarks: This material meets all requirements. Good compressive strength.

PRODUCT INFORMATION

Name: V-3 Grout (pre-mixed)

Manufacturer: W. R. Meadows, Inc.

Type: Non-Metallic

Test Results:

1. Volume Change

   a. Prior to Initial Set 0 %

   b. Following Initial Set +0.002 %

2. Time of Initial Set 4 hrs. 35 min.

3. Absorption Not Tested %

4. Compressive Strength (psi)

	Restrained	Unrestrained
a. at 24 hours	4244	4544
b. at 3 days	7462	7575
c. at 7 days	8062	8593
d. at 28 days	7327	8138

Remarks:

Good compressive strength. For deep grouting up to 50% 3/8" coarse aggregate may be added to increase yield. No expansion or contraction prior to set.

SUMMARY

1. There is no Standard of Acceptance specifically written for non-shrink grouts and mortars.
2. All ferrous grouts produce generally higher compressive strengths than do other types of grouts. However, they do not meet criteria for expansion, as all of them shrink or subside within the first twenty-eight days. Furthermore, the metallic particles cause staining and rust spots in exposed areas. Unconfined applications exposed to moisture do expand over a period of time, resulting in cracking and eventual disintegration.
3. Although all aluminum additives are thought to cause expansion in cements, our test, using a granulated aluminum powder (1-511 Atomized Powder), did not perform as expected.
4. Volume increases occured after initial set, in all cases. The gas producing grouts exhibited the majority of their expansion prior to initial set.
5. Gas producing specimens that were unrestrained resulted in lower compressive strengths than similar specimens that were restrained.
6. Erratic results in absorption were noted and did not seem to be influenced by either compressive strength or expansion.
7. See the following table for summarized results.

TEST RESULT SUMMARY

PRODUCT	TYPE	(%) ABSORPTION	TIME OF SET HOURS : MINUTES	VOLUME CHANGE PRIOR TO INITIAL SET (%)	LENGTH CHANGE AFTER INITIAL SET (%)	AVERAGE COMPRESSIVE STRENGTH P.S.I. @ 28 DAYS RESTRAINED	UNRESTRAINED
Intracrete	admixture - expansion by nitrogen gas generation	9.5	15 : 40	+ 7.30	+ 0.13	6,681	3,206
Intraplast-N	admixture - Non-ferrous	10.4	7 : 30	--	+ 0.02	6,575	4,800
Kemox-G	admixture - Ferrous	6.1	4 : 30	- 0.30	+ 0.14	11,312	10,624
Kemox-PG	Pre-mixed - Ferrous	7.5	---	---	---	11,093	10,056
Darex In-Pakt	Pre-mixed - Non-ferrous	-	---	+ 4.00	+ 0.19	---	---
Vibro-Foil	admixture - Ferrous	6.0	1 : 10	- 0.48	+ 0.04	12,937	13,124
Vibro-Foil Ready Mix	Pre-mixed - Ferrous	6.2	: 50	- 0.40	+ 0.05	11,531	11,562
Sauereisen F-100	Pre-mixed - Non-ferrous - Non-organic	9.5	2 : 50	+ 0.13	+ 0.15	7,937	8,624
3-XD Aluminum Powder	admixture - Aluminum powder	9.2	3 : 55	+ 4.60	+ 0.02	7,068	5,067
1-511 Atomized Powder	admixture - Aluminum powder	9.8	3 : 05	- 0.50	+ 0.02	8,512	7,324

(con't)

TEST RESULT SUMMARY (con't)

PRODUCT	TYPE	(%) ABSORPTION	TIME OF SET HOURS : MINUTES	VOLUME CHANGE PRIOR TO INITIAL SET (%)	LENGTH CHANGE AFTER INITIAL SET (%)	AVERAGE COMPRESSIVE STRENGTH P.S.I. @ 28 DAYS RESTRAINED	UNRESTRAINED
Masterflow 713 Grout	Pre-mixed - Non-ferrous	4.7	0 : 40	---	+ 0.05	6,781	5,656
Embeco 153 Grout	Pre-mixed - Ferrous	10.2	1 : 15	- 0.26	+ 0.05	12,625	11,062
Five Star Grout	Pre-mixed - Non-ferrous	8.2	2 : 30	0	0	10,751	9,782
UpCon	Pre-mixed - Organic	11.5	---	0	+ 0.11	---	---
Sonogrout	Pre-mixed Non-Ferrous	13.8	2 : 50	0	+ 0.16	8,062	7,407
Venus Multi-Leaf Aluminum No. 195	Admixture-Aluminum Powder	10.0	3 : 20	12.5	+ 0.02	10,094	9,282
V-3 Grout	Pre-mix Non-Metallic	Not Tested	4 : 35	0	+ .002	7,327	8,138

CONCLUSIONS & RECOMMENDATIONS

1. Non-shrink grouts should not be used or specified for use in unconfined areas. Unrestrained expansion may result in reduced density, bond, and strength.
2. Standard specifications (AASHTO or ASTM) should be developed for performance and acceptance testing of non-shrink grouts. In lieu of nationally accepted standards, the Vermont Department of Highways should adopt the following specifications:
   a) Compressive Strength: The seven day compressive strength of two inch cubes shall be 5000 p.s.i. minimum. These cubes shall be molded and cured according to AASHO T 106-64 and shall be restrained from expanding for the first twenty-four hours.
   b) Expansive Properties: All non-shrink grouts shall be capable of exhibiting settlement compensation. No shrinkage shall be allowed.

      Metallic grouts with high compressive strengths may be permitted for anchor bolt installations. A minimum wet curing period of seven days shall follow.
   c) The minimum quantity of sample submitted for testing shall be that capable of producing 1/2 cubic foot of grout.
3. Hydrogen gas producing grouts such as those containing aluminum powder should not be used in post-tensioned members, as hydrogen embrittlement of prestressing steel could result.
4. Aluminum powder additives should be used only after testing has demonstrated its effectiveness.

5. Acceptance of each product should be based upon the intended field application, in addition to satisfactory performance in laboratory tests. See Item (2) on preceding page. A list of acceptable products, as well as application restrictions, follows.

PRODUCT ACCEPTANCE LIST*

PRODUCT NAME	GROUT & MORTAR CONSTRUCTION APPLICATIONS				
	Base Plates & Structural Columns	Bridge Seats & Bearing Plates	Anchor Bolts & Dowels	Prestressed Tendons	Keyways, Seams, & Cracks
Intracrete	X	X	X	X	X
Intraplast-N	X	X	X	X	X
Kemox-G			X		
Kemox-PG			X		
Darex In-Pakt	X	X	X	X	X
Vibro-Foil			X		
Vibro-Foil Ready Mix			X		
Sauereisen F-100	X	X	X	X	X
3-XD Aluminum Powder	X	X	X		X
Masterflow 713 Grout	X	X	X		X
Embeco 153 Grout			X		
Five Star Grout	X	X	X	X	X
UpCon	X	X	X		X

*Use of these products is restricted to those applications identified by an X.

PRODUCT ACCEPTANCE LIST*

PRODUCT NAME	GROUT & MORTAR CONSTRUCTION APPLICATIONS				
	Base Plates & Structural Columns	Bridge Seats & Bearing Plates	Anchor Bolts & Dowels	Prestressed Tendons	Keyways, Seams, & Cracks
Sonogrout	X	X	X	X	X
Venus Multi-Leaf Aluminum No. 195	X	X	X		X
V-3 Grout	X	X	X	X	X

*Use of these products is restricted to those applications identified by an X.