THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

ETV JOINT VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**ULTRAVIOLET (UV) CURABLE LIQUID COATING**
APPLICATION:	**LIQUID ORGANIC COATING FOR AUTOMOTIVE MANUFACTURING**
TECHNOLOGY NAME:	**KrohnZone™ 7014**

COMPANY: **Allied PhotoChemical**
POC: **Roy Krohn, Founder & CSO**

ADDRESS: **P.O. Box 328**
Marysville, MI 48040-0328
PHONE: **(810) 364-6910**
FAX: **(810) 364-6933**

EMAIL: **roy@alliedphotochemical.com**

WEBSITE: **www.alliedphotochemical.com**

The United States Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved, cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; with stakeholder groups consisting of buyers, vendor organizations and states; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The ETV Coatings and Coating Equipment Program (CCEP), one of seven technology areas under the ETV Program, is operated by Concurrent Technologies Corporation (*CTC*) under the National Defense Center for Environmental Excellence (NDCEE) in cooperation with EPA's National Risk Management Research Laboratory. The ETV CCEP has recently evaluated the performance of an innovative liquid coating intended for automotive manufacturing applications. This verification statement provides a summary of the test results for the KrohnZone 7014 UV-curable coating manufactured by Allied PhotoChemical.

VERIFICATION TEST DESCRIPTION

The ETV CCEP evaluated the pollution prevention capabilities of the KrohnZone 7014 UV-curable coating. The coating application phase and a portion of the laboratory analyses were conducted at Allied PhotoChemical's facility in Marysville, MI. The remaining testing was completed at *CTC*'s facility in Johnstown, PA. The test was designed to verify the environmental benefit of the UV-curable coating by determining the total volatile content per ASTM D 5403. The test also verified the coating's finish quality characteristics.

In this test, the KrohnZone 7014 UV-curable coating was tested under conditions recommended by Allied PhotoChemical, the coating's vendor. The test panels were 15.2 cm long and 10.2 cm wide. Allied PhotoChemical recommended the ITW Automotive Refinishing GTi high-volume, low-pressure spray gun equipped with a 1.4 mm fluid tip and a #2000 air cap. The test consisted of five runs. During each run, one set of ten panels was sprayed manually.

The total volatile content of the KrohnZone 7014 UV-curable coating was determined using ASTM D 5403. This method determines the processing volatiles generated during the UV-cure phase and the potential volatiles generated by heat curing the UV-cured coating. Total volatiles are determined by adding the processing and potential results.

The details of the test, including a summary of the data and a discussion of results, may be found in Section 4 of the "Environmental Technology Verification Report: Allied PhotoChemical – KrohnZone 7014 UV-Curable Coating," which is available at http://www.epa.gov/etv/verifications/verification-index.html. A more detailed discussion of the test conditions, test results, and data analyses can be found in "Environmental Technology Verification Data Notebook: Allied PhotoChemical – KrohnZone 7014 UV-Curable Coating," which is available from *CTC*.

QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

The EPA ETV CCEP QA manager conducted a technical systems audit to assure that testing conducted at Allied PhotoChemical's facility was performed in compliance with the approved test plan, and the ETV CCEP QA officer conducted a performance evaluation audit of the laboratory analyses conducted in Johnstown, PA, to assure that the measurement systems employed were adequate to produce reliable data. Also, prior to the certification of the data, the ETV CCEP QA officer and the EPA ETV QA manager both audited at least 10% of the data generated during the KrohnZone 7014 test to assure that the reported data represented the data generated during testing. In addition, the EPA ETV CCEP QA manager has conducted a quality systems audit of the ETV CCEP Quality Management Plan and onsite visits during previous tests.

TECHNOLOGY DESCRIPTION

The KrohnZone 7014 UV-curable coating was tested as received from Allied PhotoChemical to assess its capabilities. The coating was manually applied using the ITW Automotive Refinishing GTi HVLP spray gun equipped with a 1.4 mm fluid tip and #2000 air cap and was set to obtain a fan pattern of 10.2 cm (4 in.) 15.2 cm (6 in.) from the gun. The KrohnZone 7014 UV-curable coating is marketed to automotive manufacturers as a single layer clearcoat.

VERIFICATION OF PERFORMANCE

The performance characteristics of the KrohnZone 7014 UV-curable coating include the following:

Environmental Factors

- Total volatile content: The KrohnZone 7014 UV-curable coating exhibited 1.6% processing volatiles and 1.0% potential volatiles, for a total volatile content of 2.6%. The standard deviation for the total volatile content was 0.9%.

- Energy Usage: The coating was UV-cured under a medium mercury vapor lamp followed by an iron-doped lamp. Both lamps were tubes 76.2 cm in length and rated for 157.5 watts/cm. The panels were passed under the lamps on a conveyor belt moving at 16.7 cm/s. Assuming that each panel passes through a 15.2 cm cure zone for each lamp, it can be calculated that 8.1×10^{-4} kWh is required to cure one panel. This value does not include the energy required to warm up the lamps or the energy expended by the length of the lamps that are idle.

Performance Factors

- Dry Film Thickness (DFT): The DFTs for all runs were determined from six points measured on each panel. The DFT averaged 3.1 mils with a standard deviation of 0.2 mil.

- Visual Appearance: *CTC* personnel assessed the visual appearance of all 50 coated panels. The intent of this analysis was to identify any obvious coating abnormalities that could be attributed to the application equipment. No defects were found, and the coating was uniform from panel to panel and run to run.

- Gloss: The gloss was measured per ASTM D 523 Test Method at three points on one panel per run at both 20° and 60°. The test method has a range of 0 to 100 gloss units. The 20° analyses yielded an average of 80.8 gloss units with a standard deviation of 4.4 gloss units. The 60° analyses yielded an average of 92.3 gloss units with a standard deviation of 2.1 gloss units.

- Salt Spray Resistance: The salt spray resistance was determined per ASTM B 117 from one coated panel per run exposed to 2000 hours of salt spray. Corrosion appeared on the scribed areas between 120 and 240 hours and on the unscribed areas between 120 and 1508 hours. The creepage at the scribe ranged from 0 to 1.6 cm. After the full 2000 hours, the scribed panels obtained an average rating of 6 (10 being no corrosion and 0 being total corrosion), and the unscribed panels obtained an average rating of 4.

- Humidity Resistance: The humidity resistance measurements were determined per ASTM D 1735 from one coated panel per run. The panels were placed in the humidity chamber unscribed and were subjected to 2000 hours in the chamber. Three of the five panels developed between 7 and 30 small blisters of 0.1 cm or less in size. The panels obtained an average rating of 9 (10 being no corrosion) after the full 2000 hours.

- Tape Adhesion: Two tape adhesion tests were conducted according to ASTM D 3359, one per Method A and one per Method B. Method A uses a scribe in the shape of an 'X'. Method B uses a scribe in a crosshatch shape. The rating scale for both methods ranges from 1 to 5, with 5 meaning no visible loss of adhesion or removal of coating. The coated panels were rated 5A and 5B, which means that no visible loss of adhesion or coating removal was present using Methods A and B, respectively.

- Direct Impact: The direct impact measurements were determined per ASTM D 2794 from one coated panel per run. The measurements for all panels averaged 3.1 J (27 in.-lbs) with a standard deviation of 0.1 J (1.0 in.-lbs).

- Mandrel Bend: The mandrel bend measurements for flexibility were determined per ASTM D 522 on a conical mandrel from one coated panel per run. The coating on all panels cracked and/or separated from the panels the entire 15.2 cm length of the sample panels.

- MEK (Methyl Ethyl Ketone) Rub: The MEK rub measurements were determined per ASTM D 5402 from one coated panel per run. The measurements for all panels rated a 4 out of 5, indicating minor effects on the coating.

- Abrasion Resistance: The abrasion resistance measurements were determined per ASTM D 4060 from one coated panel per run. All panels were subjected to 1000 cycles using a CS-10 wheel and 1000 g weight. The weight loss measurements for all panels were 92.6 mg with a standard deviation of 8.8 mg.

Original signed on

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Lee A. Mulkey
Acting Director
National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency

Original signed on

September 30, 2003

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Brian D. Schweitzer
Manager
ETV CCEP
Concurrent Technologies Corporation