TESTING SUMMARY

The following tests have been performed on **DensiCrete** prior to it being deemed acceptable by the Department of Transportation of Pennsylvania (PENNDOT). Professional Service Industries, Inc. at their Pittsburgh Testing Laboratory Division (PTL) performed numerous tests to determine how **DensiCrete** increases concrete density, flexural strength, and compression strength. Following are the tests completed: Compression and Flexure Tests; Freeze/Thaw Tests; Carbonation Testing and tests for penetration into concrete. All tests were completed with successful results.

ASTM-C42 COMPRESSIVE AND FLEXURE TEST

Low Strength Cubes

Compressive testing was performed on cores taken from St. Paul's Church in Key West, Florida. The untreated cube broke at 650 PSI. The **DensiCrete** treated cube broke at 1440 PSI, an increase in compressive strength of 215%.

Normal Strength Cubes

In compressive strength testing, the untreated cube broke at 3680 PSI, whereas, the **DensiCrete** treated cube broke at 4740 PSI, a 29% increase in compressive strength.

In flexure strength testing, the untreated cube broke at 423 PSI while the **DensiCrete** treated cube broke at 543 PSI, an increase of 28% in flexure strength.

High Strength Cubes

In compressive strength testing, the untreated cubes broke at 6120 PSI, whereas, the **DensiCrete** treated cube broke at 8060 PSI, a 32% increase in compressive strength.

ASTM-C666 FREEZE/THAW TEST

* PTL Freeze/Thaw Test for **DensiCrete** Treated Concrete: Three untreated and three **DensiCrete** treated rectangles were subjected to 300

Freeze/Thaw cycles as required by the ASTM-C666 test with the following results: The untreated concrete had completely deteriorated into sand-like particles with raw aggregate separated from their original concrete castings (they were no longer recognizable as rectangles). The **DensiCrete** treated specimens showed no visible cracking, powdering, hairline cracking or spalling. In fact, the treated rectangles appeared to be in their original pristine condition, the freeze/thaw cycles having no effect whatsoever on the integrity of the concrete matrix.

CARBONATION TEST

* PTL Carbonation Test for **DensiCrete** Treated Concrete: PTL designed a test to approximate a 10 year carbonation exposure rate that would be found in major metropolitan urban areas within the United States. All samplings were subjected to Carbon Monoxide exposure with the following results: The untreated concrete had carbonation penetration of between .57 and .63 inches. The **DensiCrete** treated samples had zero (0) carbonation penetration. All samples were subject to microscopic examination in accordance with ASTM-C856.

PENETRATION TEST

* Pittsburgh Testing Laboratories performed two penetration tests. In one test, **DensiCrete** penetrated completely through to the bottom of a 6 inch concrete cylinder. In a second test, **DensiCrete** penetrated 8.5 inches into a 12 inch concrete rectangle.

APPROVAL

* On April 28, 1995, WICKTEK INC. submitted a sample of **DensiCrete** to the Pennsylvania Department of Transportation (PENNDOT) for testing to confirm the Pittsburgh Testing Laboratory results. PENNDOT evaluated **DensiCrete** in their own laboratories located in Harrisburg, PA.

Subsequently, on April 23, 1996, The Pennsylvania Department of Transportation (PENNDOT) approved **DensiCrete** in Bulletin No. 15 as an Approved Construction Material, under "Penetrating Sealers".

CHLORIDE ION PENETRATION TEST

The Pennsylvania Turnpike Commission engaged Solar Testing Laboratories to perform the AASHTO T-259 test on **DensiCrete** treated concrete cylinders. Test parameters and results are summarized below.

TEST PARAMETERS

Because application procedures were not forwarded to the test lab, all concrete samples received five skim coats of **DensiCrete** at a spread rate of approximately 500 sq. ft. per gallon. Such application represents approximately 75% of the manufacturer's suggested saturation coat for 4000 PSI air entrained concrete.

Concrete samples were divided into two categories: those representing normal concrete surfaces (A and B) and those representing spalled concrete surfaces (C and D). Normal surfaces would reflect those road and bridge surfaces most likely encountered in the field. To simulate spalled surfaces, samples C and D were cut longitudinally, thereby exposing the aggregate, a condition unlikely to be encountered in the field.

NORMAL CONCRETE SURFACE RESULTS

Uncut concrete samples A and B were treated with **DensiCrete** and subjected to the chloride ion solution for a period of 90 days. Absorbed chloride ion percentages were 62/1000% and 34/1000% for samples A and B respectively. The average for samples A and B combined would be 48/1000% absorbed chloride ion, which equals 1.85 lbs of chlorides per cubic yard of concrete.

A measurement of 52/1000% absorbed chloride ion equates to approximately 2 lbs. of chlorides per cubic yard of concrete. This 52/1000% level or lower represents the point at which the chlorides would be nonreactive within the concrete matrix.

Because the average absorbed chloride ion percentage in **DensiCrete** treated samples A and B was less than 52/1000%, **DensiCrete** protected these concrete samples from chloride ion reactivity.

The control group measured 28.85 lbs of chlorides per cubic yard. Therefore, the **DensiCrete** treatment achieved a 94% reduction in chloride ion penetration.

SPALLED CONCRETE SURFACE RESULTS

Samples C and D were cut longitudinally exposing the aggregate and were subjected to the chloride ion solution for a period of 90 days. Absorbed chloride ion percentages were 152/1000% and 136/1000% for samples C and D, respectively. Absorbed chloride ion in the average of samples C and D was 144/1000%, which would translate into approximately 5.5 lbs. of chlorides per cubic yard of concrete. **DensiCrete** afforded the spalled concrete an 81% reduction in chlorides compared to the control group despite the presence of exposed aggregate and associated cracks.

CONCLUDING REMARKS

As a result of this test, completed on October 17, 1997, **DensiCrete** has been approved for use on the Pennsylvania Turnpike.

SKID RESISTANCE TEST

On October 10, 1997, the Ohio department of Transportation performed a skid resistance test (SHE-75-14.97) on an untreated portion of concrete surface on a bridge designated SR 119 Exit 99 over I-75. On October 31, 1997, the Ohio Department of Transportation performed the same test on a **DensiCrete** treated portion of concrete surface of the same bridge.

On November 3, 1997, WICKTEK INC. was informed by the Ohio Department of Transportation that the **DensiCrete** treated concrete bridge surface had passed the skid resistance test.

CLORIDE ION EVACUATION TEST

Solar Testing Laboratories, Inc., performed the Chloride Ion evacuation test in conformity with AASHTO T-260 standards. The test results showed that **DensiCrete** removed over 50% of the imbedded chlorides from the concrete matrix.

The treatment was simple, in which a concrete slab was treated with a single treatment consisting of 1.5 applications of **DensiCrete**. Over the next few weeks, the slab was brushed and rinsed to remove the chlorides that were expelled from it. During this period, five samples were taken and analyzed to determine the level of chloride removal.

The first key point is that the application of **DensiCrete** achieved a greater removal of chlorides from the concrete than that which can be achieved using the much more expensive and time consuming cathodic ponding technique. As a matter of fact, **DensiCrete** allows the use of the concrete roads or concrete structures within an hour of treatment.

The second key point is that the treatment of the concrete matrix with **DensiCrete** will not only remove existing chlorides from the matrix, but will also prevent future penetration of additional chlorides. See the AASHTO T-259 results for details on prevention of chloride intrusion.