Version 9.24

E5 ANALYSIS GUIDE

E5® Incorporated

E5® NANO SILICA CONCRETE SOLUTIONS

The World's Solution for Concrete Durability and Sustainability.

WHAT IS E5® NANO SILICA?

E5® Nano Silica products consist of proprietary formulations of colloidal silica, which is a suspension of nano silica particles of various sizes, surface areas and other chemical properties. NOT ALL NANO SILICA IS THE SAME. E5® Nano Silica products have been expertly formulated specifically for use in concrete and are exclusively manufactured for E5® by the world's leading producer of nano silica under the highest quality standards.

WHAT DOES NANO SILICA DO FOR CONCRETE?

E5® Nano Silica products both improve the fresh state properties of concrete for easier pumping, placing and finishing and also provide for particle packing, thereby reducing air voids and increasing the density of hardened concrete. This dense concrete matrix not only significantly reduces permeability but also increases abrasion resistance at the surface of the concrete.

WHAT ARE E5® INTERNAL CURE® AND E5® LIQUID FLY ASH®?

E5® Internal Cure® is a nano silica-based suspension that attracts and weighs down water molecules, preventing loss of moisture to surface evaporation and creating up to 30% greater cement hydration efficiency. By improving the hydration of the cement binder in concrete, E5® Internal Cure® ensures an optimal cure and reduces shrinkage, cracking and curling.

E5® Liquid Fly Ash® is a nano silica-based suspension that is pozzolanic and can replace up to 15% of cement (and/or other supplementary cementitious materials (SCMs)) in concrete.

When used together, E5® Internal Cure® and Liquid Fly Ash® provide effective waterproofing, without the use of sealers or membranes.

Both by increasing the quality and durability of concrete and reducing the amount of cementitious material used in concrete production, E5® Nano Silica products offer the highest performing and most sustainable solution for concrete available to the market today.

HOW DOES PROPER CURING IMPROVE CONCRETE?

Proper curing is crucial for concrete to reach its full strength and durability potential. Proper curing involves maintaining concrete's moisture content for an extended period of time after placement and finishing to allow the concrete to hydrate properly. Concrete that is not cured properly can suffer from dry shrinkage cracking and a porous surface which results in poor abrasion resistance, staining, and damage from freeze-thaw cycles and de-icing chemicals, all of which reduce the concrete's service life.

HOW WILL E5® BENEFIT THE CONSTRUCTION PROCESS?

In addition to providing high-performing, highly durable concrete that is easier on the finisher and better for the planet, E5® Nano Silica products reduce wear and tear on pumping equipment and substantially reduce construction time, labor and materials.

E5® Internal Cure® eliminates the need for all traditional wet curing methods, curing compounds and densifiers and the associated time, labor, expense and human error. Further, when E5® Internal Cure® is used together with E5® Catalyst, a topical solution that chemically reacts with the nano silica contained in E5® Internal Cure® to create a highly dense surface barrier, it replaces moisture mitigation systems for use with flooring and roofing materials that must adhere to concrete surfaces. As a result, construction schedules can be accelerated, with savings of up to 7 days over wet curing methods and up to 21 days over other moisture mitigation systems. Additionally, costly and time-consuming removal of any topically applied curing compounds and membranes is completely eliminated.

WHAT IS E5® NANO SILICA'S TRACK RECORD AND IS IT RELIABLE ACROSS APPLICATIONS?

E5® Nano Silica products have been used in millions of yards of concrete in both critical civil infrastructure and significant commercial structures, including in medical, retail, educational, and heavy industrial applications. E5® Nano Silica products have been submitted to over half the Departments of Transportation in the U.S. for approval and are approved for use in nearly a dozen of those - and counting. E5® Nano Silica products have been used in several hundred bridge decks and bridge overlays as well as thousands of miles of mainline paving, barrier wall, curbs and sidewalks. In addition to being relied upon by DOTs, some of the most prestigious companies in the world, including American Honda Motor Co., Amazon, Microsoft, Facebook, Google, Subaru Corporation, Rolls-Royce, IU Medical, St. Francis Health, El Lilly & Co., Nike, Toyota, P&G, Nokian, Kroger and many others, rely upon E5® Nano Silica products every day for ensuring the highest quality, most sustainable concrete available for their construction projects.

ANALYSIS AND FINDINGS

In addition to its proven track record in the field, the effectiveness of E5® Nano Silica has been validated by third-party laboratories at multiple renowned institutions.

The research group at the Lyles School of Civil Engineering at Purdue University has worked hand-in-hand with E5® Incorporated to develop comprehensive and systematic testing protocols for E5® Nano Silica admixtures in concrete. Using a fundamental materials science approach, Professor Luna Lu (Associate Dean for the Faculty | Reilly Professor, Lyles School of Civil Engineering | Inaugural Director, Center for Intelligent Infrastructure) and her team have worked tirelessly to more fully understand the internal curing and densification effect of, and fresh state properties of concrete containing, E5® Nano Silica. This independent research and laboratory verification has helped generate work with DOTs all across the United States as well as validate the years of results seen in the field by the team at E5.

Additionally, Dr. Jason Weiss (Professor, School of Civil and Construction Engineering Miles Lowell and Margaret Watt Edwards Distinguished Chair in Engineering Oregon State University) and Dr. Jon Belkowitz have collaborated to examine the use of E5® Liquid Fly Ash® to potentially reduce the susceptibility of concrete to deicing salt damage. Specifically, deicing salts, like calcium chloride and magnesium chloride, can react with water and calcium hydroxide in concrete to form an expansive product called calcium oxychloride. Supplementary cementitious materials (SCMs), such as Class F fly ash, slag, and silica fume, can reduce calcium oxychloride formation through dilution of the cement, which further reduces calcium hydroxide through chemical reaction. This research concluded that E5® Nano Silica reduced calcium oxychloride at lower dosages than all other SCMs included in the study, making it the most efficient of all SCMs researched.

Westbrook, M.; Ghantous, R.; Weiss, W.J.; Belkowitz, J. Utilizing Nano Silica to Reduce Calcium Oxychloride Formation in Cementitious Materials. Transportation Research Record Journal of the Transportation Research Board (October 2022).

PURDUE UNIVERSITY · WJE · SGS TEC · Oregon State University · ASTM INTERNATIONAL · CENTER FOR INTELLIGENT INFRASTRUCTURE · CTLGROUP · US Army Corps of Engineers®

E5® Nano Silica has emerged as a dynamic concrete solution that is beneficial for virtually all applications across all segments of the industry.

E5® Nano Silica addresses the diverse set of challenges presented by the concrete industry - including, ever-accelerating construction schedules, the impact of changes in cement chemistry, a general lack of proper curing, issues with water-cement ratios and concrete workability, material consistency and reliability, and the need for carbon reduction.

E5

WHAT IS INTERNAL CURING?

Utilizing E5® Nano Silica to internally cure concrete.

Concrete is the most used construction material in the world and is composed primarily of cement, water, sand, and rock. To properly cure concrete, it is critical to provide the concrete with a sufficient amount of moisture for a sufficient period of time. Traditionally, curing of concrete has been achieved through the use of curing blankets, burlap and visqueen, and/or curing compounds to help retain moisture within the concrete and/or through the addition of water to the surface of the concrete as moisture is lost to evaporation. However, this "wet curing" of concrete has become more challenging to implement (or implement properly) due to the accelerated pace of construction, construction budget limitations, and human error, among other factors. These challenges have led, more recently, to efforts to enable internal curing of concrete.

So what is internal curing and how can it be used to improve concrete?

surface and subsurface. Over time, these channels allow water and de-icing salts and other harmful chemicals to leach into the concrete, resulting in increased freeze-thaw damage and deterioration of any steel reinforcements within the concrete.

Internal curing not only helps prevent the bleeding of water through concrete, but also allows water to penetrate deeper into the concrete mixture, allowing for hydration of more cement. Unlike traditional wet curing, which does not allow water to penetrate much beyond the surface of the concrete, internal curing provides water that is dispersed throughout the depth of the concrete (Federal Highway Administration, 2016). Further, internal curing does not require the addition of any water to the surface of the concrete post-placement, as is often the case with traditional wet curing, which can have negative affects on the pore structure and permeability of the concrete surface.

E5® Internal Cure® alters the back-bone of concrete, increasing its resiliency to physical and chemical attack, through internal curing and particle-to-particle packing.

In 2018, the American Concrete Institute (ACI) established a definition for an alternative to traditional wet curing known as "internal curing". According to the ACI, internal curing involves "supplying water throughout a freshly placed cementitious mixture using reservoirs, via pre-wetted lightweight aggregates, that readily release water as needed for hydration or to replace moisture lost through evaporation or self-desiccation". Basically, the goal of internal curing is to retain sufficient water within the concrete mixture to enable proper hydration of the cement within the concrete, without the need to add water to the surface of the concrete post-placement (or to use other traditional wet curing methods).

As water evaporates from the surface of concrete, several negative effects result. First, the cement binder within the concrete loses access to water essential for complete hydration, which negatively impacts the durability of the concrete. Second, this evaporation can cause the pooling of excess water ("bleed water") on the surface of the concrete, which can result in the formation of bleed channels. As the concrete begins to set, this excess water then migrates through the porous concrete matrix, leaving open channels (capillaries) within the concrete

E5® Internal Cure® optimally cures concrete from the inside – without the need for any wet curing methods or curing compounds and without the need to manage pre-wetted lightweight aggregates (LWAs). The nano silica particles contained in E5® Internal Cure® control the loss of water within the concrete mix to ensure optimal hydration of the cement and fill voids within the concrete matrix to densify the concrete, resulting in a substantial reduction in concrete permeability, shrinkage, and cracking potential. A less permeable substrate protects the concrete matrix from rapid deterioration. The homogenous mixture created with E5® Internal Cure® results in concrete pavement that is not only resistant to de-icing salts and chemical attack, but the prevention of bleed channels creates a pavement more resistant to steel corrosion and premature failure. Additionally, internal curing with E5® Internal Cure® reduces moisture migration producing concrete that is more resilient to adhesion bond failure and delamination of floor and roofing coverings.

References: Federal Highway Administration. "Internal Curing for Concrete Pavements." 2016.

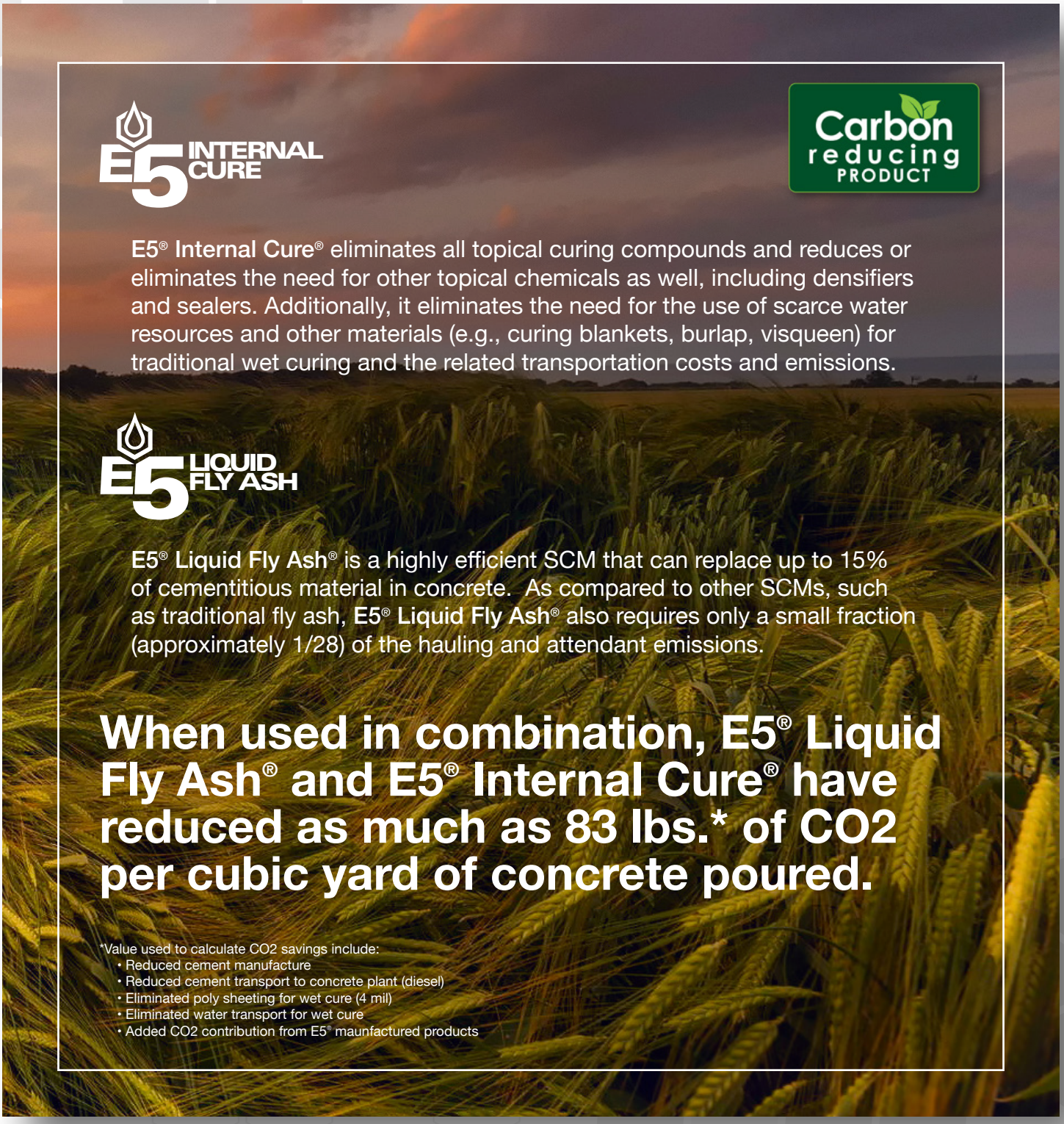
CONTENTS

CARBON REDUCTION ADVANTAGE

E5® Nano Silica is the planet's answer for sustainable concrete.

The most sustainable concrete is durable concrete. **E5® Nano Silica** substantially improves the durability, and extends the service life, of concrete by controlling water, ensuring a proper cure and filling voids within the concrete's naturally porous structure.

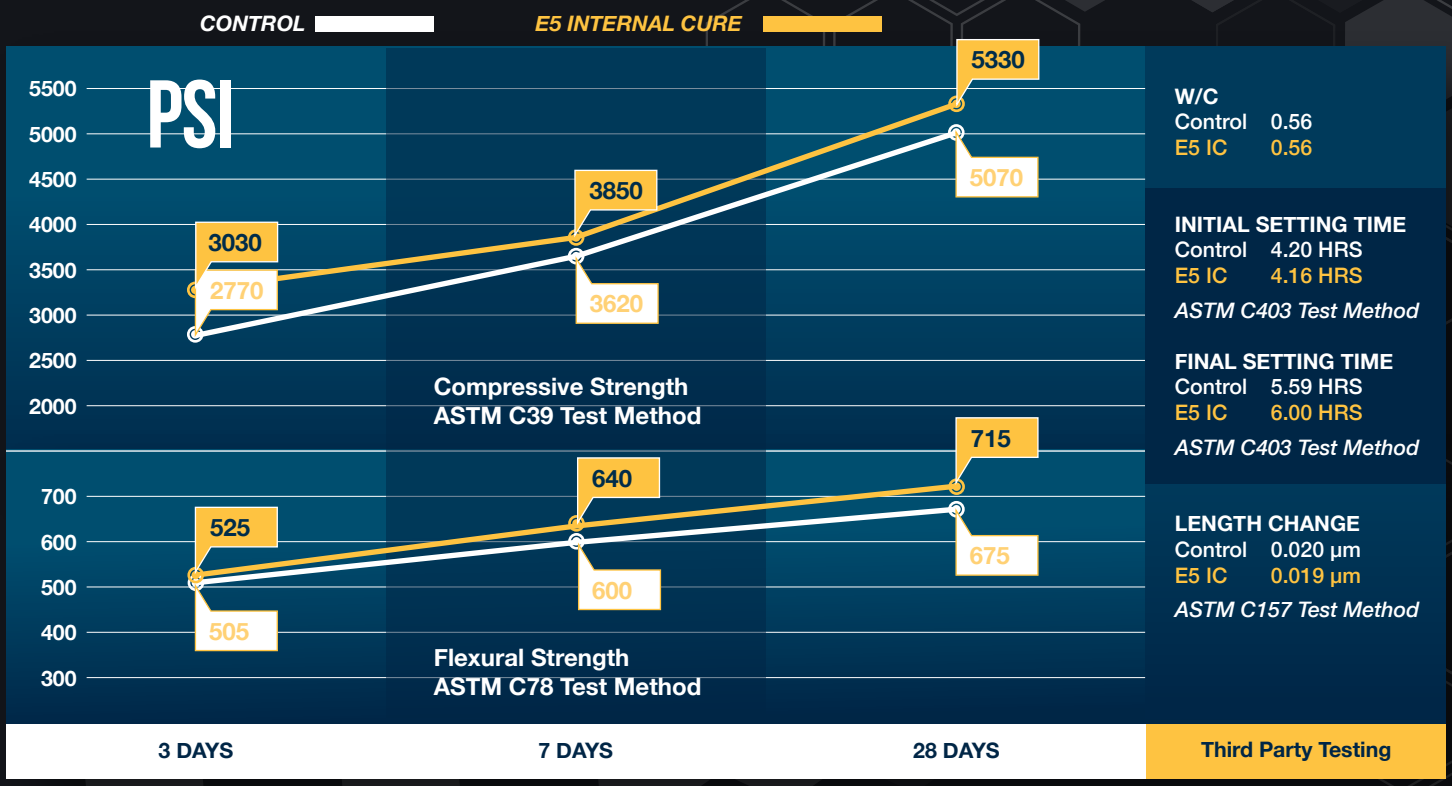
E5® Nano Silica products also enable a reduction of cement and supplementary cementitious materials (SCMs) in concrete mixes and eliminate all materials used for traditional wet curing.


E5 INTERNAL CURE
Carbon reducing PRODUCT
E5® Internal Cure® eliminates all topical curing compounds and reduces or eliminates the need for other topical chemicals as well, including densifiers and sealers. Additionally, it eliminates the need for the use of scarce water resources and other materials (e.g., curing blankets, burlap, visqueen) for traditional wet curing and the related transportation costs and emissions.
E5 LIQUID FLY ASH
E5® Liquid Fly Ash® is a highly efficient SCM that can replace up to 15% of cementitious material in concrete. As compared to other SCMs, such as traditional fly ash, E5® Liquid Fly Ash® also requires only a small fraction (approximately 1/28) of the hauling and attendant emissions.
When used in combination, E5® Liquid Fly Ash® and E5® Internal Cure® have reduced as much as 83 lbs.* of CO2 per cubic yard of concrete poured.
*Value used to calculate CO2 savings include:
• Reduced cement manufacture
• Reduced cement transport to concrete plant (diesel)
• Eliminated poly sheeting for wet cure (4 mil)
• Eliminated water transport for wet cure
• Added CO2 contribution from E5® maunfactured products

ADMIXTURE COMPLIANCY

ASTM C494 Chemical Admixtures

E5® Internal Cure® is an ASTM C494 Type S Admixture. “Type S” is defined as a specific performance admixture and, in the case of **E5® Internal Cure®**, the specific performance is internal cure of concrete. Consistent with ASTM C494 Specifications for Chemical Admixtures, third-party testing of concrete samples containing **E5® Internal Cure®** was conducted and compared against otherwise identical reference samples that excluded **E5® Internal Cure®**.



To prove that concrete containing **E5® Internal Cure®** successfully internally cures concrete – that is, cures from inside the concrete matrix (i.e., without wet curing, curing compounds or other traditional curing methods) – third-party testing was conducted to compare (i) control concrete cylinders without **E5® Internal Cure®** which were subject to standard laboratory moist curing (i.e., water bath submersion) and (ii) concrete samples containing **E5® Internal Cure®** which where not moist cured but simply exposed to open laboratory air. All samples were, then, subjected to 3-day, 7-day and 28-day compressive strength and flexural strength testing. The results of this testing support **E5® Internal Cure®** compliance as an ASTM C494 Type S Admixture, as seen in the chart above.

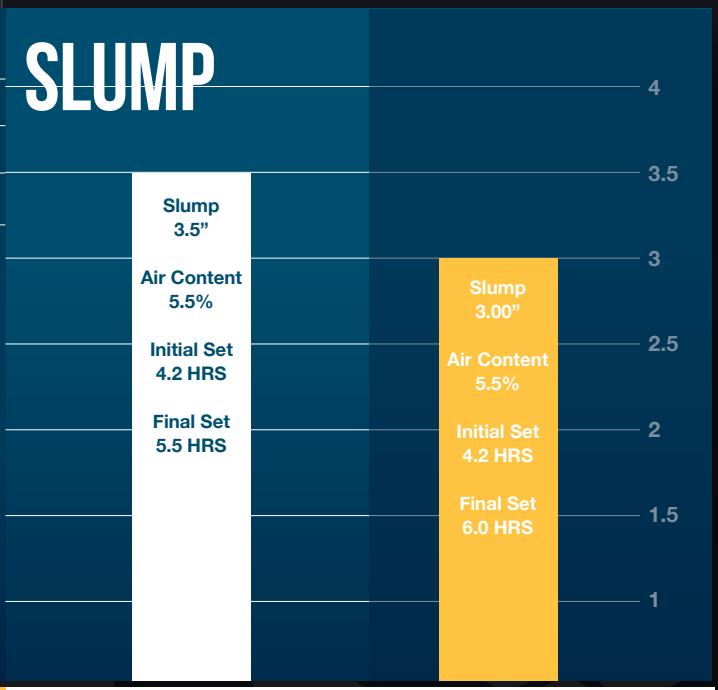
ADMIXTURE COMPLIANCY

Fresh Properties

Plastic testing was performed by certified technicians on both test concrete samples containing **E5® Internal Cure®** and control concrete samples without **E5® Internal Cure®** to compare relative fresh state properties. The chart (below) shows that the concrete sample containing **E5® Internal Cure®** had an increased slump value (and no changer in air content) and a minimal delay in final set time, which was within accepted parameters as established by ASTM C494.

CONTROL *E5 INTERNAL CURE*

	CONTROL	E5 IC
MATERIALS		
Cement	517 lb/cy	517 lb/cy
Sand	1155 lb/cy	1155 lb/cy
Moisture content	4.2%	4.2%
Absorption	1.2%	1.5%
Coarse aggregate	1851 lb/cy	1851 lb/cy
Moisture content	0.4%	0.4%
Absorption	1.3%	1.3%
Effective Water Content	290 lb/cy	290 lb/cy
E5 INTERNAL CURE	0 oz/hwc	4 oz/hwc

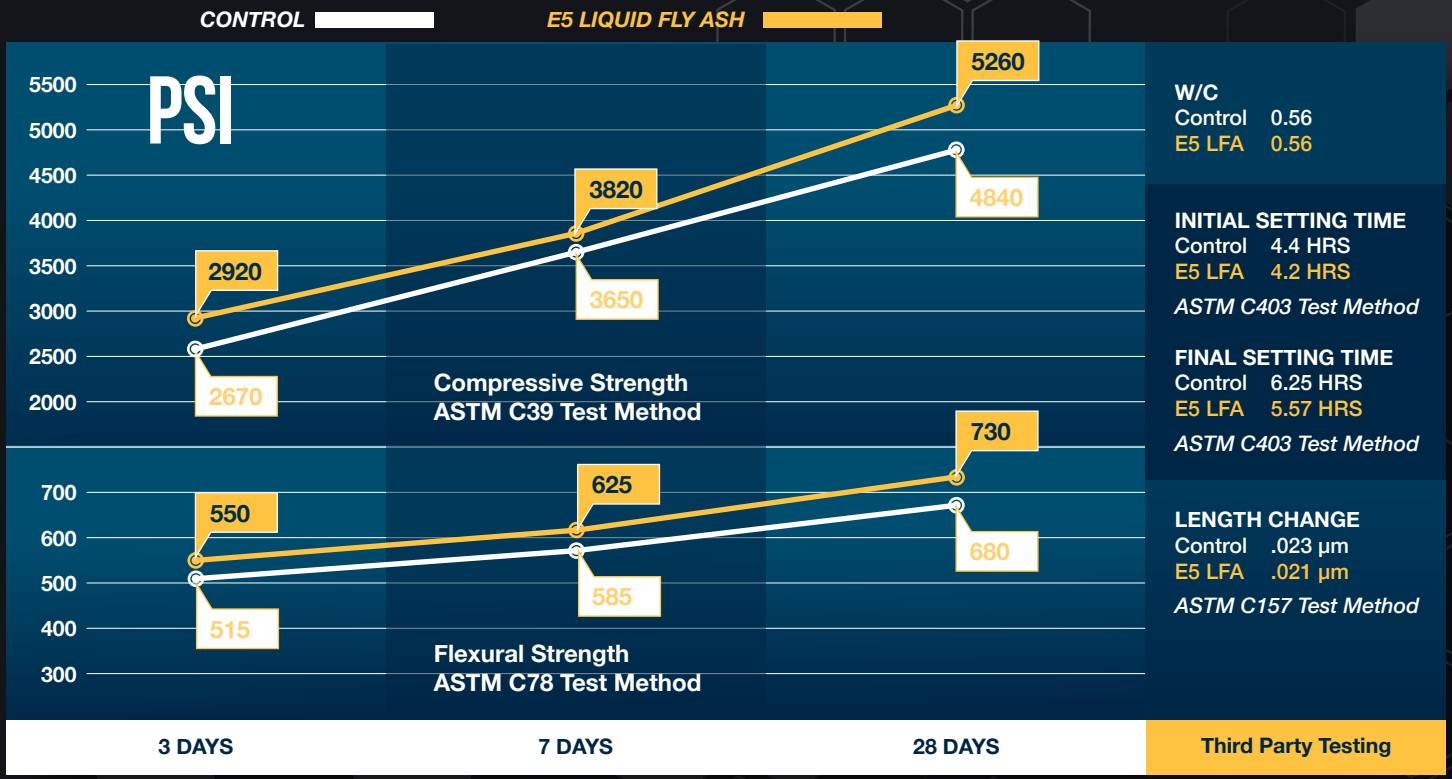


Third Party Testing | Properties

ADMIXTURE COMPLIANCY

ASTM C494 Chemical Admixtures

E5® Liquid Fly Ash® is an ASTM C494 Type S admixture. “Type S” is defined as a specific performance admixture, and in the case of **E5® Liquid Fly Ash®**, the specific performance is pozzolanic reaction for the consumption of calcium hydroxide and conversion to calcium silicate hydrate reaction to consume calcium hydroxide. ASTM C494 Specifications for Chemical Admixtures requires certain properties to be met when compared to a control batch. The control batch is designed to have the same amount of materials, with the exception of **E5® Liquid Fly Ash®**. The table below shows that **E5® Liquid Fly Ash®** is compliant as an ASTM C494 Type S admixture.



To prove that concrete containing **E5® Liquid Fly Ash®** successfully creates a pozzolanic reaction within the concrete, third-party testing was conducted to compare (i) control concrete cylinders without **E5® Liquid Fly Ash®** and (ii) a concrete sample containing **E5® Liquid Fly Ash®**. All samples were, then, subjected to 3-day, 7-day and 28-day compressive strength and flexural strength testing. The results of this testing support **E5® Liquid Fly Ash®** compliance as an ASTM C494 Type S Admixture, as seen in the chart above.

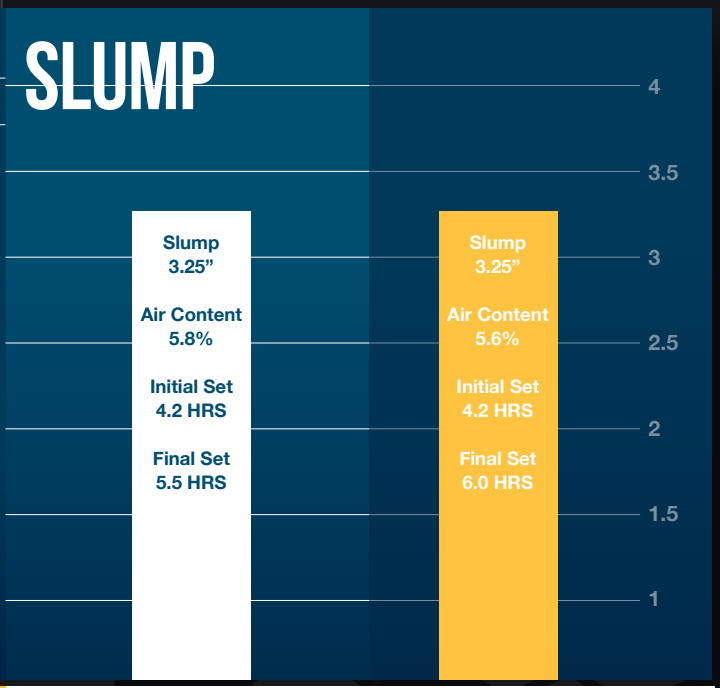
ADMIXTURE COMPLIANCY

Fresh Properties

Plastic testing was performed by certified technicians on both test concrete samples containing **E5® Liquid Fly Ash®** and control concrete samples without **E5® Liquid Fly Ash®** to compare relative fresh state properties. The chart (below) shows that the concrete sample containing **E5® Liquid Fly Ash®** had no effect on slump value and nominal effect on air content and a minimal delay in final set time, which was within accepted parameters as established by ASTM C494.

CONTROL *E5 LIQUID FLY ASH*

	CONTROL	E5 LFA
MATERIALS		
Cement	516 lb/cy	516 lb/cy
Sand	1151 lb/cy	1155 lb/cy
Moisture content	4.2%	4.2%
Absorption	1.2%	1.5%
Coarse aggregate	1851 lb/cy	1851 lb/cy
Moisture content	0.4%	0.4%
Absorption	1.3%	1.3%
Effective Water Content	290 lb/cy	290 lb/cy
E5 LIQUID FLY ASH	0 oz/hwc	8 oz/hwc



Third Party Testing | Properties

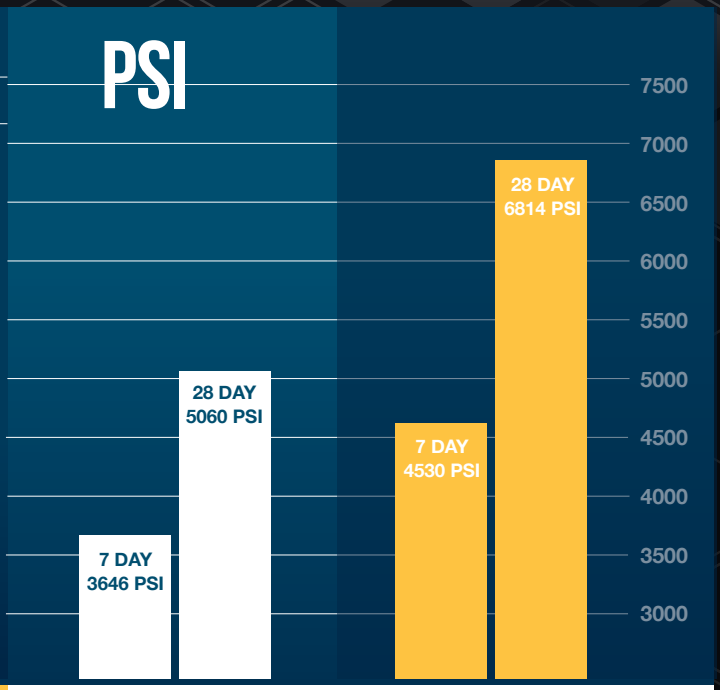
STRENGTH TESTING

ASTM C39 Compressive Strength

ASTM C39 testing determines the compressive strength of cylindrical concrete specimens, such as molded cylinders and drilled cores, by applying a compressive axial load to the specimens until failure occurs. Third-party testing was conducted to compare concrete specimens containing **E5® Internal Cure®** to control specimens without **E5® Internal Cure®**. The chart below identifies the materials used in the test samples and compressive strength results at 7 days and 28 days.

CONTROL *E5 INTERNAL CURE*

	CONTROL	E5 IC
MATERIALS		
Cement type 1	400 lb/cy	400 lb/cy
#8 gravel	1960 lb/cy	1957 lb/cy
Moisture content	3.00%	3.0%
Absorption	2.04%	2.04%
Sand	1500 lb/cy	1500 lb/cy
Moisture content	3.65%	3.67%
Absorption	2.04%	2.04%
Sika air 260	0.2 lb/cy	0.2 lb/cy
Water Reducer	16.3 oz/hwc	16.3 oz/hwc
E5® Internal Cure	0 oz/hwc	4 oz/hwc



Third Party Analysis | Properties

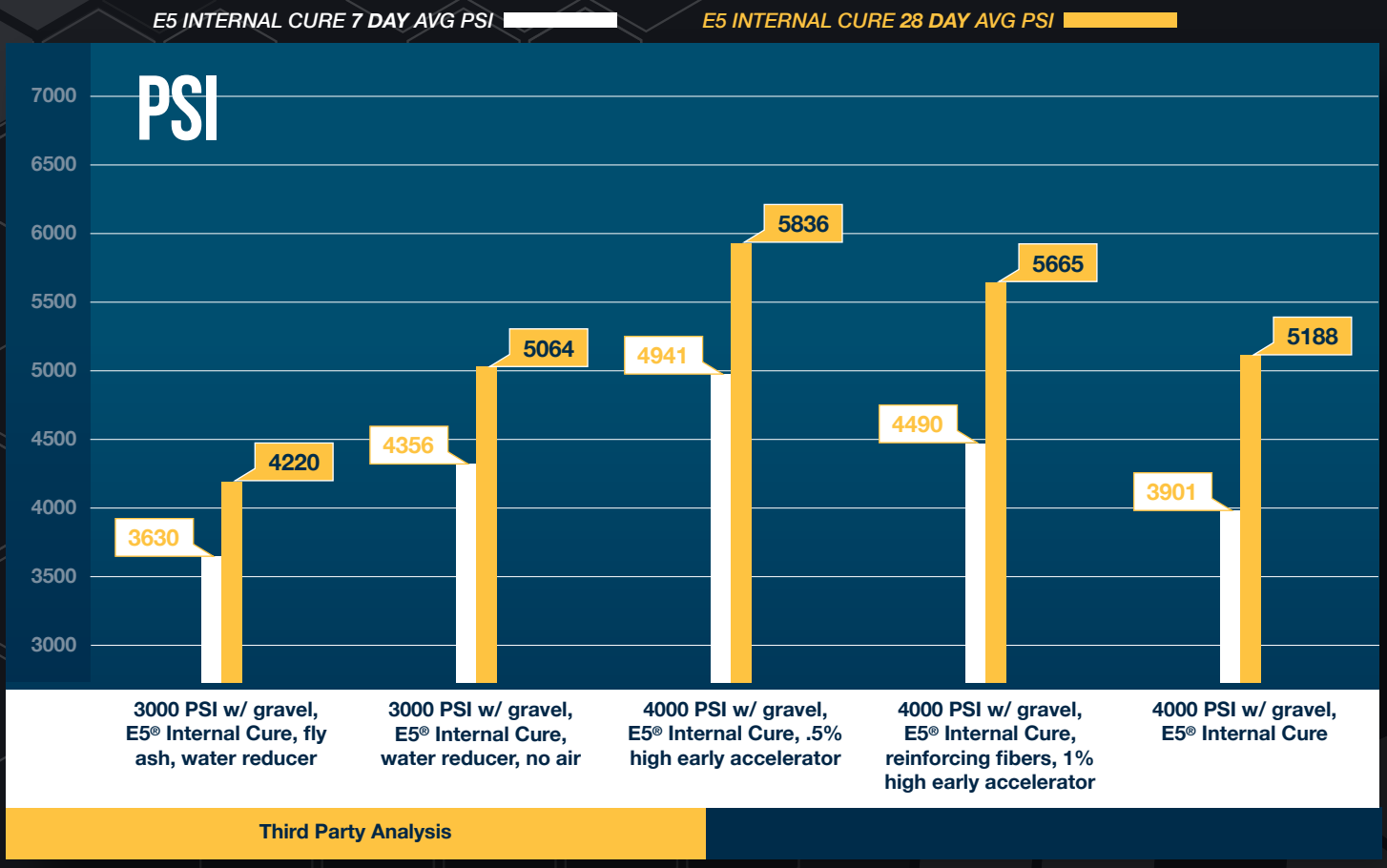
Compression strength tests were performed on both concrete mixtures. Cylinders that contained **E5® Internal Cure®** broke at 124% of the 7-day control samples and at 135% of the 28-day control samples. The increase in strength was attributed to **E5® Internal Cure®** increasing the amount of hydrated cement.

STRENGTH TESTING

ASTM C39 Compressive Strength

Compression strength is viewed as the most important test done on hardened concrete. It indicates not only that the concrete mixture is designed correctly, but also that the concrete has been cured properly and sufficient cement particles have been hydrated.

The chart below compiles average compressive strength test results, at both 7 days and 28 days, for multiple concrete samples using the various identified mix designs.

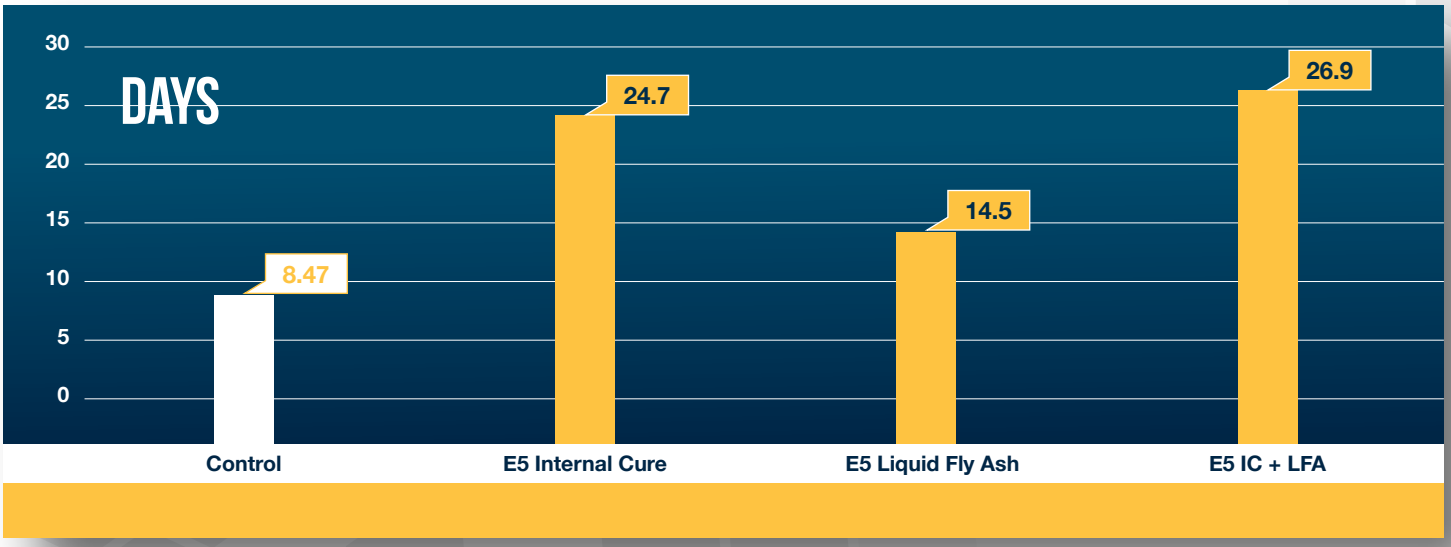


These concrete mixtures contain a variety of other admixtures (water reducers, accelerators, corrosion inhibitors) and supplementary cementitious materials (fly ash). Interactions between admixtures and SCMs are identified through compressive strength testing. Not only does **E5® Internal Cure®** have a positive impact on compressive strength at both 7 days and 28 days, but it also is compatible with a wide range of admixtures, SCMs and other materials.

RESTRAINED SHRINKAGE

ASTM C1581 Determining Age at Cracking and Induced Tensile Stress

The ASTM C1581 test method is used to determine the relative likelihood of early-age cracking of different cementitious mixtures and to aid in selecting materials that are less likely to crack under restrained shrinkage. This laboratory test can be used to determine the relative effects of concrete material variations on induced tensile stresses and cracking potential, including, but not limited to aggregate source, aggregate gradation, cement type, cement content, water content, supplementary cementitious materials and chemical admixtures. The procedure can be used to determine the effects of variations in the proportions and material properties of mortar or concrete on cracking due to both drying shrinkage and deformations caused by autogenous shrinkage and heat of hydration.

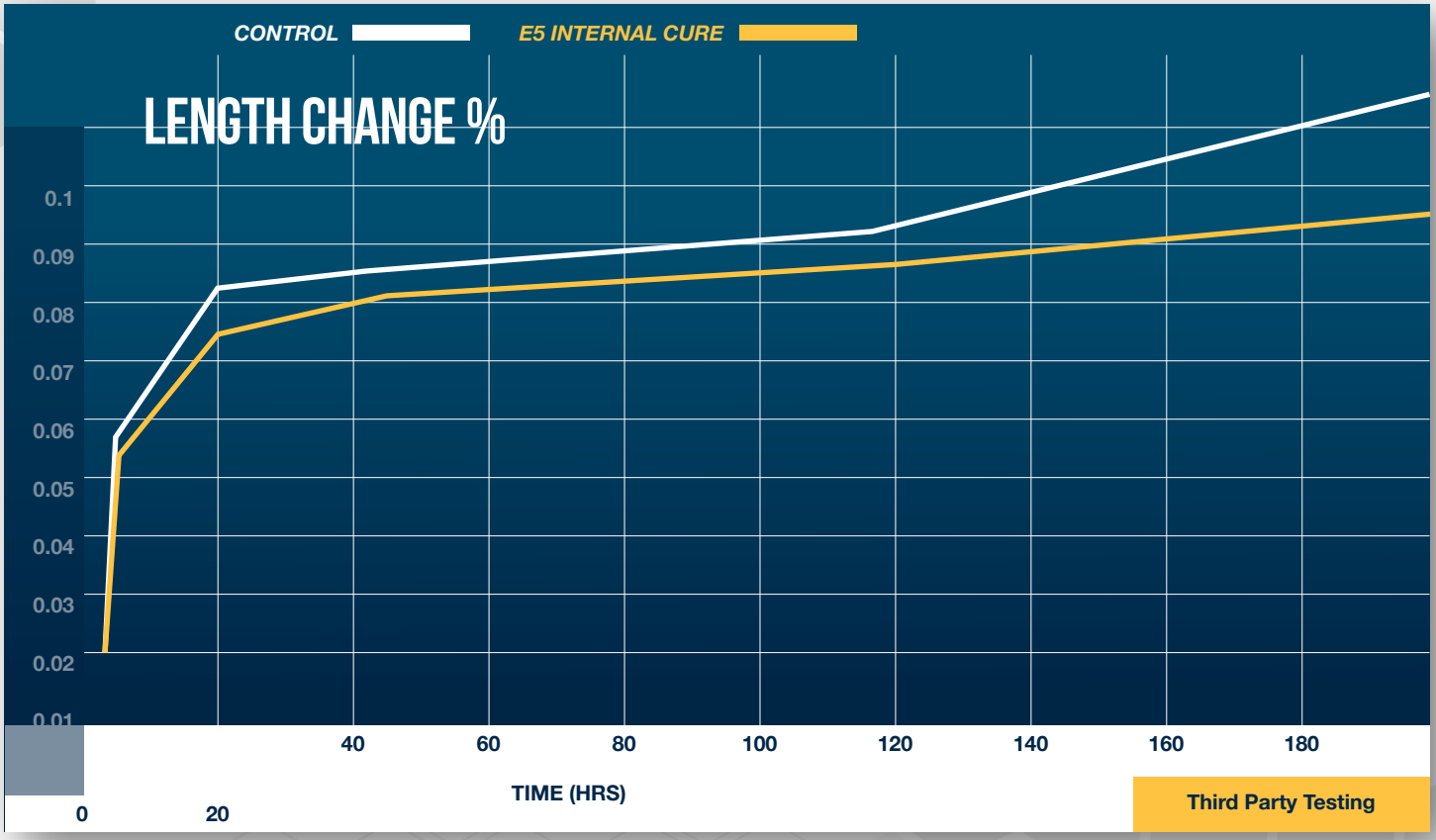


Reference samples and samples containing both **E5® Internal Cure®** and **E5® Liquid Fly Ash®**, independently and in combination, were moist cured for 24 hours and tested pursuant to ASTM C1581 standards reflected in the chart above. Test results showed that adding **E5® Internal Cure®** and **E5® Liquid Fly Ash®** to a concrete mixture, alone and in combination, substantially increased the time to cracking as compared to a control concrete mixture without **E5®**.

SHRINKAGE TESTING

ASTM C157 Length Change

ASTM C157 drying shrinkage testing is performed to determine the volumetric contraction of concrete caused by the loss of moisture. This testing measures the change in length of a concrete or mortar specimen over time under controlled temperature and moisture levels. The chart below shows the results of C157 testing of a control sample without **E5® Internal Cure®** as compared to a sample with **E5® Internal Cure®**.

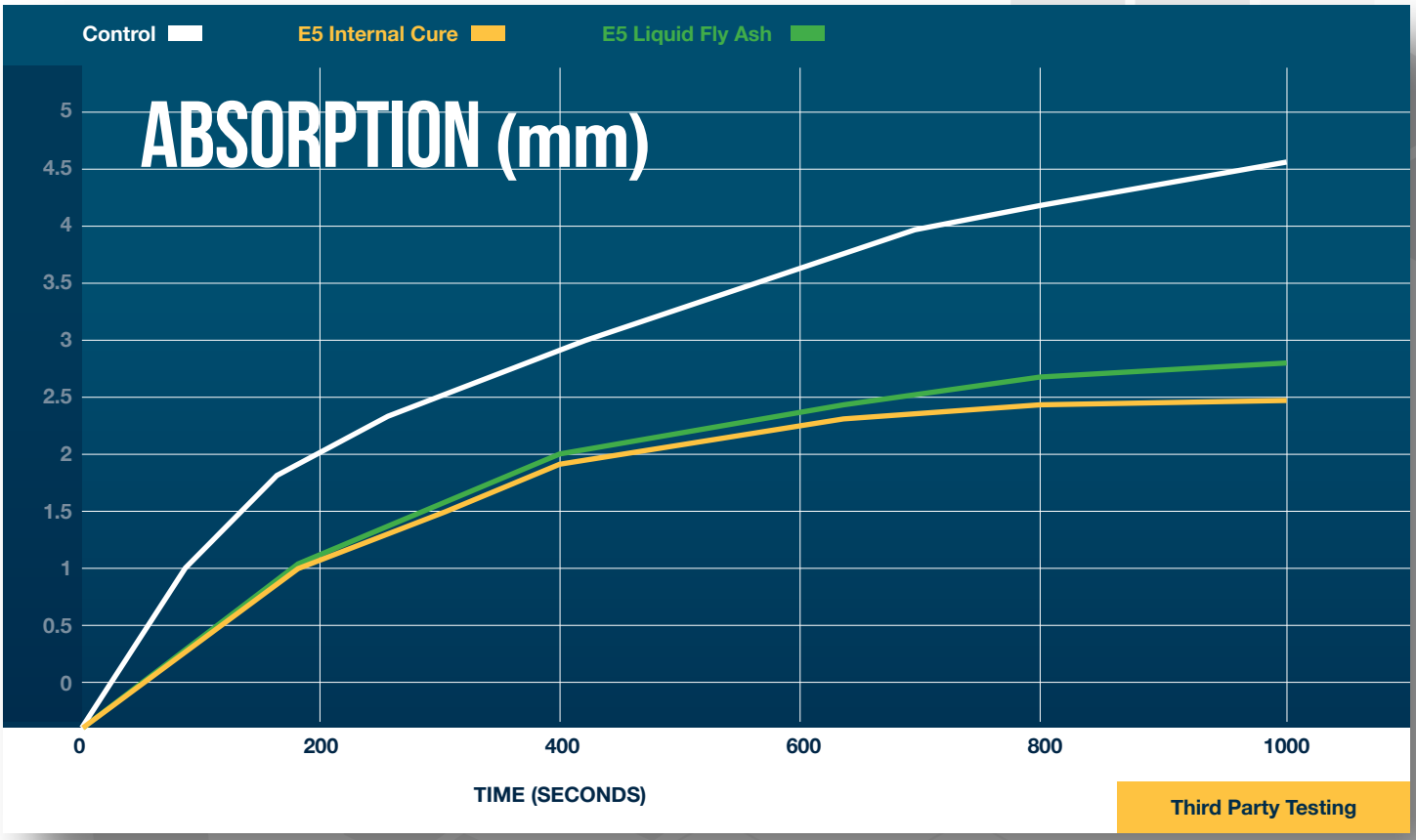


The reduction in the amount of length change shown above can be attributed to **E5® Internal Cure®** assisting in the hydration of cement particles and creating a more stable matrix that resists cracking.

MOISTURE TESTING

ASTM C1585 Rate of Absorption

ASTM C1585 measures the rate of water absorption of concrete. The test involves exposing one side of unsaturated concrete to water in order to determine the penetrability of the concrete pore system. A third-party lab tested the penetrability of concrete samples containing **E5® Internal Cure** and **E5® Liquid Fly Ash.** The table below shows the rates of absorption.



The results of this testing nominal water absorption rates of concrete containing **E5® Internal Cure®** and **E5® Liquid Fly Ash®** demonstrating a highly consolidated pore structure. Over the course of testing conducted, there was a 44% +/- decrease in absorption from control indicating that **E5® Internal Cure®** and **E5® Liquid Fly Ash®** create a barrier and prevent moisture from penetrating the C-S-H matrix.

MOISTURE TESTING

ASTM C642 Density, Absorption and Voids in Hardened Concrete

ASTM C642 testing involves subjecting cured concrete samples to oven drying for 24 hours, immersion in room temperature water for 48 hours, immersion in boiling water for five hours, and finally suspension in water in order to determine the apparent mass, providing a measure of the total water permeable pore space. This test method is used in conversions between mass and volume.

ASTM C642	E5 IC SAMPLE 1	E5 IC SAMPLE 2
Absorption after immersion and boiling	0.090023%	0.080078%
Bulk dry density	2.363 mg/m^3	2.465 mg/m^3
Apparent density	2.414 mg/m^3	2.512 mg/m^3
Percent voids in hardened concrete	2.113%	2.243%
	Third Party Testing	

The table to the right shows **E5® Internal Cure®** tightens the pore structure in the concrete, thus absorbing very little water during the various steps of the testing. This prevents the infiltration of unwanted water, there by reducing corrosion to steel reinforcements and cracking during freeze thaw cycles.

ASTM C156 Water Loss

ASTM C156 testing subjects mortar squares to a constant temperature and humidity for 72 hours to measure the amount of mixing water that evaporates during the early hardening period. **E5® Internal Cure®** was incorporated into the mortar mixture. The table to the right shows the results for C156 testing and the calculated mass loss per unit area after 72 hours.

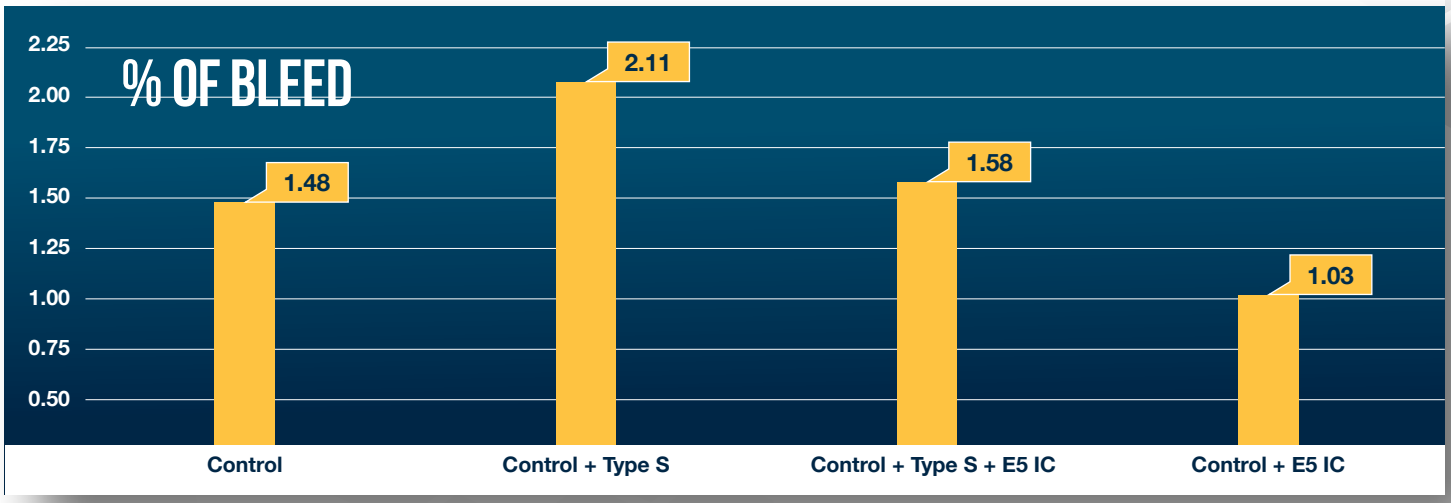
This test method determines the efficiency of the curing process. This third-party analysis determined that mortar samples containing **E5® Internal Cure®** were highly effective with mass loss less than that allowed by both C156 (0.40 kg/m2) and C309 (0.55 kg/m2).

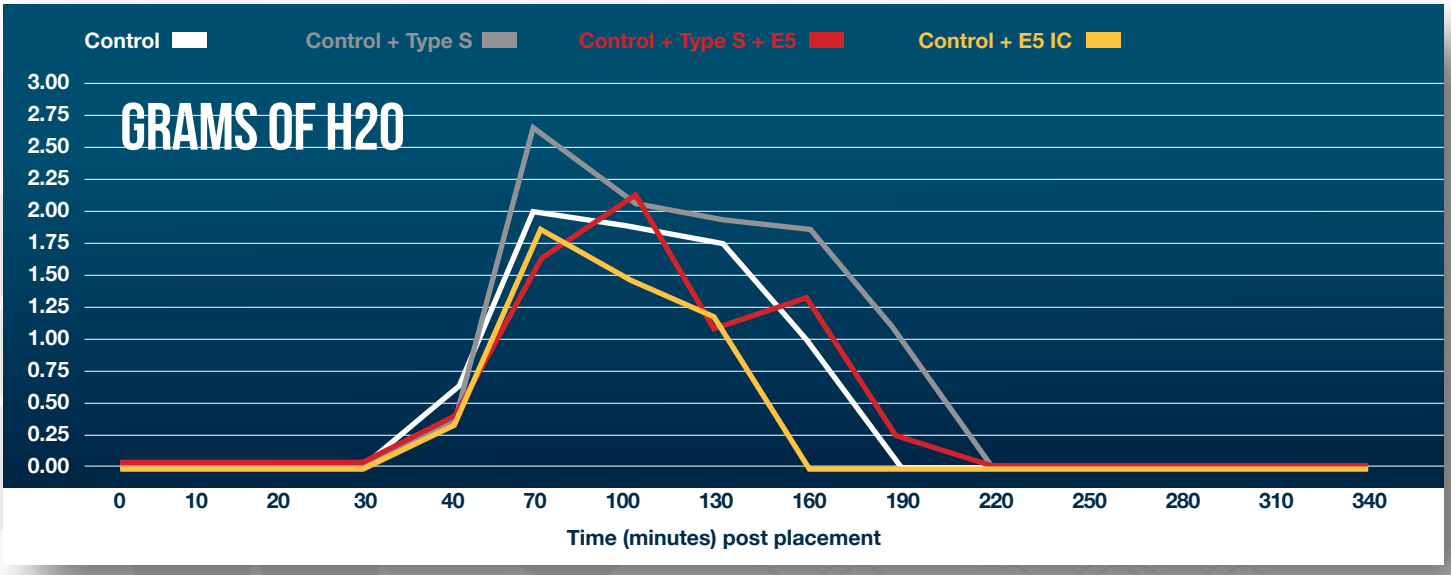
ASTM C156	E5 IC SAMPLE 1	E5 IC SAMPLE 2	E5 IC SAMPLE 3
Exposed surface area	27096.7 mm^2	27096.7 mm^2	27096.7 mm^2
Mass Loss	9.60 g	8.70 g	8.50 g
Mass Loss per unit area	0.354 kg/m^2	0.321 kg/m^2	0.314 kg/m^2
ASTM C156	**E5 IC SAMPLE 4**	**E5 IC SAMPLE 5**	**E5 IC SAMPLE 6**
Exposed surface area	16129 mm^2	16129 mm^2	16129 mm^2
Mass Loss	7.25 g	7.26 g	7.25 g
Mass Loss per unit area	0.421 kg/m^2	0.433 kg/m^2	0.427 kg/m^2
	Third Party Testing		

MOISTURE TESTING

ASTM C232 Bleed Rate

ASTM C232 testing measures the amount of bleed water in a concrete sample based on variables of composition, treatment and environment. Bleed channels created during placement, and left open after the curing process, expose the concrete matrix to contaminants and moisture emissions. The charts below show that **E5® Internal Cure®** significantly reduces the bleed rate of concrete as compared to reference. It does this by chemically binding the mix water to the cement grains for complete hydration during curing.

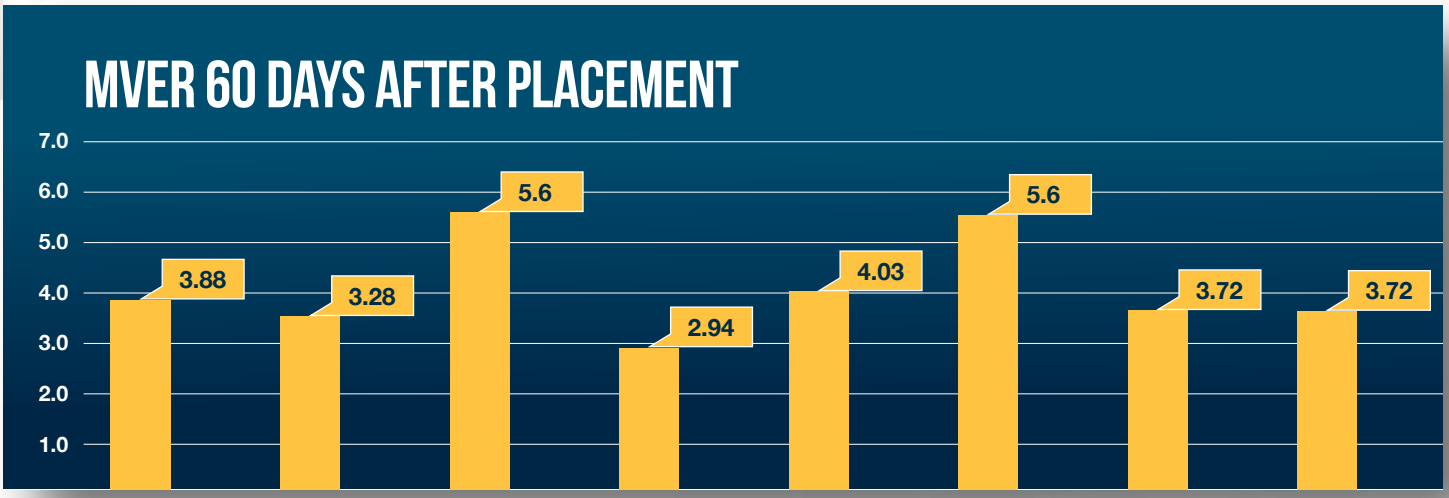


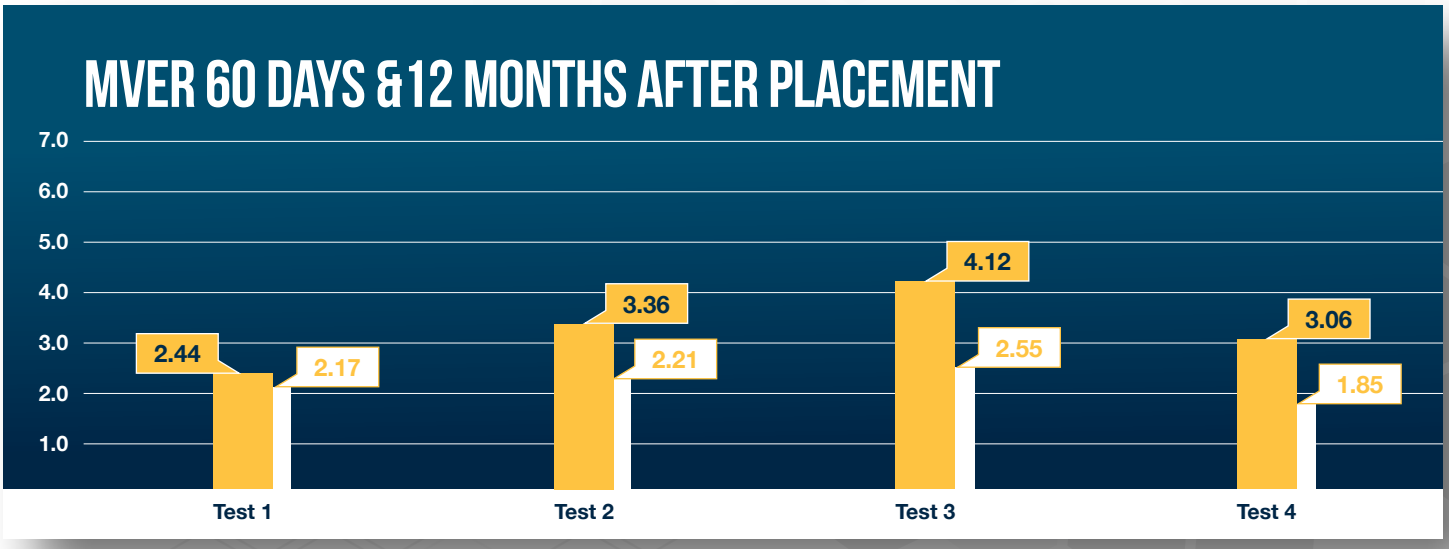


MOISTURE TESTING

ASTM F1869-16 Moisture Vapor Emissions Rate

The Moisture Vapor Emissions Rate, MVER, is a standard used to determine whether adhesives will properly bind to concrete surfaces. MVER, alone, however is not an indication of adhesive failure. High alkalinity (pH) combined with moisture vapor transmission are the major cause of adhesive failures. The charts below show **E5® Internal Cure + E5® Catalyst** (applied to the surface of the concrete containing **E5® Internal Cure®**) continue to hydrate the concrete well after placement, closing the capillaries and reducing moisture emissions.





MOISTURE TESTING

ASTM E96 Water Vapor Transmission

ASTM E96 is a standard test method to measure the rate at which water vapor passes through permeable and semi-permeable materials. It was first developed to establish permeability ratings for products like plastic visqueen. The test has been adapted to measure the moisture permeability of concrete. Third-party testing was used to determine the ability of **E5® Internal Cure®** to decrease vapor emissions in concrete through reduced bleed channels and capillary size within the concrete matrix. Core samples were taken from concrete slabs containing **E5® Internal Cure®** 28 days after concrete placement. Testing was performed on two cores at three different one-inch layers through the depth of each core (the top one-inch layer, which includes the original surface finish; the middle one-inch layer that sits directly beneath the top layer; and the bottom one inch layer that sits directly beneath the mid-layer). The US perm rating is one grain of water vapor per hour per square foot per inch of mercury. As reflected in the table below, concrete samples containing **E5® Internal Cure®** fall within "Class 2" of the ASTM standard.

CORE LAYERS	E5 IC CORE 1	E5 IC CORE 2
Top layer perm	0.50	0.47
Mid layer perm	0.54	0.54
Bottom layer perm	0.52	0.50
PERM AVERAGE	0.52	0.50

Third Party Testing

ASTM E96 VISQUEEN CLASSIFICATION

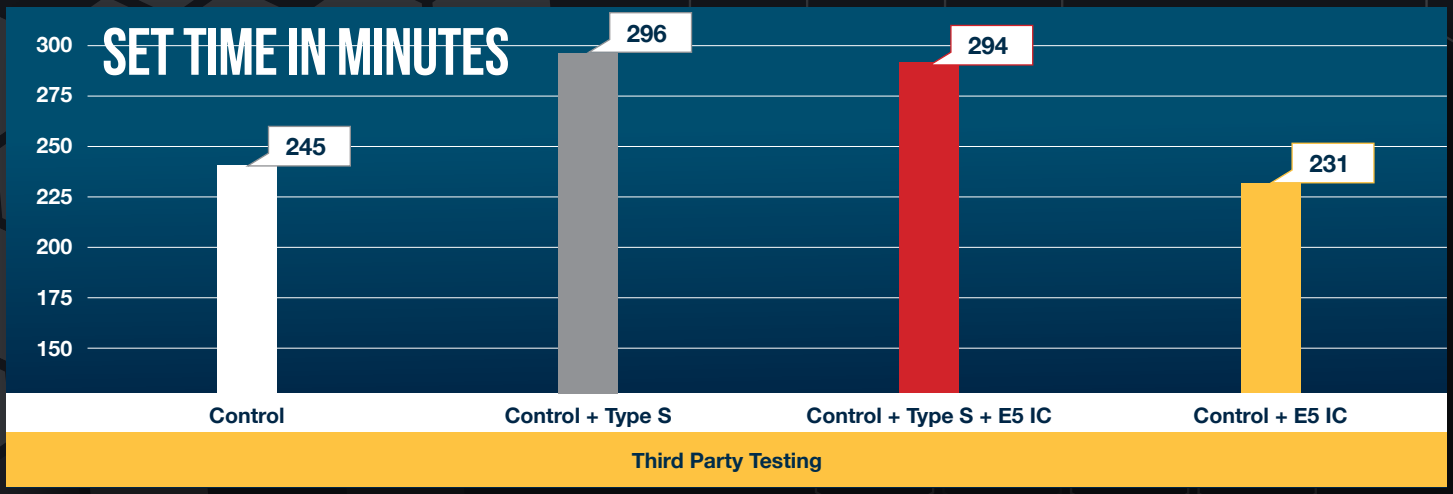
Class 1 - 0.1 and lower

Class 2 - 0.1-1.0

Class 3 - 1.0 and higher

ASTM C403 Set Time Evaluation

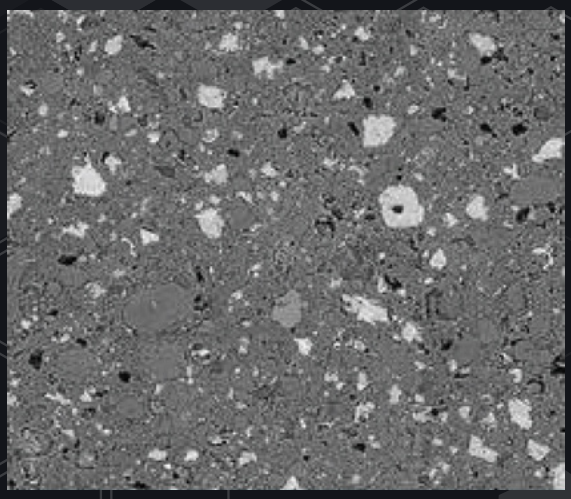
ASTM C403 testing determines concrete set time by measuring the amount of time required for a mortar sample to reach specified values of resistance to needle penetration. Concrete set times determine the speed of concrete placement and construction. Slow set times delay contractors, add cost and create complications with finishing and curing. Fast set times challenge finishers and create undesirable finishing characteristics with service-life issues. Testing of samples containing **E5® Internal Cure®** as compared to reference samples, with and without other admixtures, showed that **E5® Internal Cure®** had no material impact on set times.



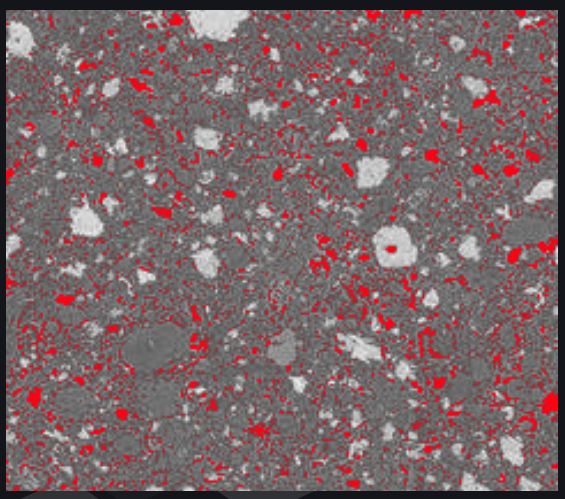
MOISTURE TESTING

Backscattered Electron Image Analysis

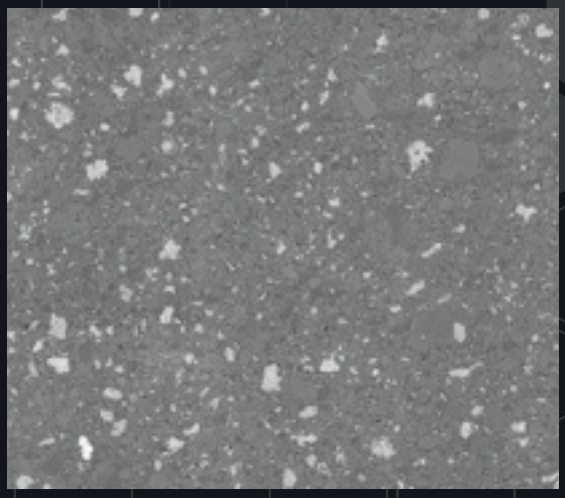
The microscopic Backscattered Electron (BSE) images of hydrated cement matrices shown below evidence the closing of the concrete pore structure (i.e., reduction of voids) caused by **E5® Internal Cure®**. This results in a significant reduction in bleed channels and an increased percentage of cement hydration, which creates high surface strengths, reduces capillary absorption at the surface, and lowers moisture emissions.



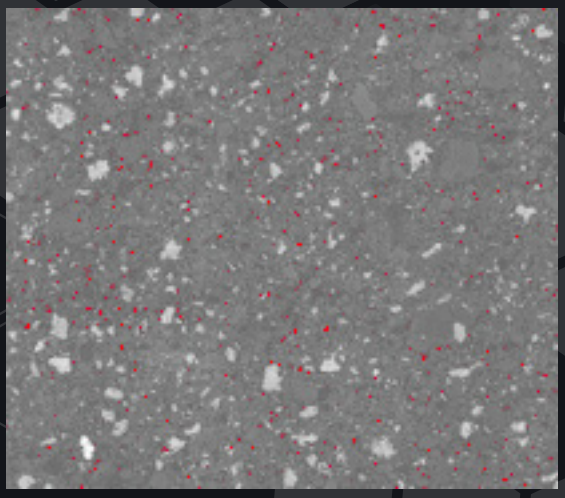
Control



Control (Red indicates voids)



E5® Internal Cure®



E5® Internal Cure® (Red indicates voids)

DURABILITY TESTING

ASTM C666 Resistance to Freezing and Thawing

According to the PCA Design and Control of Concrete Mixtures, the ability to resist freezing and thawing is essential to exterior concrete's longevity. When water freezes, it's volume increases by 9%. If water is allowed to penetrate the concrete matrix, the volume expansion of the water can put pressure on the pore structure and cause cracks and other forms of instability. ASTM C666 exposes concrete to 300 cycles of freezing and thawing to measure the durability factor of the concrete. The results of ASTM C666 testing are found below.

MATERIALS	E5 INTERNAL CURE	FRESH PROPERTIES	E5 INTERNAL CURE	FREEZE THAW	E5 INTERNAL CURE
Cement type 1	600 lb/cy	Slump	5.50"	# of cycles	300
Coarse aggregate	1800 lb/cy	Unit weight	146.6 lb/ft^3	Durability factor	89
Fine aggregate	1250 lb/cy	Yield	26.8 ft^3		
Admixtures		Temperature	67°C		
Darex 2	0.8 oz/100wt	Air content	4.0%		
E5 Internal Cure	4.0 oz/100wt				
Third Party Testing					

According to C494 specifications for Chemical Admixtures, the minimum durability factor that must be achieved is 80. The results of the third-party testing show a durability factor of 89 for concrete with **E5® Internal Cure®**. Note that the air content of the test specimen was only 4.0% which is less than the air entrainment level of 5.0% - 8.0%, which has been cited by PCA Standards as needed for yielding concrete with a higher durability factor.

DURABILITY TESTING

C779/C944 Abrasion Resistance

PCA Design and Control of Concrete Mixtures provides that abrasion resistance is an important property of concrete for floors, pavements and hydraulic structures, as those placements are exposed to greater risk of abrasion. To determine the abrasion resistance of concrete prepared with **E5® Internal Cure®** (both with and without use of **E5® Catalyst** applied to the surface), ASTM C944 test procedures were performed by abrading the concrete surface using a normal 22 lb. load for a doubled duration of 4 minutes. The total mass loss was measured in grams of concrete abraded from the surface. The table below shows the results of the C944 Abrasion Resistance test.

E5 INTERNAL CURE	MASS LOSS DUE TO ABRASION	E5 INTERNAL CURE + E5 CATALYST	MASS LOSS DUE TO ABRASION
EXP 1	1.1 g	EXP 1	0.6 g
EXP 2	1.2 g	EXP 2	0.7 g
EXP 3	1.3 g	EXP 3	0.8 g
LOSS AVERAGE	1.2 g	LOSS AVERAGE	0.7 g
Third Party Testing			

The industry standard for abrasion resistance is 2.5 grams or less total abraded mass loss. As shown above, concrete containing **E5® Internal Cure®** resulted in an average abraded mass loss of 1.2 grams and **E5® Internal Cure®** plus **E5® Catalyst** resulted in an average abraded mass loss of less than 0.7 grams.

Weight Change

To evaluate the effect of **E5® Internal Cure®** on weight change, mass measurements of mortar mixtures containing **E5® Internal Cure®** were collected over the course of several days and compared to mass measurements of reference mortar mixtures that did not include **E5® Internal Cure®**. The table below shows material proportions, fresh concrete properties and percent weight change results as between the tested samples. Testing showed that **E5® Internal Cure®** has little effect on weight change in mortar specimens.

MATERIALS	E5 INTERNAL CURE	FRESH PROPERTIES	E5 INTERNAL CURE	% WEIGHT CHANGE	E5 INTERNAL CURE
Cement type 1	500 lb/cy	Slump	4.00”	3 days	98.38%
Coarse aggregate	1780 lb/cy	Unit weight	149.6 lb/ft^3	7 days	98.03%
Fine aggregate	1500 lb/cy	Yield	26.8 ft^3	10 days	97.93%
w/c ratio	0.55	Temperature	67°C	18 days	97.65%
Admixtures					
E5® Internal Cure	4.0 oz/100wt				
Third Party Testing					

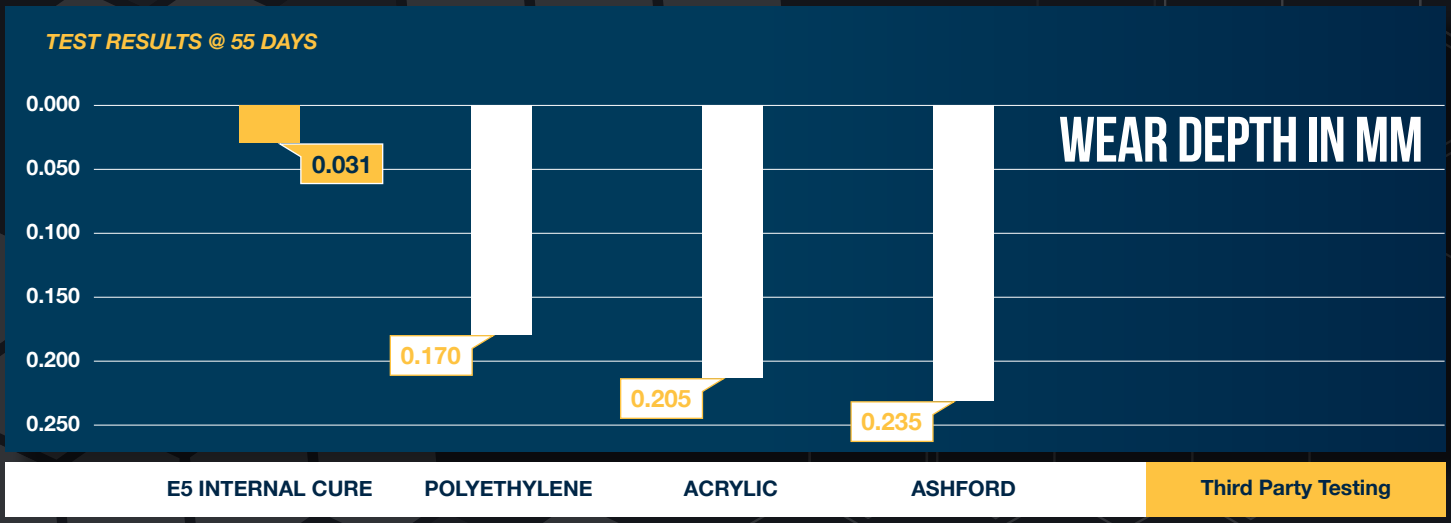
CHAPLIN ABRASION

BS 8204: 1987: Part 2 - Concrete Wear Analysis

The Chaplin Abrasion Test helps determine the abrasion resistance of concrete floors. It is also used to test the effectiveness of surface treatments used to protect concrete flooring. The depth of wear in the concrete floor resulting from the action of 75mm diameter by 20mm wide steel wheels rotating on its surface is used determine the abrasion resistance. The table below shows the wear classes established with Chaplin Abrasion testing, with the highest wear class being “Special” for the most extreme industrial use cases.

WEAR CLASS	DEGREE OF WEAR RESISTANCE	MAXIMUM WEAR DEPTH	TYPICAL USE	TRAFFIC
Special	Extremely High	0.055 mm	Very heavy-duty factories	Heavily loaded steel tires, impact, dragged loads
AR1	Very High	0.100 mm	Heavy-duty factories and warehouses	Steel tires, impact
AR2	High	0.200 mm	Medium-duty factories and warehouses	Lightly loaded steel tires, hard plastic tires
AR3	Good	0.400 mm	Light-duty factories and warehouses	Rubber tires

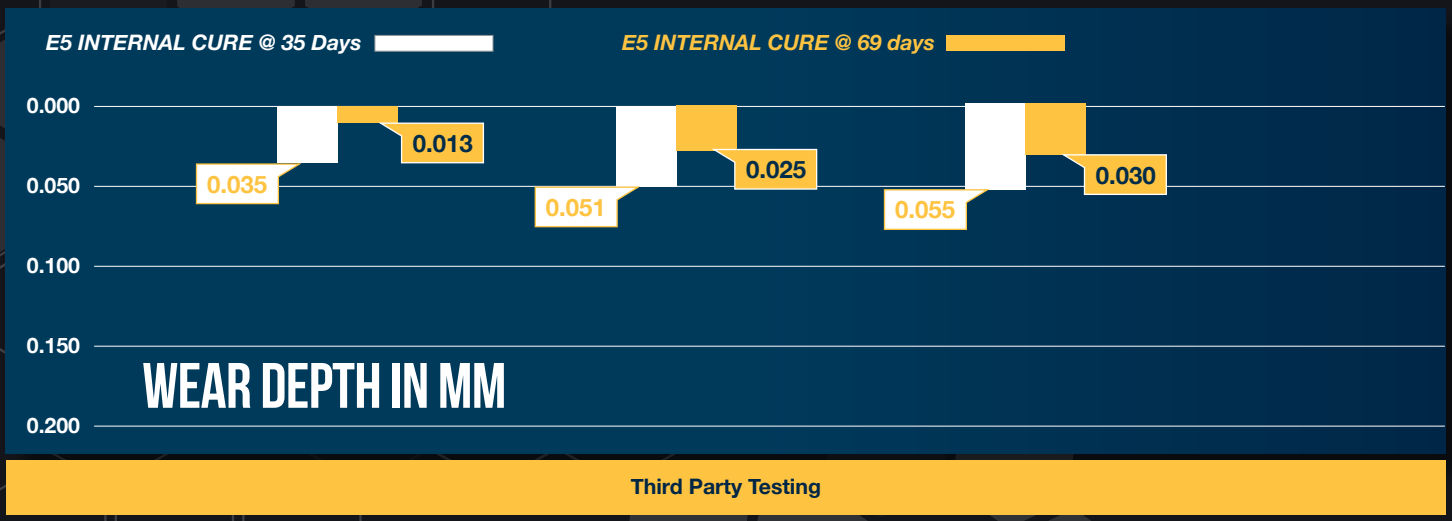
In addition to a slab containing **E5® Internal Cure®**, three concrete slabs were prepared using three alternative surface preparations: polyethylene, acrylic, and Ashford Formula. Chaplin Abrasion testing was performed on each slab to determine which method provided the greatest wear resistance. At the 55-day mark, three tests were performed on each slab to determine a mean average for each method. The following chart reflects the result of this testing, with **E5® Internal Cure®** outperforming all three alternative methods by as much as 7 times.



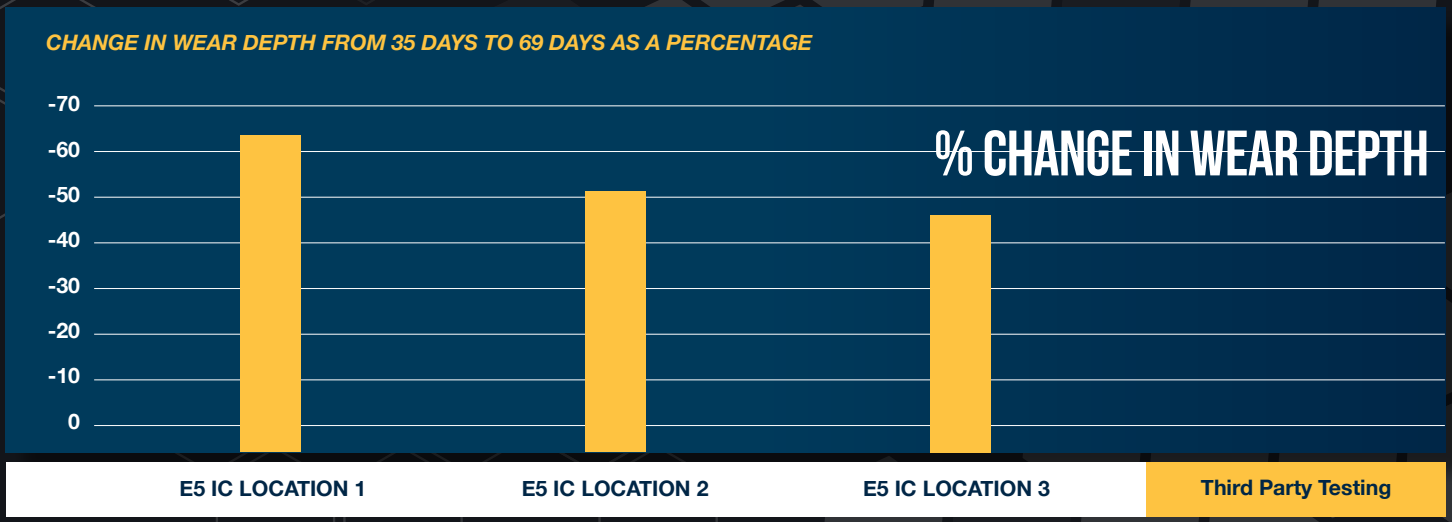
CHAPLIN ABRASION

BS 8204: 1987: Part 2 - Concrete Wear Analysis

The three test slabs prepared using **E5® Internal Cure** were tested for abrasion resistance at three time points over a test period of 35 to 69 days. Each slab performed in the highest wear class on the earliest test date and continued to improve in wear resistance over the test period. There was a noted improvement in surface strength, with a mean wear depth improving from 0.05 to 0.02.



Each **E5® Internal Cure®** wear resistance improved greatly from the earliest test at 35 days post-pour to the last test at 69 days post-pour, though the ranking did not change from location to location. The graph below shows wear resistance improvement at each location. The taller the column, the greater the reduction in wear depth and the greater the improvement in wear resistance over time.

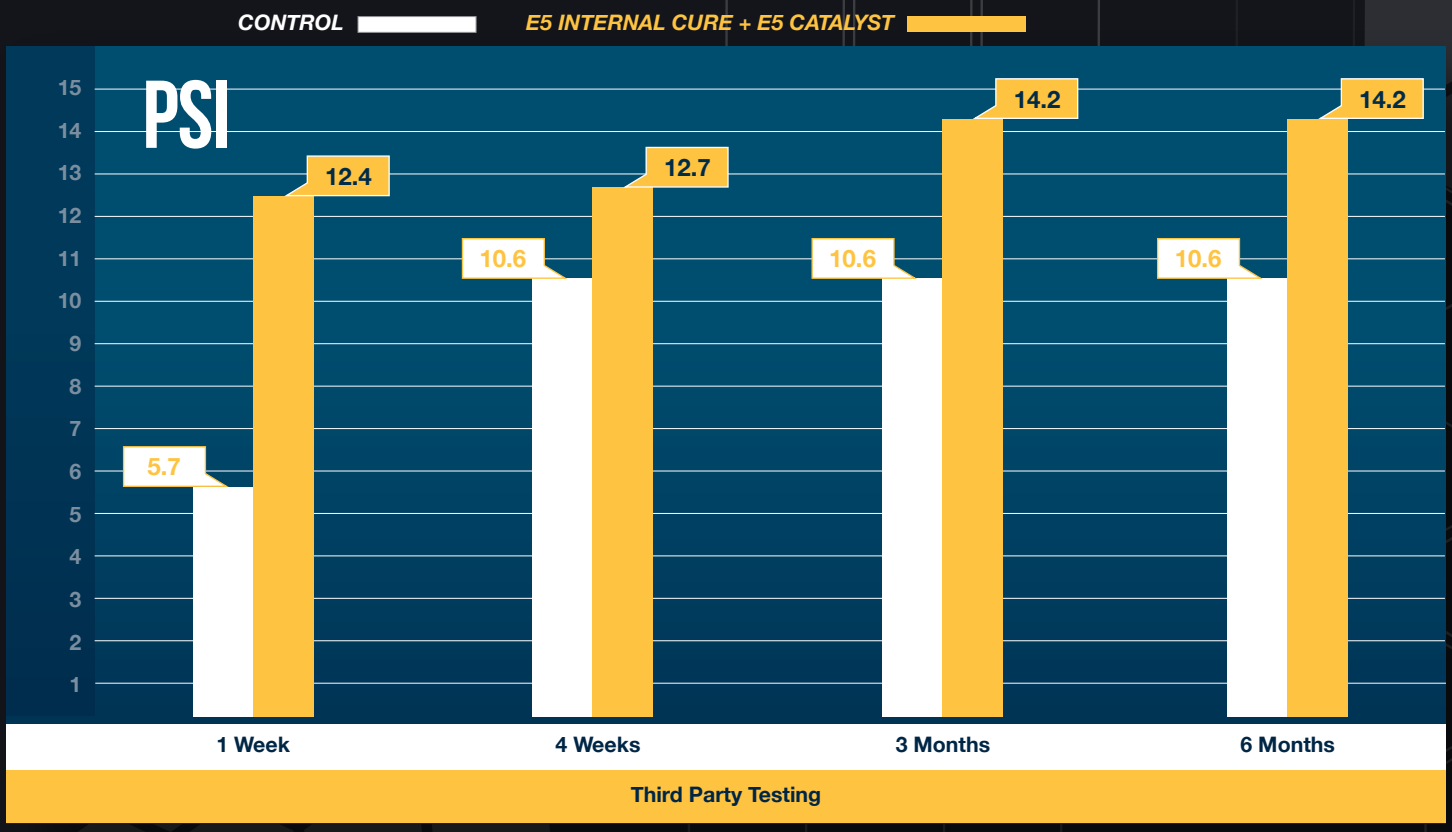


Location 1, which produced the best results in both rounds of testing, also showed the most improvement. But the improvement was dramatic at all three locations. Overall the wear class remained constant over the entire test period giving the slab with **E5® Internal Cure®** a wear class of **Special**, the highest category overall.

ADHESION TESTING

ASTM D903 Peel Strength of Adhesive Bonds

When applying flooring to new concrete, installers are known to wait at least 30 days to ensure that the concrete is dry enough for the flooring adhesive to work properly. ASTM D903 measures the maximum force it takes to peel a membrane from the concrete. The industry standard strength is 9 PSI to ensure that the concrete, adhesive, and membrane are bonded. The table below documents the maximum peel strengths for both the control concrete and concrete containing **E5® Internal Cure® + E5® Catalyst**.



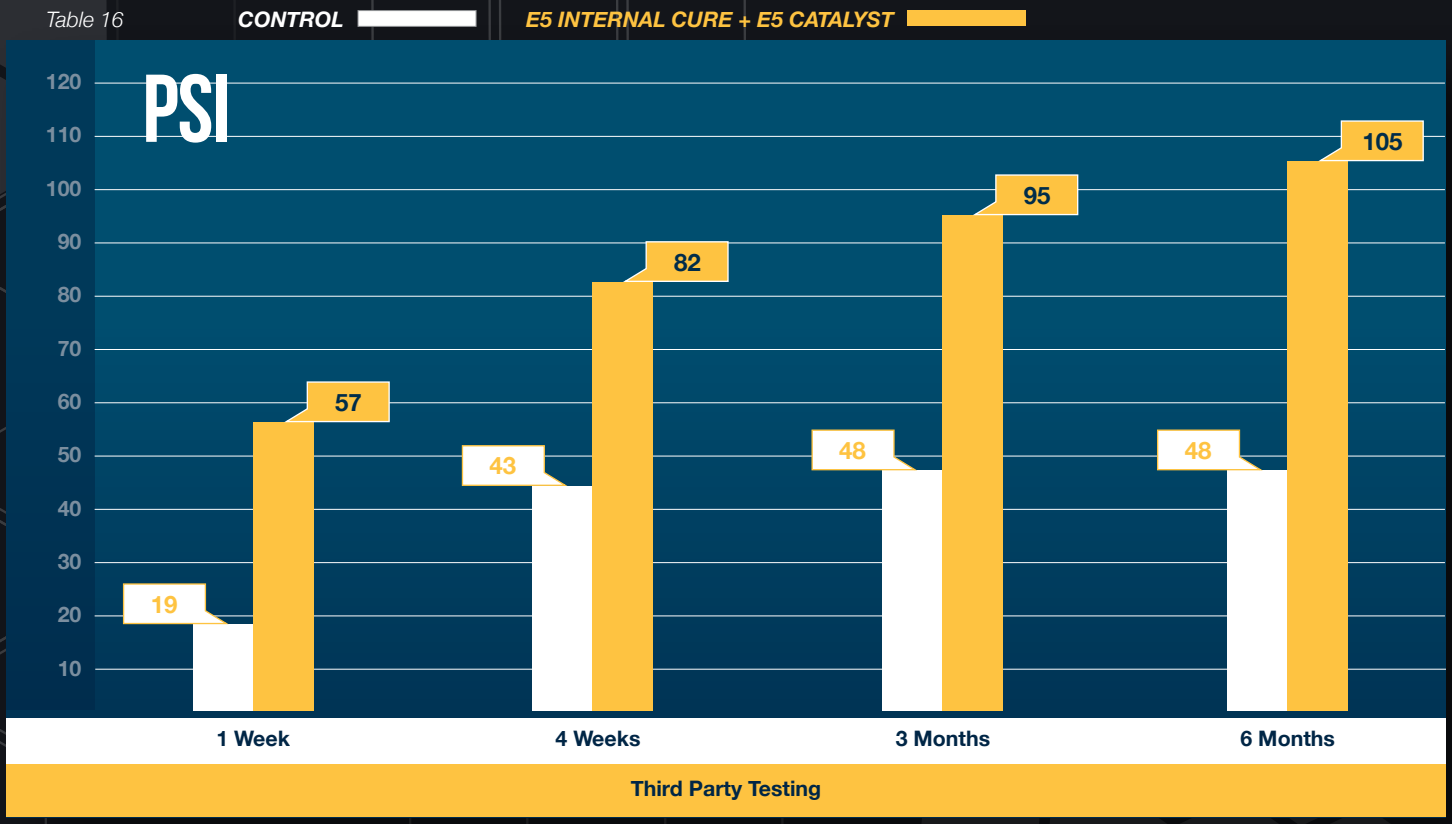
The results show that the control concrete meets the 9 PSI minimum after 4 weeks. The concrete containing **E5® Internal Cure®** meets the minimum at only one week. Using **E5® Internal Cure®** in combination with **E5® Catalyst** (topically applied post-placement) provides highly effective moisture mitigation, allowing flooring installations to be completed three weeks sooner than with traditional concrete without E5®.

ADHESION TESTING

ASTM D7234 Pull-Off Adhesion Strength

ASTM D7234 determines if new concrete is ready for flooring installation. The method incorporates a puck that is directly adhered to the coating surface; the test apparatus pulls the puck until the bond fails. The strength at which the failure occurs indicates the greatest perpendicular force that the surface area can bear. The table below states the maximum pull strengths of the control concrete and concrete containing **E5® Internal Cure® + E5® Catalyst**.

Table 16



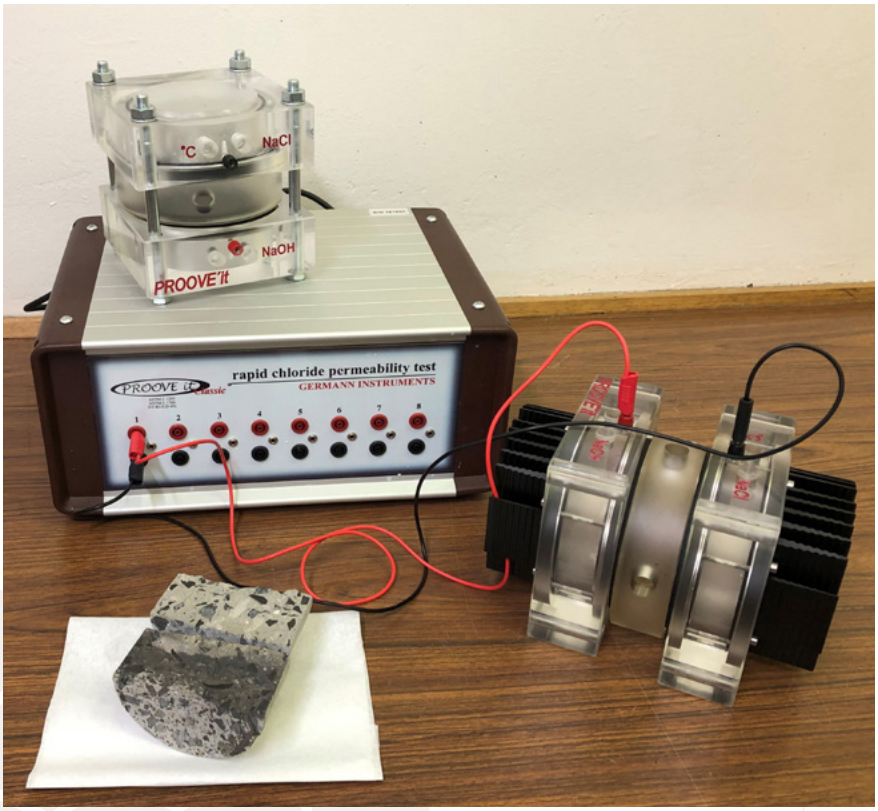
The results show that the concrete containing **E5® Internal Cure® + E5® Catalyst** nearly triples the pull-off strength at only one week. Incorporating **E5® Internal Cure®** into a concrete mixture ensures installation of floor coverings at higher success rates.

DIFFUSION COEFFICIENT

NT Build 492 Non-Steady State Chloride Migration

Rapid Chloride Permeability testing (RCPT) is commonly used to estimate the permeability of concrete materials. With RCPT, concrete samples are subjected to an electrical charge, which stimulates the penetration of chloride ions, a common cause of concrete deterioration. By measuring electrical resistance (i.e., how much electric charge passes through a concrete sample in a set time), RCPT quantifies the chloride permeability of the concrete material.

However, per ASTM C1202, RCPT "should not be used to assess field concretes if there is exposure to, and uptake of, chlorides and other anion-aggressive chemicals as this will skew the test results." **E5® Internal Cure and E5® Liquid Fly Ash are anionic materials and, thus, cannot be accurately tested for permeability using RCPT.**



Like RCPT, NT Build 492 testing is used to determine chloride migration in concrete materials. NT Build 492 is an electrochemical method similar to RCPT and the test equipment is similar to that used for RCPT. The test is run for a time and at a voltage determined by the sample's initial current with an applied 30V. Cut samples (4-inch by 8-inch) go through 24-hour conditioning, similar to RCPT, whereby each sample is exposed to a sodium chloride solution and a sodium hydroxide solution.

The Diffusion Coefficient (D) is calculated based upon:

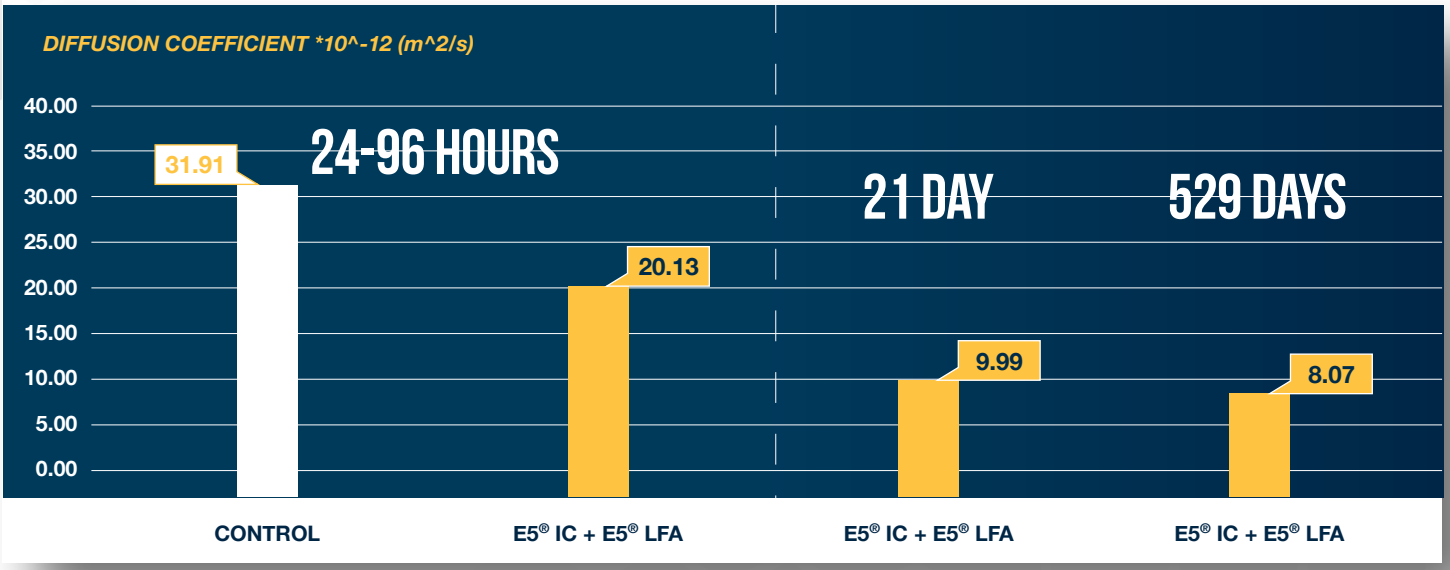
- Chloride penetration
- Concrete sample thickness
- Exposure time
- Voltage
- Average sample temperature

Left Image: NT Build 492 test setup. Each cell has a sodium hydroxide (NaOH) solution on one side and a sodium chloride (NaCl) solution on the other.

DIFFUSION COEFFICIENT

NT Build 492 Non-Steady State Chloride Migration

However, with NT Build 492 testing, in addition to estimating permeability through electrical resistance measurements, after exposure of the concrete samples to the sodium chloride solution and sodium hydroxide solution for 24 to 96 hours, the samples are split open and a silver nitrate solution is sprayed on the fractured surface. When white precipitation is visible, the actual penetration depth of the silver nitrate is measured and recorded at seven locations across the fractured surface.



As shown in the above chart, the accelerated measurement of the diffusion coefficient shown using the Diffusion Coefficient (D) of concrete samples containing **E5® Internal Cure®** and **E5® Liquid Fly Ash®** is 36.9% less than that of the control samples.

ADDITIONAL PROPERTIES

ASTM C1028 Coefficient of Friction

ASTM C1028 was performed with the use of an American Slip Meter (Model: ASM 725 and Serial No. 72511104) in accordance with ASTM F609 Standard Test Method for Using a Horizontal Pull Slipmeter. The table below summarizes the test results at three different locations using **E5® Internal Cure®**. It is recommended to have a static coefficient of friction of 0.6 or greater for accessible routes and 0.8 or greater for ramps.

ADDITIONAL PROPERTIES

ASTM E1155 Floor Flatness or Levelness

The test method in ASTM E1155 covers a quantitative method of measuring floor surface profiles to obtain estimates of the floor's characteristic; Floor Flatness and Floor Levelness (F Numbers). Higher F Numbers ensure no resurfacing will need to be done to concrete receiving a covering. Specifications indicate the minimum FF a floor needs to reach in order to receive a covering. **E5® Internal Cure** aids the finisher with a workable, hydrated mix even in harsh environmental conditions.

Floor Flatness
92

Floor Levelness
53

FLOOR SPECIFIED AT 50/30 FF/FL

Third Party Testing

ADDITIONAL PROPERTIES

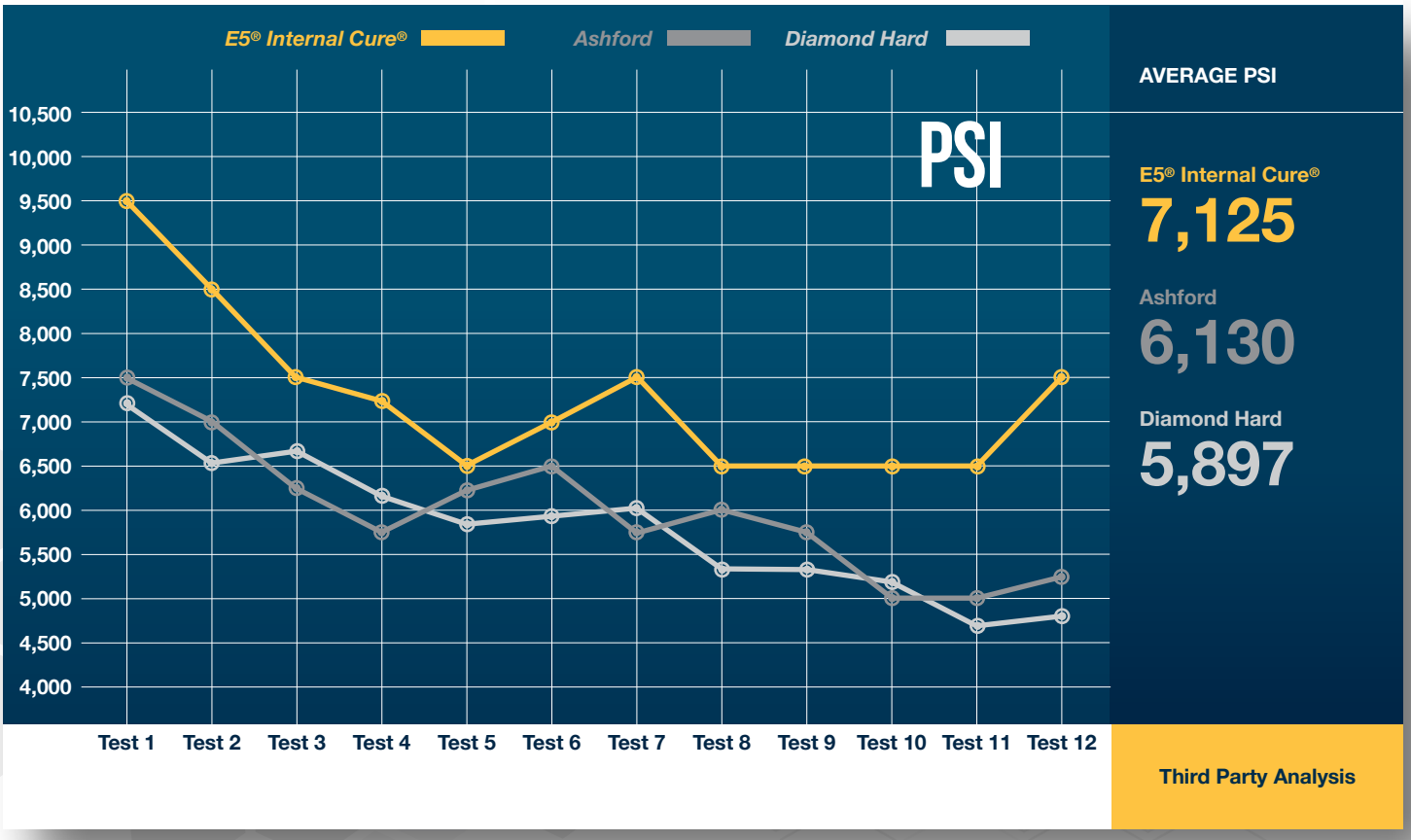
ASTM C805 Rebound Hammer

ASTM C805 measures the elastic properties or strength of concrete; mainly surface hardness and penetration resistance. The hammer measures the rebound of a spring-loaded mass impacting against the surface. The analysis consists of 12 tests or rebounds on the surface in random locations throughout the building. Once the 12 tests have been performed, the standard drops the highest and lowest readings and then averages the remaining 10.

COMPETITIVE ANALYSIS

(E5® INTERNAL CURE VS. ASHFORD VS. DIAMOND HARD)

For comparison, three test sites were analyzed. The first testing location utilized a 5 bag blended aggregate mix with **E5® Internal Cure®**. The second testing location utilized a 5.5 bag blended aggregate mix with **Ashford** applied to the surface. The third testing location utilized a 5 bag blended aggregate mix with **Diamond Hard** applied to the surface.



CONCRETE ROOFING ANALYSIS

The following pages document analysis specifically targeting concrete roofing applications. These tests were performed by a third-party laboratory in the Midwest. The goal was to produce two slabs, one designed per the requirements of the roofing membrane manufacturer and one produced using E5® Internal Cure®. Once cured, the test slabs received a covering and were tested for compliance.

The team at E5® Incorporated placed two 5'x5' mock-ups replicating a metal-deck roof structure. The first mock-up was placed with a concrete mix designed by the roofing membrane manufacturer. The second mock-up was placed with a concrete mix containing E5® Internal Cure®. The control slab was finished according to the roofing membrane manufacturer's specifications, which required the slab be completed with a rough profile. The slab containing E5® Internal Cure® was completed with a standard trowel finish using E5® Catalyst, a topical solution that chemically reacts with the nano silica within the finished concrete slab to form a protective barrier.

After allowing the concrete to set for two weeks, the teams returned to place the roofing membrane on both mock-up slabs. The control slab was ground with a mechanical grinder per the roofing membrane manufacturer's specifications. Then, the first adhesive product was applied. The slab containing E5® Internal Cure® + E5® Catalyst was left untouched specifically to test the strength of the slab. The roofing membrane was applied to both slabs, per specifications, with the roofing membrane manufacturer's certified installer.

The following week, two standard ASTM Adhesion analyses were performed on both slabs. From visual observations, the control slab showed signs of failure early in the process. The E5® Internal Cure® slab, on the other hand, remained unchanged. The Peel Strength analysis resulted in less than 9 strands for the control slab and 12 strands for the E5® Internal Cure® slab. The Pull-Off Adhesion analysis resulted in 19 psi for the control slab and 57 psi for the slab with E5® Internal Cure®. Without even preparing the troweled surface, the E5® Internal Cure® slab had surpassed the roofing membrane manufacturer's recommendations.

Notwithstanding the strong adhesion testing results of E5® Internal Cure®, E5® Internal Cure® concrete mixtures do not typically pass roofing membrane manufacturer Relative Humidity (RH) requirements.

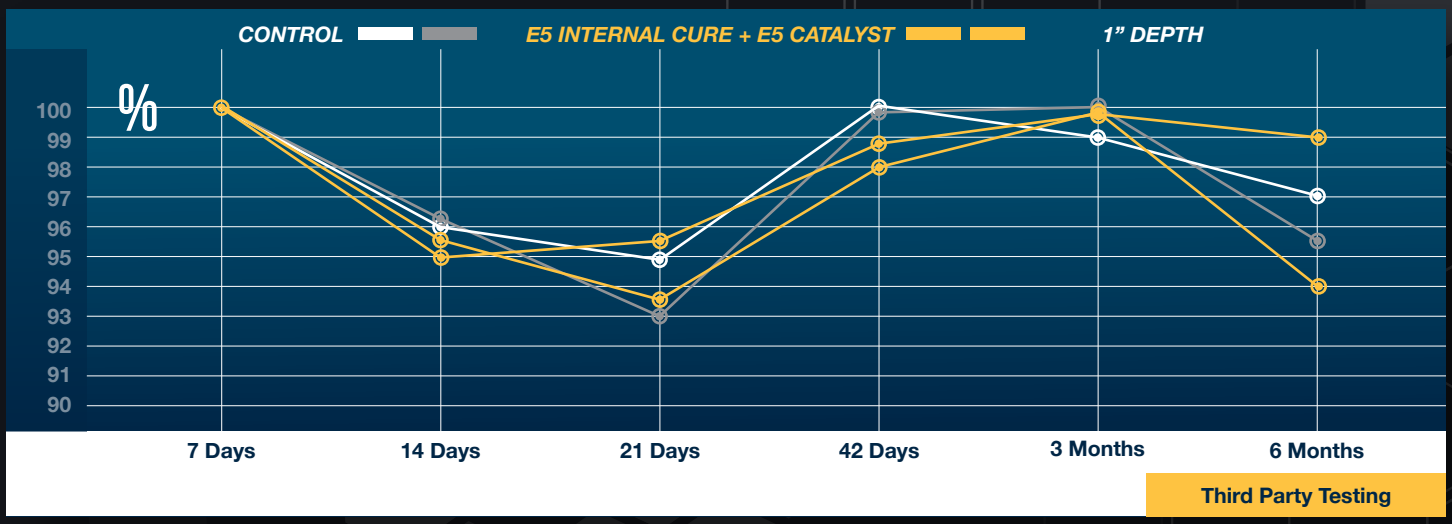
RH refers to the amount of moisture held in the air inside the concrete slab and is expressed as a percentage. Moisture readings in excess of 15% typically indicate the need for further inspection. Levels between 25-30% typically indicate that there may be water ingress and remedial work may be required. The following tables indicate a high RH for the slabs containing E5® Internal Cure®. This is to be expected and a high RH is good in that it reflects even hydration of the concrete, which is the goal of E5® Internal Cure®. However, for roofing membrane adhesion, controlling moisture at the slab's surface is the key consideration and RH testing does not adequately assess surface moisture, which is controlled by the barrier created by the chemical reaction that occurs between E5® Internal Cure® within the slab and E5® Catalyst applied on the surface of the slab.

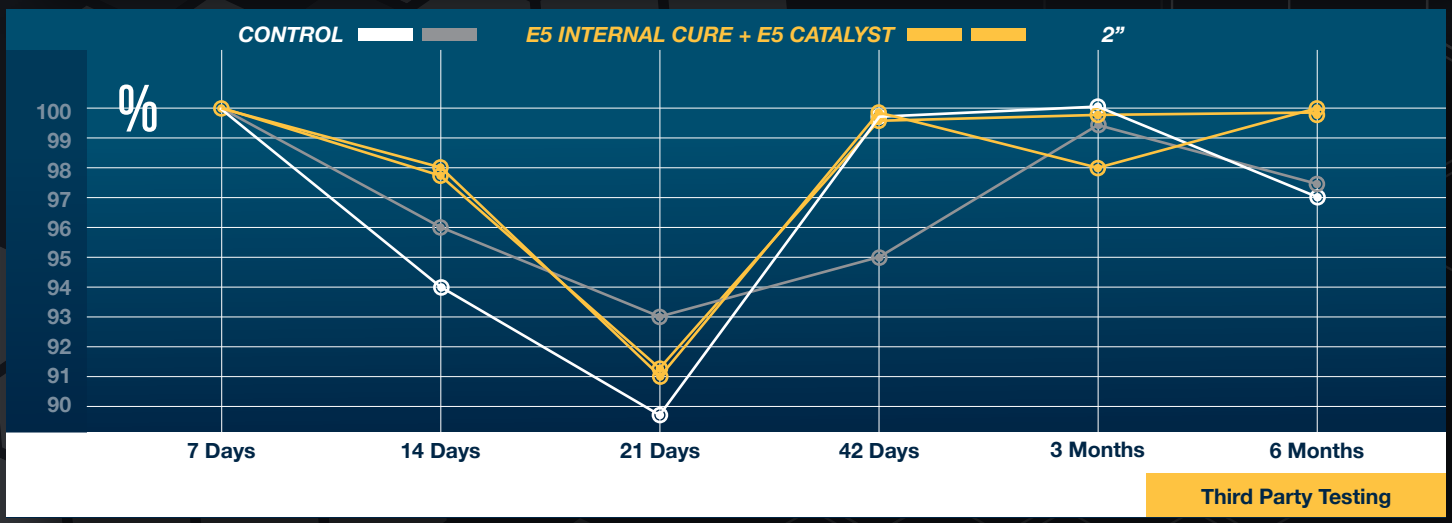
The results of the adhesion analysis and the RH analysis, along with hundreds of successful projects in the field, validate that E5® Internal Cure® plus E5® Catalyst is a very effective solution for both ensuring proper curing of concrete slabs and effective moisture mitigation for proper adhesion of roofing materials to those slabs.

CONCRETE ROOFING

ASTM F2170 Internal Relative Humidity

Following the requirements of ASTM F210, 5/8 inch diameter holes were drilled into each roofing mock-up slab five days after concrete placement. Holes were drilled to two different depths: 1 and 2 inches. Probe sleeves were then inserted into each hole and capped. At the time of internal relative humidity measurement, the cap of the sleeve was removed, and the internal relative humidity (IRH) probe was inserted into the sleeve. The probe was left in the sleeve for a minimum of 2 hours in order for the internal relative humidity around the probe to equilibrate with the concrete. The internal relative humidity measurements were made using Vaisala Model HMP 44 probes.

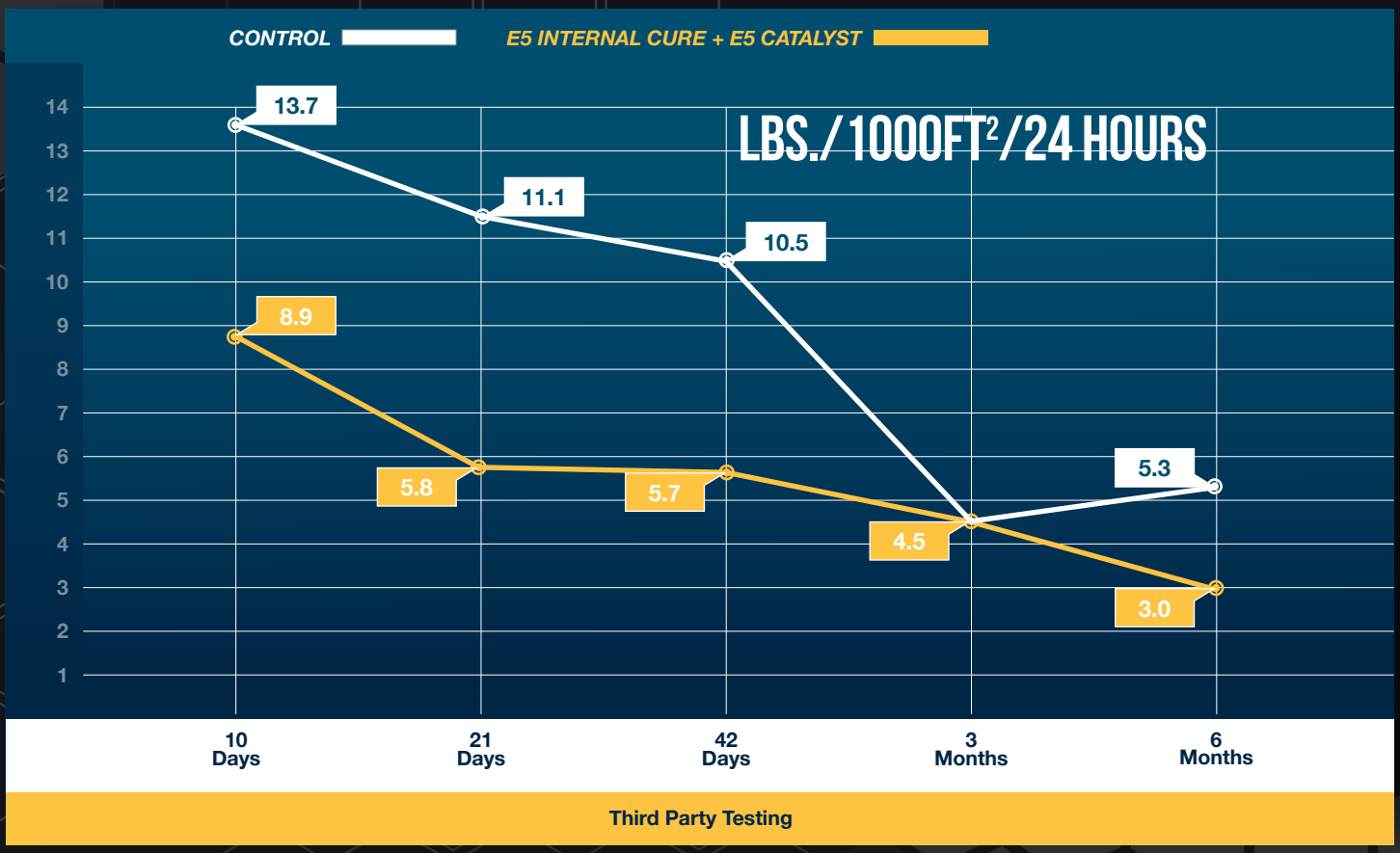




CONCRETE ROOFING

ASTM F1869 Moisture Vapor Emissions Rate

ASTM F1869 tests were conducted on the same concrete roof structure as ASTM F2170 Internal Relative Humidity testing over the same 6 month period. Before the roofing membrane was applied, MVER domes were adhered without any surface grinding, given that the surface texture was already smooth. After the roofing was applied, the surface was prepared by cutting away a section of the roofing, grinding off any of the roofing membrane, and then taping the edges of the dome to the adjacent roofing material.



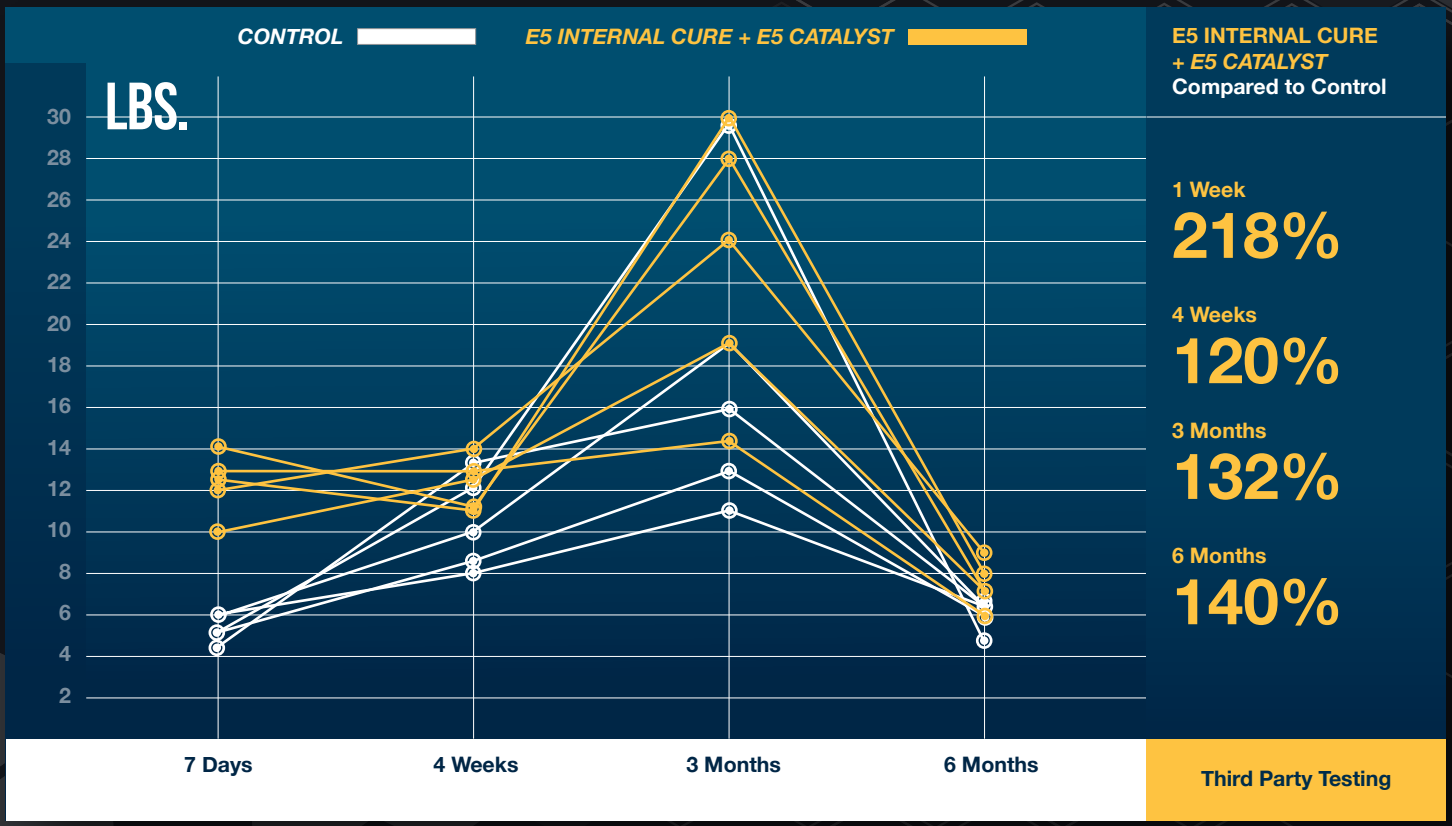
Concrete containing **E5® Internal Cure®** maintains the mix water for even hydration of the cement while preventing moisture from entering or exiting the slab, without added weight or loss of mass.

CONCRETE ROOFING

ASTM D903 Peel Strength of Adhesive Bonds

This test measures the maximum force needed to peel off a 1-in. wide and 10-in. long strip from a substrate. Per ASTM D903, the test can only be applied in the laboratory. The laboratory followed a peel test procedure (based on CMI Industries Incorporated Testing CIM PLI Strength to Substrate (Using Spring Scale and Clamp Method)), which is applicable to outdoor mockups. The test consists of cutting the membrane into 1-inch-wide and 10-inch-long ribbons and peeling an edge to apply a clamp that is connected to a SHIMPO FG-3000 digital force gauge. The sample was pulled perpendicularly upward, peeling the sample from the substrate and recording the maximum pull force.

A total of five peel adhesive strength tests were performed on the Control and **E5® Internal Cure** roofing membrane at 1 week, 4 weeks, 3 months, and 6 months after application of the roof membrane.

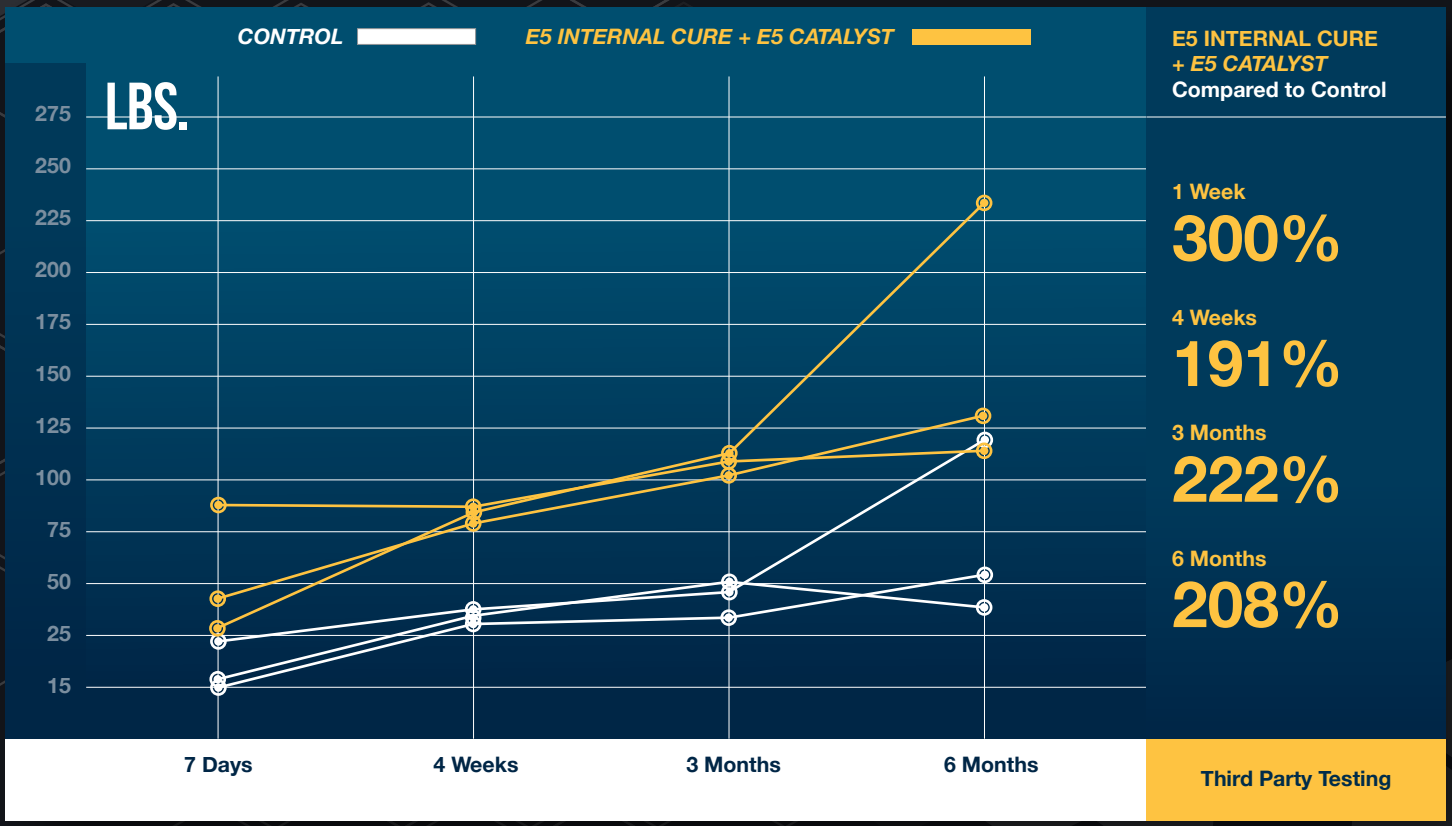


CONCRETE ROOFING

ASTM D7234 Pull-Off Adhesion Strength

Pull-Off Adhesion Strength testing was performed using 2-in. diameter pucks to the surface of the concrete roofing. Prior to adhering the pucks, the roofing membrane was cut and substrate concrete was scored using a two inch internal diameter coring barrel. The pucks were adhered using a fast setting epoxy, which was allowed to cure at least 24 hours to permit development of sufficient bond. After curing, the pucks were pulled in direct tension using a Proceq Dyna Tester. The peak load was recorded, and the pull-off adhesion strength was calculated by dividing the peak load by the areas of the pucks.

A total of three pull-off strength tests were performed on the Control and **E5® Internal Cure + E5 Catalyst** at 1 week, 4 weeks, 3 months, and 6 months after application of the roof membrane on each of the control sample without **E5®** and the sample with **E5® Internal Cure + E5 Catalyst** .



WATERPROOFING

DIN 1048-5 Standard for Depth of Penetration of Water Under Pressure

Testing hardened concrete: Depth of penetration of water under pressure measures the depth of water penetration into concrete samples subjected to 0.5 MPa (72.5 psi) of hydrostatic pressure over a period of three days. Concrete specimens are cast and cured for 28 days. After curing, samples are then placed in the testing device. The sample holders are open at both ends, with one end subjected to hydrostatic pressure. After three days, the samples are removed from the testing apparatus and cracked in half vertically. The maximum depth of water penetration into the sample is then measured.

WHERE DIN 1048 APPLIES

These tests determine the true permeability of concrete by evaluating the resistance of concrete against the penetration of water under hydrostatic pressure. A permeability test should be considered the dominant test to evaluate the case whereby concrete is subjected to hydrostatic pressure. When analyzing the results, the smaller the depth of penetration results in a higher resistance to water under hydrostatic pressure. This test method is useful for structures such as basements, tunnels, and water reservoirs because it recreates the pressure conditions these structures are subjected to in a realistic way.

TEST PROCEDURES

Testing was initiated with three individual references (without chemical admixture) batches and three individual experimental (with chemical admixture including E5® Internal Cure® and E5® Liquid Fly Ash®) batches. All samples were prepared using concrete batched, mixed, and cast by certified technicians and engineers at a CCRL Colorado facility. The concrete mixtures assessed are listed below.

Table 1 – Concrete Mixture Identifications and Test Matrix

Concrete Mixture Identification	Reference	E5, 4 floz per cwt and LFA, 8 fl oz per cwt
Cast Date	13-APR	20-APR

Table 2 – Test Characteristics

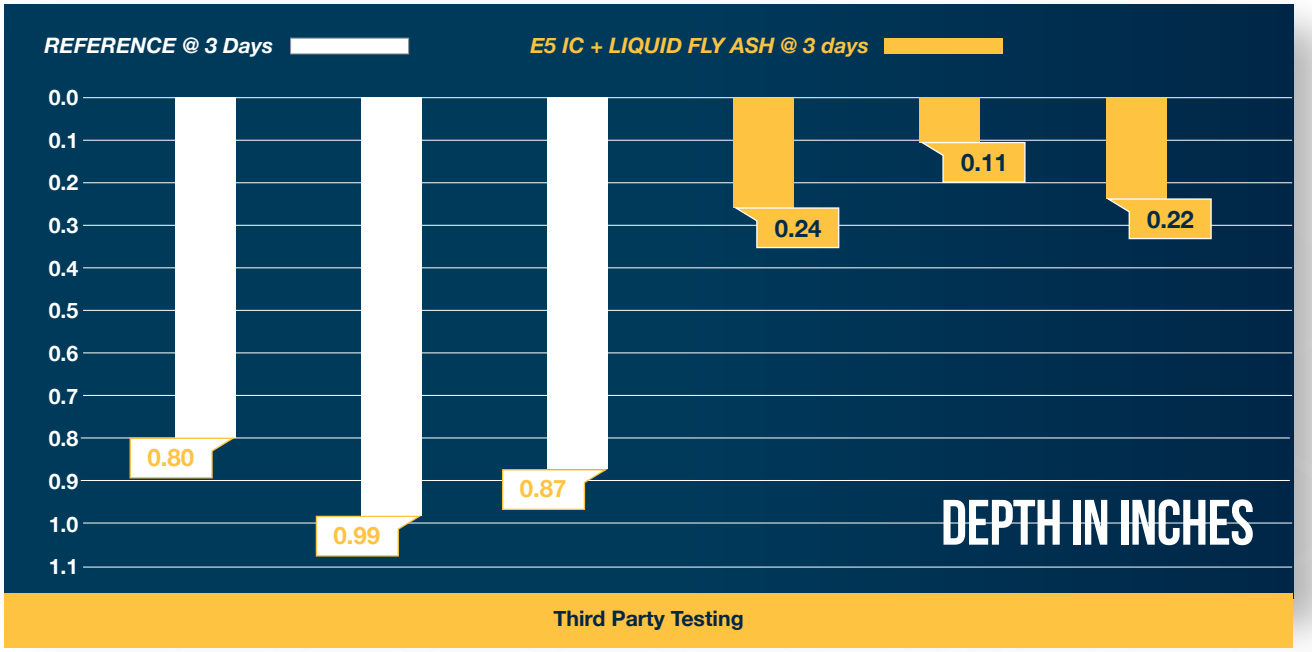
Specimen Shape	Cube	**Date of Test**	11-MAY and 18-MAY
Specimen Dimensions (in x in x in)	6 x 6 x 6	**Direction of Water Application with Respect to Casting Direction**	Water applied to prepped surface
Age of Specimen at Test, Days	28	**Curing Conditions**	Standard

WATERPROOFING

DIN 1048-5 Standard for Depth of Penetration of Water Under Pressure

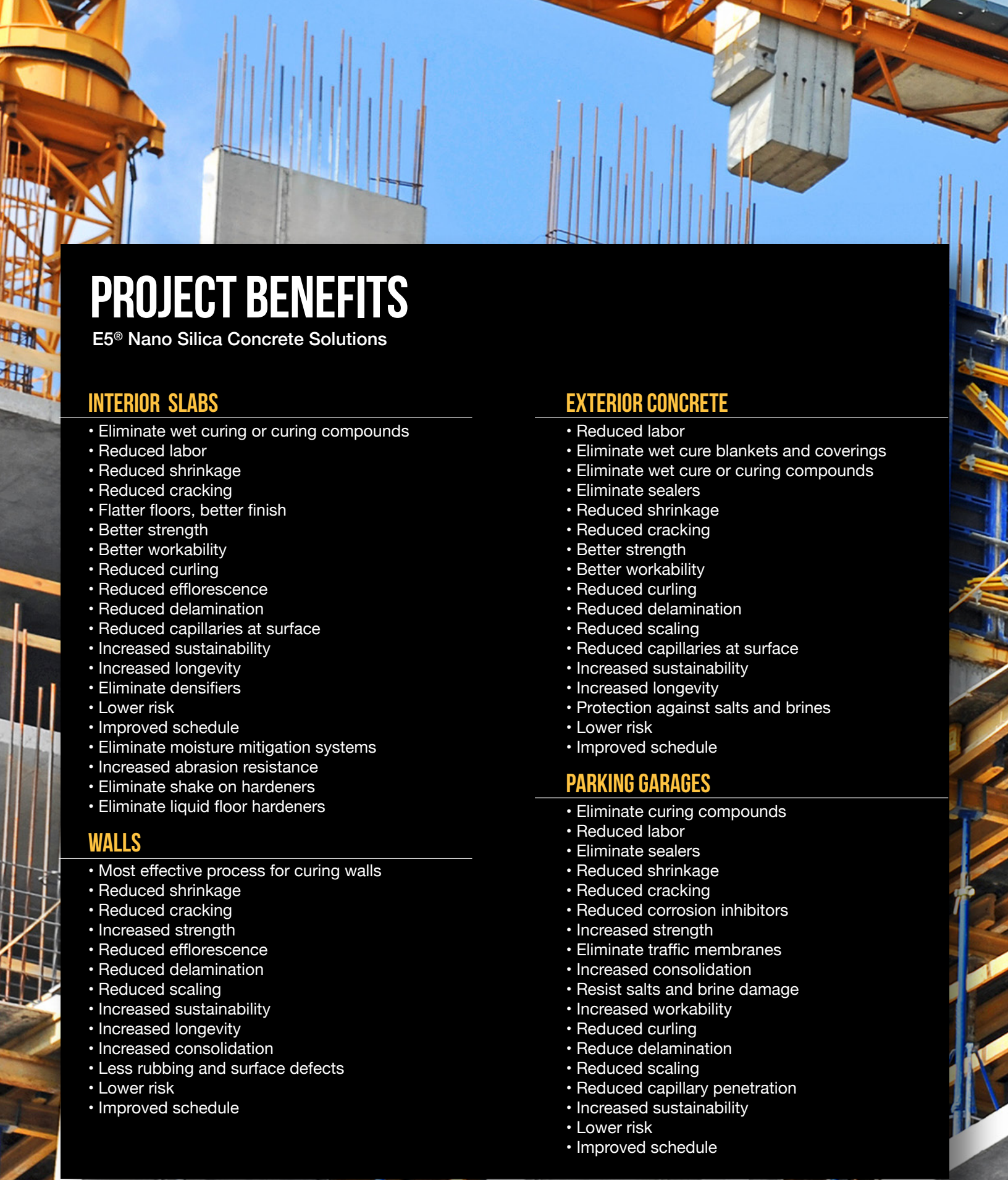
Table 3 – DIN 1048 Test Results

Mix ID	Sample	Maximum Depth of Penetration (in)	Average Depth of Penetration (in)	Difference From REF (%)
1 - Reference	Depth, 1	0.80	0.89	–
	Depth, 2	0.99		
	Depth, 3	0.87		
4 - E5, 4 / LFA, 8	Depth, 1	0.24	0.19	79.55
	Depth, 2	0.11		
	Depth, 3	0.22		



CONCLUSION

The average water penetration in inches is shown above. The samples including E5® Internal Cure® and E5® Liquid Fly Ash® performed 79% better than the reference samples.



PROJECT BENEFITS

E5® Nano Silica Concrete Solutions

INTERIOR SLABS

- Eliminate wet curing or curing compounds
- Reduced labor
- Reduced shrinkage
- Reduced cracking
- Flatter floors, better finish
- Better strength
- Better workability
- Reduced curling
- Reduced efflorescence
- Reduced delamination
- Reduced capillaries at surface
- Increased sustainability
- Increased longevity
- Eliminate densifiers
- Lower risk
- Improved schedule
- Eliminate moisture mitigation systems
- Increased abrasion resistance
- Eliminate shake on hardeners
- Eliminate liquid floor hardeners

WALLS

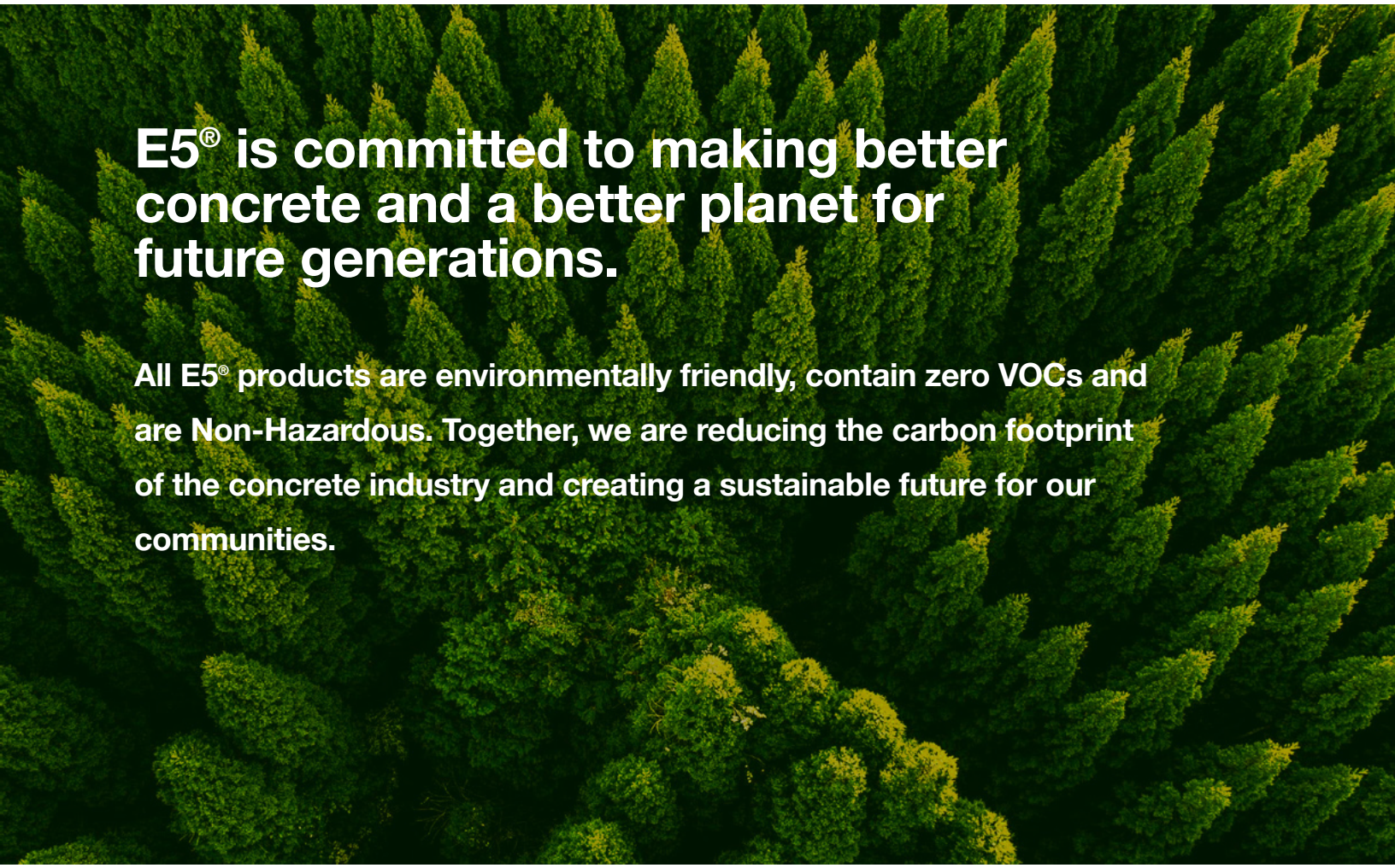
- Most effective process for curing walls
- Reduced shrinkage
- Reduced cracking
- Increased strength
- Reduced efflorescence
- Reduced delamination
- Reduced scaling
- Increased sustainability
- Increased longevity
- Increased consolidation
- Less rubbing and surface defects
- Lower risk
- Improved schedule

EXTERIOR CONCRETE

- Reduced labor
- Eliminate wet cure blankets and coverings
- Eliminate wet cure or curing compounds
- Eliminate sealers
- Reduced shrinkage
- Reduced cracking
- Better strength
- Better workability
- Reduced curling
- Reduced delamination
- Reduced scaling
- Reduced capillaries at surface
- Increased sustainability
- Increased longevity
- Protection against salts and brines
- Lower risk
- Improved schedule

PARKING GARAGES

- Eliminate curing compounds
- Reduced labor
- Eliminate sealers
- Reduced shrinkage
- Reduced cracking
- Reduced corrosion inhibitors
- Increased strength
- Eliminate traffic membranes
- Increased consolidation
- Resist salts and brine damage
- Increased workability
- Reduced curling
- Reduce delamination
- Reduced scaling
- Reduced capillary penetration
- Increased sustainability
- Lower risk
- Improved schedule



E5® is committed to making better concrete and a better planet for future generations.

All E5® products are environmentally friendly, contain zero VOCs and are Non-Hazardous. Together, we are reducing the carbon footprint of the concrete industry and creating a sustainable future for our communities.

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