Environmental Technology Verification Coatings and Coating Equipment Program (ETV CCEP)

Anest Iwata LPH400-LV HVLP Spray Gun – Testing and Quality Assurance Project Plan (TQAPP)

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SI to English Conversions

SI Unit	English Unit	Multiply SI by factor to obtain English
°C	°F	(1.80 E + 00), then add 32
L	gal. (U.S.)	2.642 E - 01
m	ft	3.281 E + 00
kg	lbm	2.205 E + 00
kPa	psi	1.4504 E - 01
cm	in.	3.937 E - 01
mm	mil (1 mil = 1/1000 in.)	3.937 E + 01
m/s	ft/min	1.969 E + 02
kg/L	lbm/gal. (U.S.)	8.345 E + 00

List of Abbreviations and Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ACS	American Chemical Society
ANSI	American National Standards Institute
AOAC	Association of Official Analytical Chemists
ARDEC	Armaments Research, Development and Engineering Command
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
CCEP	Coatings and Coating Equipment Program
CTC	Concurrent Technologies Corporation
DFT	dry film thickness
EPA	Environmental Protection Agency
ETF	Environmental Technology Facility
ETV	Environmental Technology Verification
HAP	hazardous air pollutant
HVLP	high-volume, low-pressure
IR	infrared
ISO	International Standardization Organization
NDCEE	National Defense Center for Environmental Excellence
NIST	National Institute for Standards and Technology
OFL	Organic Finishing Line
PLC	programmable logic controller
QA/QC	quality assurance/quality control
QMP	Quality Management Plan
SOP	Standard Operating Procedures
TE	transfer efficiency
TQAPP	Testing and Quality Assurance Project Plan
VOC	volatile organic compound
WBS	work breakdown structure

1.0 INTRODUCTION

1.1 Purpose of the Anest Iwata LPH400-LV HVLP Spray Gun - TQAPP

The primary purpose of this document is to establish the Testing and Quality Assurance Project Plan (TQAPP) for the Anest Iwata LPH400-LV HVLP Spray Gun. The objective of this TQAPP is to verify the performance of the LPH400-LV spray gun while applying the PPG Deltron 2000 DBC-4185 automotive basecoat. The format and guidelines for this TQAPP were established by the Environmental Technology Verification Coatings and Coating Equipment Program (ETV CCEP) HVLP Coating Equipment – Generic Verification Protocol (Revision 1), to which reference will be made frequently throughout this document as the HVLP GVP.

This TQAPP establishes specific data quality requirements for all technical parties involved in the verification of the LPH400-LV spray gun. This TQAPP follows the format described below to facilitate independent reviews of the project plans and test results, and to provide a standard platform of understanding for stakeholders and participants.

1.2 Quality Assurance for the ETV CCEP

Projects conducted under the auspices of the Environmental Technology Verification Coatings and Coating Equipment Program (ETV CCEP) meet or exceed the requirements of the American National Standards Institute/American Society for Quality Control (ANSI/ASQC), Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, ANSI/ASQC E-4 (1994) standard. This TQAPP will ensure that project results are compatible with and complementary to similar projects. All ETV CCEP TQAPPs are adapted from this standard and the ETV Program Quality Management Plan (QMP). TQAPPs will contain sufficient detail to ensure that measurements are appropriate for achieving project objectives, that data quality is known, and that the data are legally defensible and reproducible.

1.3 Organization of the Anest Iwata LPH400-LV HVLP Spray Gun - TQAPP

This TQAPP contains the sections outlined in the ANSI/ASQC E-4 standard. As such, this TQAPP identifies processes to be used, test and quality objectives, measurements to be made, data quality requirements and indicators, and procedures for the recording, reviewing and reporting of data.

The major technical sections discussed in this TQAPP are as follows:

- Project Description
- Project Organization and Responsibilities
- Quality Assurance (QA) Objectives
- Site Selection and Sampling Procedures
- Analytical Procedures and Calibration
- Data Reduction, Validation and Reporting
- Internal Quality Control (QC) Checks
- Performance and System Audits
- Calculation of Data Quality Indicators
- Corrective Action
- Quality Control Reports to Management
- Appendices

1.4 Formatting

In addition to the technical content, this TQAPP also contains standard formatting elements required by the ANSI/ASQC E-4 standard and Concurrent Technologies Corporation (*CTC*) deliverables (see Section 1.4 of the HVLP GVP).

1.5 Approval Form

Key ETV CCEP personnel indicate their agreement and common understanding of the project objectives and requirements by signing the TQAPP Approval Form for the verification testing of the LPH400-LV spray gun. Acknowledgment by each key person indicates commitment toward implementation of the plan (see Figure 1 of the HVLP GVP for the template of the Approval Form).

2.0 PROJECT DESCRIPTION

2.1 General Overview

The overall objective of the ETV CCEP is to verify pollution prevention and performance characteristics of coating technologies and make the results of the testing available to prospective coating technology users. The objective of this particular TQAPP is to establish the performance of the LPH400-LV spray gun. The LPH400-LV spray gun was specially designed to enhance the efficiency of manual coating applications. The LPH400-LV (see Appendix D, LPH400-LV Product Data Sheets) spray gun is designed to achieve fine atomization of coatings in a very uniform spray pattern at low inlet air pressure, which is intended to bring about higher transfer efficiency (TE). This test will examine the effectiveness of the LPH400-LV spray gun at applying the PPG Deltron 2000 DBC-4185 automotive basecoat, used in automotive refinishing operations. The test data from this verification test will be compiled and used to develop a Verification Report. In addition, a Verification statement will be developed from the data contained in the Verification Report. Anest Iwata may use the Verification Statement as a marketing tool for the LPH400-LV spray gun.

TE will be the primary criteria for verifying the performance of the LPH400-LV spray gun in terms of pollution prevention. As the TE increases, less coating material is needed, reducing solvent emissions and the amount of coating solids that are released into the environment. Therefore, equipment that assists in achieving a higher TE is able to provide a means of pollution prevention to the end-users.

The testing of the LPH400-LV spray gun will be conducted on the Organic Finishing Line (OFL), in the Demonstration Factory operated by *CTC*. A drawing of the Equipment Testing Location is shown in Appendix A, and a drawing of the Apparatus Set-Up is shown in Appendix B.

The results of this test will be compared to a conventional air spray (CAS) baseline data set established using the ETV CCEP PPG Deltron 2000 DBC-4185 CAS Gun Baseline TQAPP.

2.1.1 Demonstration Factory Testing Site

CTC has been tasked under the National Defense Center for Environmental Excellence (NDCEE) Program to establish a demonstration factory capable of prototyping processes that will reduce or eliminate environmentally harmful materials used or produced in manufacturing. To accelerate the transition of environmentally friendly processes to the manufacturing base, *CTC* offers the ability to test processes and products on full-scale, commercial equipment. This demonstration factory is a major national asset. It includes a combination of organic finishing, cleaning, stripping, inorganic finishing, and recycle/recovery equipment. The organic finishing equipment in the demonstration factory will be available for the pilot-scale testing performed in this project, (e.g., surface pretreatment, powder coating, electrocoating, wet spray, and conventional and infrared cure ovens). Ancillary equipment for plating, nonhalogenated cleaning, and non-chromate conversion coating are also available. Layouts of the *CTC* Demonstration Factory and the organic finishing line are shown in Figures 1 and 2, respectively.

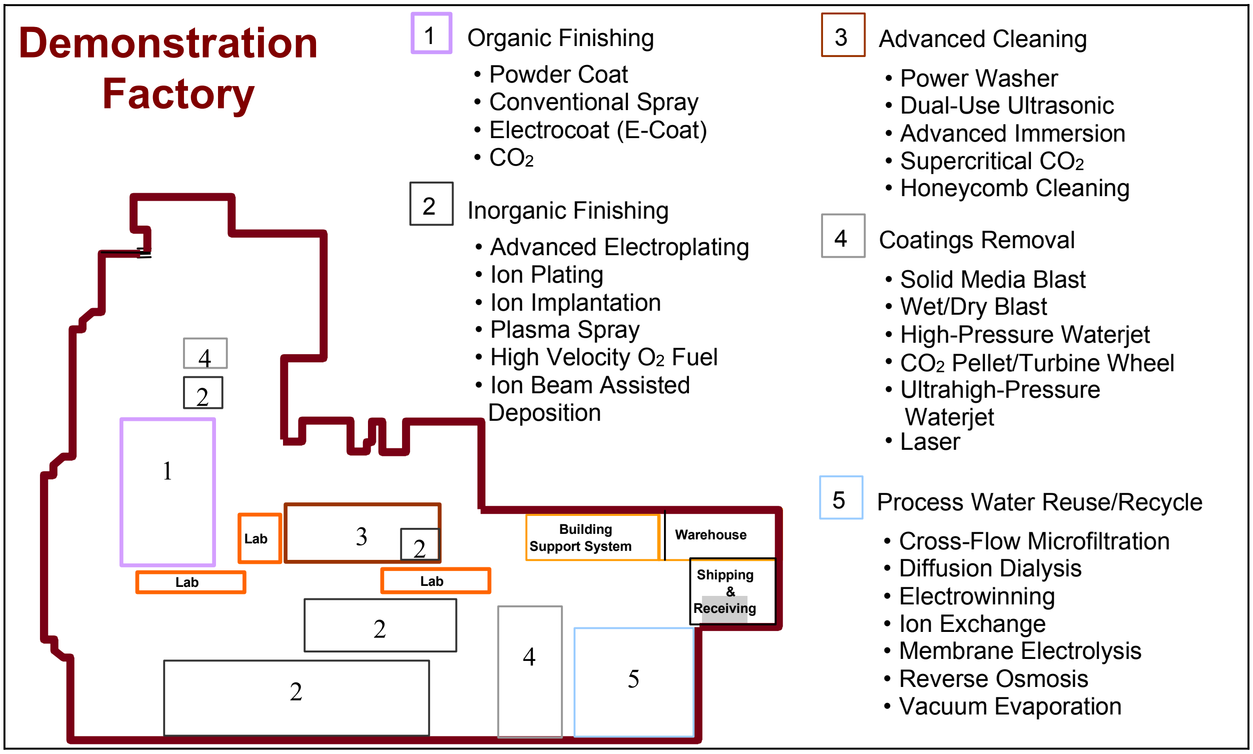


Figure 1. Demonstration Factory Layout

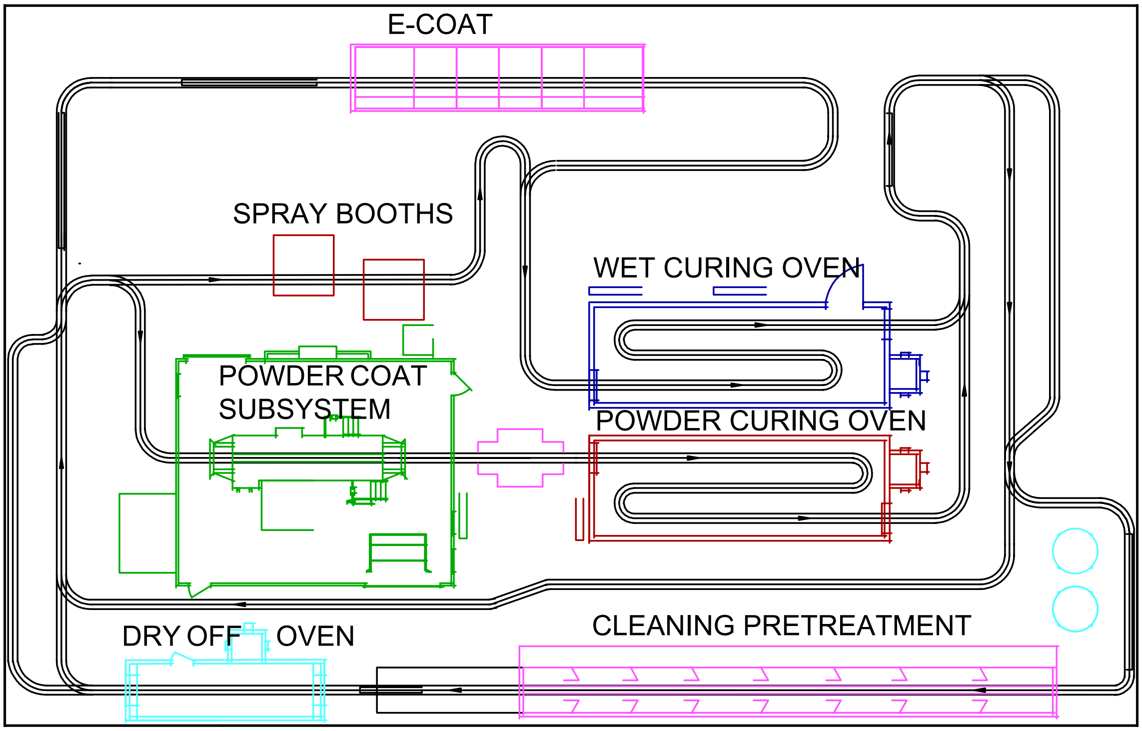


Figure 2. Demonstration Factory Organic Finishing Line

2.1.2 Laboratory Facilities

In support of the demonstration factory organic finishing processes, *CTC* maintains extensive state-of-the-art laboratory testing facilities. These laboratory facilities are used for the measurement and characterization of processes and specimens, as well as bench-scale coating technology evaluations. Laboratory facilities available from the NDCEE are described in Section 2.1.2 of the HVLP GVP.

2.1.3 Statement of Project Objectives

The overall objective of the ETV CCEP is to verify pollution prevention characteristics and/or performance of coatings and coating equipment technologies and to make the results of the verification tests available to prospective technology users. The ETV CCEP aspires to increase the use of more environmentally friendly technologies in products finishing in an effort to reduce emissions.

The objective of this TQAPP is to verify the increase in TE and finish quality of manual spray applications utilizing the LPH400-LV spray gun. Where possible, analysis methods used for these tests will follow those developed by the American Society for Testing and Materials (ASTM).

TE is related to pollution prevention in the paints and coatings industry. TE is defined as the ratio of the quantity of coating solids reaching the panel being covered, divided by the quantity of coating solids being applied (U.S. EPA Office of Pollution Prevention, 1994). In other words, TE is the amount of coating actually applied to the panel divided by the amount of coating sprayed, expressed as a percentage. This fraction is expressed in percent and can be calculated using the volume, or the mass, of solids, as shown in the following formula:

$$\text{Transfer Efficiency} = \frac{\text{Volume (or Mass) of Solids Deposited}}{\text{Volume (or Mass) of Solids Sprayed}} \times 100\%$$

According to the EPA Manual of Pollution Prevention in the Paints and Coatings Industry (1996), the maximization of the TE ratio is the most predominant approach to minimize pollution in the paints and coatings activities. Small improvements in TE can result in a significant reduction of volatile organic compounds (VOC) emissions. Conversely, overspray results in wasted material and represents inefficiency in the coatings system. It contributes to air and water pollution, increases solid hazardous waste, and solid non-hazardous waste.

From information gained during the testing of the LPH400-LV spray gun, the end-users may better determine if the LPH400-LV spray gun would provide them with a pollution prevention benefit while meeting the finish quality requirements of their application. The end-users will be able to make an informed decision based on the best available data. This project intends to supply the end-users with the unbiased technical data to assist them in that decision making process.

The quantitative pollution prevention benefit in terms of improved TE depends on any of the innumerable factors that are unique to each coating production line. The task of verifying every possible combination of these factors is impractical; therefore, the LPH400-LV spray gun will be tested under a specific set of conditions requested by Anest Iwata, and the resulting verification data will be representative of the exact conditions tested. However, in an effort to qualify the existence of an environmental benefit, this project will conduct a test to determine a quantitative transfer efficiency comparison of the LPH400-LV spray gun with respect to a CAS baseline. The CAS baseline for the LPH400-LV spray gun was completed per the PPG Deltron 2000 DBC-4185 CAS Gun Baseline TQAPP.

2.2 Technical/Experimental Approach and Guidelines

The following tasks are proposed in pursuit of this project (see estimated schedule in Section 2.3, Table 5):

- Obtain Anest Iwata's concurrence with this TQAPP.
- Obtain *CTC* and EPA approval of this TQAPP.
- Conduct verification test
- Prepare and provide draft Verification Report to EPA
- Prepare and provide final Verification Report to EPA
- Prepare Verification Statement for approval and distribution

Table 1 describes the general guidelines and procedures that will be applied to this TQAPP.

Table 1. Overall Guidelines and Procedures Applied to this TQAPP

• A detailed description of each part of the test will be given.
• Critical and non-critical factors will be listed. Non-critical factors will be held constant throughout the testing. Critical factors will be listed as control (process) factors or response (coating product quality) factors (see Section 2.2.11)
• The TQAPP will identify the testing site or sites.
• The testing will be under the control and close supervision of ETV CCEP representatives to ensure the integrity of the third party testing.
• The QA portions of the LPH400-LV TQAPP will be strictly adhered to.
• A statistically significant number of samples will be analyzed for each critical response factor (see Table 4). Variances (or standard deviations) of each critical response factor will be reported for all results.

2.2.1 Test Approach

The following approach will be used for this TQAPP:

- Anest Iwata will identify the performance parameters to be verified and recommend the optimum equipment settings for application and curing;
- *CTC* will obtain enough standard test panels for the verification test;
- Anest Iwata will provide the PPG Deltron 2000 DBC-4185 basecoat and any additional required additives or catalysts for the verification test;
- Anest Iwata will provide the LPH400-LV spray gun and all necessary accessories to be verified;
- Data such as panel weight (before and after coating application), quantity of sprayed coating, quantity of supplied coating, and mil thickness of coating will be collected, following the ASTM methods, or equivalent;

- A statistically valid test program that efficiently accomplishes the required objectives will then be used to analyze the test results.

2.2.2. Verification Test Objectives

The objectives of the verification test performed per this TQAPP are to determine the transfer efficiency and the finish quality achieved by the LPH400-LV spray gun. During the coating application phase, inlet air pressure and outlet air pressure will be measured. The coated test panels will be tested for dry film thickness (DFT), DFT variation, gloss, visual appearance, and TE.

2.2.3 Standard Test Panel

The standard test panel to be used for this verification test is shown in Appendix C (Standard Test Panel). The panels that will be used for the LPH400-LV spray gun verification testing will be approximately 30.5cm by 10.2cm (12 in. x 4 in.) and made of 22 gauge steel. The panels will have a 0.6cm (0.25 in.) hole in one end so that they may be suspended from hooks. They are flat cold rolled steel panels from ACT Laboratories, Inc. meeting SAE 1008 specifications. The panels will be received treated with a zinc phosphate pretreatment.

The standard test panels will be transported through the system on racks suspended from the overhead conveyor. Each rack will hold eight (8) test panels, as shown in Appendix B (Apparatus Set-up). The test panels will be fixtured on the rack to minimize movement during spraying. The fixturing consists of a flat bar that connects the hooks that will minimize side to side rotation of the panels and a second bar that prevents the bottom of the panels from moving away from the gun. The conveyor advances until a rack is centered in the paint booth, and then will be stopped while the topcoat is applied to the test panels.

2.2.4 Coating Specification

The test coating chosen by Anest Iwata meets the following criteria:

- The test coating is sprayable by both HVLP and CAS guns
- The coating contains no lead or chromate.
- The VOC content of the coating meets 5.0 pounds of VOC per gallon of coating as part of a basecoat/topcoat system, the limit established by the U.S. EPA's National Volatile Organic Compound Emission Standards for Consumer and Commercial Products, 40 CFR 59, Subpart B, Automobile Refinish Coatings, published September 11, 1998.

Anest Iwata has chosen the PPG Deltron 2000 DBC-4185 automotive basecoat as the standard test coating. Anest Iwata will supply the standard test coating to be used for the verification test of the LPH400-LV spray gun. This coating has a VOC content, as applied, of less than 6.6 pounds per gallon. This coating would be part of a compliant system when combined with a topcoat with a VOC content less than 4.2 pounds per gallon, such as PPG DCU 2080 clear coat. The test coating was chosen based on its use in the automotive refinishing industry.

The ETV CCEP will be provided with a quantity of the test coating to complete the verification test. The test coating will be prepared following the coating manufacturer's recommendations (see Appendix E, Coating Product Data Sheets). The exact coating preparation procedures will be recorded. For comparison, the test coating will be prepared the same as it was for the baseline tests. The amount of material in the gravity cup should not fall below 2/3 of the volume of the cup to ensure consistent fluid delivery flow rates. Since the PPG Deltron 2000 DBC-4185 has a long pot life, a single batch will be mixed for the verification test. The gun, gravity cup, and batch container will be weighed as a single system. The batch container will be kept closed, unless refilling the gravity cup. The coating system will be weighed before and after each run to determine the amount of material used during the run. Each batch will be mixed in the laboratory at a 1:1 ratio of PPG Deltron 2000 DBC-4185 basecoat to PPG DT885 reducer. A total of 5.0 L will be mixed for the verification test (2.5 L of basecoat and 2.5 L of reducer). Samples will be taken just prior to coating the test panels to measure the temperature, viscosity, percent solids, and density. The coating measurements will be recorded on the coating batch worksheet. The test coating will be applied to a dry film thickness 0.8 – 1.2 mils, using 3 coats and 5 passes per coat. All three coats will be applied before moving on to the next rack. The flash time between coats will be 3 minutes. After the final coat, the panels will be allowed to air dry for at least 2 hours. The gun distance and fan adjustments will be set to obtain approximately a 9 inch pattern at the target.

2.2.5 Standard Apparatus

This TQAPP includes a standard apparatus set-up for the verification test. Appendix B shows the position of the test panels with respect to the spray booth as part of the standard apparatus set-up, and Appendix A shows the testing location of the wet spray booths relative to the Organic Finishing Line. All testing will be performed in the same wet spray booth in the *CTC* Demonstration Factory.

This verification test is designed to simulate an actual production line finishing environment at a typical small business. The standard test panels will be suspended from racks, containing eight panels per rack. The test panels will be transported to the spray booth by an overhead conveyor. A mechanical stop mechanism will align the racks of test panels in the proper position relative to the spraying mechanism. Once the racks are in position, the translator's PLC will activate the motors that drive the linear motion translators. The translator will move both horizontally and vertically. This set-up will be able to cover an area approximately 1.37m by 1.37m (4.5ft. x 4.5 ft.). The panels will be automatically sprayed using vertical overlap of the fan pattern. The spraying mechanism's PLC will also control the triggering of the LPH400-LV spray gun by way of a pneumatically actuated clamp. During dwell time between passes, coating flow will be interrupted to minimize coating usage. Once the spray application is complete, the mechanism's PLC will release the mechanical stop holding the rack so that the overhead conveyor can move the next rack into position.

The spray booth air filters will be changed prior to setting up the standard apparatus for the verification test. The pressure drop across the filters will be checked prior to each run and at the end of the test. The pressure drop is monitored in the event that the filter bank system malfunctions. A pressure drop across the filter bank greater than 1 cm (0.4 in.) of water shall indicate that the system requires service. As a comparison, the spray booth air filters were also changed before the CAS baseline tests. This will minimize the difference in the initial booth air velocity between the guns. The booth air velocity will be measured in close proximity to the panels. Although the air velocity through the booth exceeds 0.5m/s (100 ft/min), the velocity measured near the panels will be lower due to the disruption of the air currents by the rack of panels.

After the panels are coated, the conveyor will move the next rack into position. The coated panels will be allowed to air-cure for a minimum of 2 hours. After the standard test panels have been cured, they will be transferred to the laboratory for analysis.

2.2.6 Process Standards

The standard test panels will be of one type and used for all tests (see Appendix C). The pretreatment method will be the same for all standard test panels. The preparation of the test coating will be the same for the LPH400-LV verification test and the CAS baseline test. The TE analysis will follow Procedure A of ASTM D 5286. The environmental (ambient) conditions of the Demonstration Factory will be monitored, both inside the booth near the spray zone and in the curing area. The curing process for this verification will be the same as the baseline test. Operating parameters will be held relatively constant throughout the baseline and verification tests.

2.2.7 Design of Experiment

This TQAPP will determine the performance characteristics of the LPH400-LV spray gun. A mean value and variance (or standard deviation) will be reported for each critical response factor. A confidence and specification limit of 95% will be applied to these tests.

One hundred thirty three (133) test panels will be obtained for this test, which includes: five (5) random test panels to be removed for pretreatment analysis, eight (8) test panels to be used for the start-up phase, and one hundred twenty (120) test panels to be coated. The verification test will consist of five (5) runs, three (3) racks per run, and eight (8) standard test panels per rack. This will enable both total and run-to-run variations to be determined for each response factor. The statistical analyses for all response factors will be performed using a statistical software package. For the TE analysis, the weight of all panels will be measured before being coated and again after being cured.

2.2.8 Performance Testing

The ETV CCEP will consult the manufacturers' recommendations for key factors to be used for testing, including the coating specifications: viscosity, weight % solids, etc. Recommended equipment settings for the coating have been obtained from Anest Iwata. The ETV CCEP will test these conditions prior to starting the verification test. These conditions may be modified during the start-up phase to ensure proper gun performance. During the tests, no attempt will be made to optimize the equipment.

The LPH400-LV spray gun will be monitored for both inlet and outlet air pressures. Standard test panels will be used to measure equipment performance. The test panels will be used for DFT, DFT variation, gloss, visual appearance, and TE analysis. The coating characteristics may be affected by other parameters of the testing process, such as pretreatment, apparatus setup, and cleanup methods. The pretreatment process will be the same for all test panels; therefore, the variability of the pretreatment process should not be a significant factor. Non-critical control factors will be monitored or held relatively constant for the verification test. DFT measurements will be used to determine the variations in film thickness. Gloss tests will be used to analyze the quality of the coating finish. TE measurements will be used to determine the quantitative improvement between the CAS baseline data and the LPH400-LV spray gun data. The TE test will follow Procedure A of ASTM D 5286. The visual appearance analysis will look for any abnormalities in the applied coating. A comparison will be made from panel to panel, rack to rack, and run to run.

The standard test panels will be weighed and the weights recorded prior to being suspended on the conveyor. The weight of the gun, cup, coating, and coating container will be recorded on the worksheets immediately before applying the coating to each test panel. After each standard test panel has been coated, the spray gun, cup, coating, and coating container will be re-weighed and the weights will be recorded.

The standard test panels will be air-cured in the Demonstration Factory. After the panels are cured, the panels will be re-weighed. The DFT of the coating on each panel will also be recorded in the logbook. DFT readings will be taken in several locations on each panel.

2.2.9 Quantitative Measurements

In order to evaluate the TE and the finish quality obtained with the tests utilizing the LPH400-LV spray gun, several measurements will be taken from the non-coated and coated test panels. In the case of the non-coated panels, the area in square feet and the weight of the panels will be measured. For the coated panels, weight and DFT will be measured.

The uniformity of the coating applied can be determined by measuring DFT at several specified locations on the standards test panels. Measurement sites will be at nine locations on the coated surface of the standard test panel. Appendix C displays the standard test panels with their respective locations of the DFT measurements. These sites will be numbered and measurements will be taken accordingly. The recorded measurements can be correlated to a specific site on each standard test panel for each test. The thickness measurement data will be used to evaluate not only the mean thickness across the panel, but also the variation of the thickness and differences in the edge and the central portions of the panels.

In addition to the performance analyses, the ETV CCEP will evaluate the potential environmental benefits associated with using the LPH400-LV spray gun. Therefore, TE values will be quantitatively measured for each test panel using nearly identical test conditions. A qualitative comparison will then be made to determine if the LPH400-LV spray gun has a potentially higher TE than a CAS gun baseline.

2.2.10 Participation

Anest Iwata is welcome to participate in the start-up phase and observe the verification and baseline testing. The ETV CCEP personnel will be responsible for performing all necessary test and demonstrations required for performance evaluation and full-scale validation.

2.2.11 Critical and Non-Critical Factors

For the purpose of this TQAPP, the following definitions will be used for critical control factors, non-critical control factors, and critical response factors. A critical control factor is a factor that is varied in a controlled manner within the design of the experiment to determine its effect on a particular outcome of a system. Non-critical control factors are all the factors that are to be held relatively constant or randomized throughout the testing for each specific piece of equipment (some non-critical factors may vary from equipment to equipment). Critical response factors are the measured outcomes of each combination of critical and non-critical control factors given in the design of experiments.

In this context, the term "critical" does not convey the importance of a particular factor (that can only be determined through experimentation and characterization of the total process), but its relationship within the design of experiments. In the case of the verification testing of a particular piece of coating equipment, there is only one critical control factor, and that is the piece of coating equipment itself. All other processing factors will be held relatively constant (or randomized) and are non-critical control factors. Therefore, the multiple runs and sample measurements within each run for each critical response factor will be used to determine the amount of variation expected for each critical response factor.

For this TQAPP, the critical control factors, non-critical factors, and critical response factors are identified in a table format along with acceptance criteria (where appropriate), data quality indicators, measurement locations, and measurement frequencies, broken down by each run. For example, parameters associated with the panel pretreatment will remain constant and thus be non-critical control factors, while a parameter such as DFT is identified as a critical response factor.

The only critical control factor is the LPH400-LV spray gun itself (see Table 2). The non-critical control factors are shown in Table 3, and the critical response factors to be measured are shown in Table 4.

The pretreatment process will be the same for all standard test panels. The pretreatment process should not have an impact on the results of this verification test. The pretreatment of the panels is intended to prepare the surface for coating application and to promote adhesion. The pretreatment process provides a continuous surface on which the test coating can then be applied. To verify that these panels have been pretreated properly, an analysis of the pretreatment coating weight will be conducted.

The DFT measurements will follow ASTM B 499 (Magnetic). Thickness measurements will be taken on a representative sample of the standard test panels as shown in Appendix C. From these data, an overall DFT and a DFT variation across the standard test panel will be reported. The purpose of this comparison is to verify that a uniform DFT has been applied to the standard test panels.

The gloss analysis will follow ASTM D 523. Gloss measurements will be taken on one random test panels from each run as a comparison of finish quality.

The visual appearance analysis will use normal lighting to examine the surface of the coated panel. The panels will be examined for fish-eyes in the finish, the presence of orange peel, the evenness of the coating, and the difference in the visual gloss caused by sandpaper finish, drips, runs, and inclusions (such as dirt, fuzz, and fibers).

The TE test will follow ASTM D 5286. A TE value will be determined for each rack of eight standard test panels. From this data, an average TE will be calculated for each run and for the entire test.

The values in the Total Number column reflect the experimental design of coating one hundred twenty standard test panels.

Table 2. Critical Control Factors

Critical Control Factor	Air Cap	Fluid Needle	Fluid Nozzle	Fan Adjustment	Fluid Adjustment	Fan Pattern at the Target
LPH400-LV spray gun	LPH400-LV	20015	400LV-14 (1.4mm)	TBD	TBD	23cm @ 15.2 cm from panel

Table 3. Non-Critical Control Factors

Non-Critical Factor	Set Points/ Acceptance Criteria	Measurement Location	Frequency	Total Number for the Test
Product Involved in Testing	Standard Test Panels	Factory floor	120 panels coated, 8 for start-up, and 5 for pretreatment analysis	133
Pretreatment Analysis	Varies <1.0 g/m^2	Random panels removed prior to start-up	5 random panels per test	5
Surface Area of Test Panel	Varies <13 cm^2 (<2 in.^{2})	Factory floor	Once per run	5
Ambient Factory Relative Humidity	Varies <10% during test	Factory floor	Once per run	5
Ambient Factory Temperature	Varies <5 °C during test	Factory floor	Once per run	5
Booth Relative Humidity	Varies <10% during test	Factory floor	Once per run	5
Booth Temperature	Varies <5 °C during test	Factory floor	Once per run	5
Spray Booth Air Flow	0.4-0.6 m/s (80–120 ft/min)	Factory floor	Once per run	5
Temperature of Panels as Coated	Varies <5 °C during test	Center of test panel	Once per run	5
Distance to Panels	Varies <2.5 cm (<1 in.) during test	Factory floor	Once per run	5
Horizontal Gun Traverse Speed	(TBD at start-up)	Factory floor	Once per test	1
Vertical Drop Between Passes	7.4-7.9 cm (2.9–3.1 in.)	Factory floor	Once per test	1
Dwell Time Between Passes	4-6 seconds	Factory floor	Once per test	1
Volatile Content of Applied Coating	<790 g/L (<6.6 lbs./gallon)	Sample from coating pot	1 sample per run	5
Density of Applied Coating	1000–1100 g/L (7.6–8.6 lb/gal)	Sample from coating pot	1 sample per run	5
Wt.% Solids of Applied Coating	25–32 %	Sample from coating pot	1 sample per run	5
Coating Temperature, as Applied	Varies <5 °C during test	Sample from coating	1 sample per run	5
Coating Viscosity as Applied	30-45 sec. #2 Ford cup	Sample from coating pot	1 sample per run	5
Cure Time	>2 hours	Factory floor	Once per test	1

Table 4. Critical Response Factors†

Critical Response Factor	Measurement Location	Frequency	Total Number for the Test
Dynamic Inlet Air Pressure	Factory Floor	Once per run	5
Dynamic Outlet Air Pressure	Factory Floor	Once per run	5
Overall DFT (Magnetic method)	Appendix C shows location of measurement points.	9 points on five coated panels per run	225
DFT Variation	Calculated from DFT data	Variation on individual panels and variation from run to run	N/A
Gloss	From ASTM D 523	3 points on five coated panels per run	75
Visual Appearance	Entire test panel	1 per coated panel and 1 per run	85
Transfer Efficiency	From ASTM D 5286	One per run	5

† See Sections 2.1.3 and 2.2 for the environmental basis to which these factors relate.

Other factors used to test the LPH400-LV spray gun include:

- Equipment preparation — per Anest Iwata
- Target Inlet Pressure — 16 psi
- Fan Pattern — 9 in. @ 6 in. from panels
- Overlap — 67% (per baseline test)
- Number of passes — 5 per coat
- Number of coats — 3
- Target dry film thickness — 0.8 – 1.2 mils
- Target gloss — 10 out of 100 at 60°

2.3 Schedule

ETV CCEP uses standard tools for project scheduling. Project schedules are prepared in Microsoft Project, which is an accepted industry standard for scheduling. Project schedules show the complete work breakdown structure (WBS) of the project, including technical work, meetings and deliverables. Table 5 shows the estimated schedule for the testing of the LPH400-LV spray gun.

Table 5. Estimated Schedule as of 4/15/03

ID	Name	Duration	Start Date	Finish Date
Task 1	Approval of TQAPP	15d	TBD	TBD
Task 2	Verification Testing	10d	TBD	TBD
Task 3	Complete Data Analyses	30d	TBD	TBD
Task 4	Prepare Verification Report	10d	TBD	TBD
Task 5	Approval of Verification Report	30d	TBD	TBD
Task 6	Issue Verification Statement	10d	TBD	TBD

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

CTC employs a matrix organization, with program and line management, to perform projects. The laboratory supports the ETV CCEP Project Manager and the ETV CCEP Project Leader by providing test data. Laboratory Analysts report to the ETV CCEP Laboratory Leader. The ETV CCEP Laboratory Leader and Organic Finishing Engineer coordinate with the ETV CCEP Project Leader on testing schedules. The ETV CCEP Project Leader is the conduit between the laboratory and the ETV CCEP Project Manager. The ETV CCEP Project Leader answers directly to the ETV CCEP Project Manager. For the ETV CCEP, the ETV CCEP Project Leader will be responsible for preparing the TQAPPs and Verification Report and Statement for each test.

The ETV CCEP QA Officer, who is independent of both the laboratory and the program, is responsible for administering *CTC* policies developed by the Quality Committee. These policies provide for, and ensure that quality objectives are met for each project. The policies are applicable to laboratory testing, factory demonstration processing, engineering decisions, and deliverables. The ETV CCEP QA Officer reports directly to *CTC* senior management and is organizationally independent of the project or program management activities.

The project organization chart, showing lines of responsibility and the specific *CTC* personnel assigned to this project, is presented in Figure 3. A summary of the responsibilities of each *CTC* participant, his/her applicable experience, and his/her anticipated time dedication to the project during testing and reporting is given in Table 6.

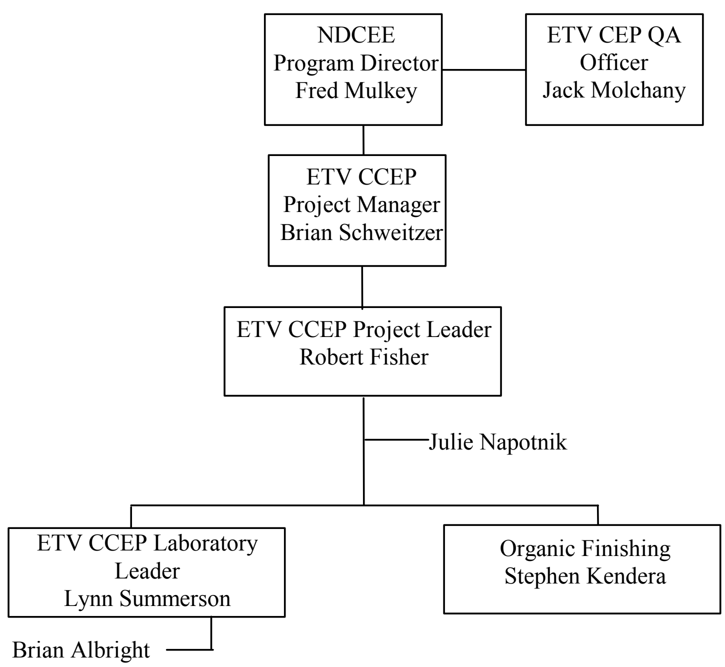


Figure 3. Project Organization Chart

Table 6. Summary of ETV CCEP Experience and Responsibilities

Key *CTC* Personnel and Roles	Responsibilities	Applicable Experience	Education	Time Dedication
Fred Mulkey – NDCEE Program Manager	Manages NDCEE Program Accountable to *CTC* Technical Services Manager and *CTC* Corporate Management	Laboratory Chemist and Manager (15 years) Project Quality Assurance (15 years) Project Management (14 years) Registered Environmental Manager	M.S., Chemistry B.S., Chemistry	5%
Brian Schweitzer – Manager, Process Engineering/ *CTC* Project Manager	Responsible for overall ETV CCEP technical aspects, budget, and schedule issues on daily basis Accountable to NDCEE Program Manager	Process Engineer (14 years) Project Manager, Organic Finishing (9 years)	B.S., Mechanical Engineering	25%
Jack Molchany – *CTC* QA Officer	Responsible for overall project QA Accountable to NDCEE Program Manager	Industrial QA/QC and (14 years) Quality Mgmt. /ISO 9000 (8 years) Environmental Compliance and ISO 14000 Management Systems (8 years) Certified Hazardous Materials Mgr.	B.S., Industrial Engineering	5%
Rob Fisher – Staff Process Engineer/ *CTC* Project Leader	Technical project support Process design and development Accountable to *CTC* Project Manager	Organic Finishing Regulations (9 years) Organic Finishing Operations (6 years) Professional Engineer	B.S., Chemical Engineering	50%
Julie Napotnik - Assistant Process Engineer/ *CTC* Project Team	Technical project support Process design and development Accountable to *CTC* Project Manager	Organic Coating Systems (3 years) Process Engineer (4 years)	B.S., Geo-Environmental Engineering	50%
Steve Kendera – Sr. Organic Finishing Technician	Performs day-to-day operations of the Organic Finishing Line Accountable to Finishing Engineer	Industrial Paint and Coatings Experience (28 years)		10%
Lynn Summerson – *CTC* Laboratory Leader/Statistical Support Staff	Laboratory analysis Accountable to Lab Manager	Industrial and Environmental Laboratory Testing (20 years)	M.S., Chemistry B.S., Chemistry	20%
Brian Albright – *CTC* Assistant Laboratory Analyst	QC Analysis Accountable to *CTC* Laboratory Manager	Environmental and QC Testing (7 years)	B.S., Chemistry	10%

The ETV CCEP personnel specified in Table 6 are responsible for maintaining communication with other responsible parties working on the project. The frequency and mechanisms for communication are shown in Table 7.

Table 7. Frequency and Mechanisms of Communications

Initiator	Recipient	Mechanism	Frequency
NDCEE Program Manager, ETV CCEP Project Manager, and/or ETV CCEP Project Leader	EPA ETV CCEP Project Manager	Written Report Verbal Status Report	Monthly Weekly
ETV CCEP Project Manager	NDCEE Program Manager	Written or Verbal Status Report	Weekly
ETV CCEP Laboratory Manager	ETV CCEP Project Leader	Data Reports	As Generated
ETV CCEP Project Leader	ETV CCEP Project Manager	Written or Verbal Status Report	Weekly
ETV CCEP QA Officer	NDCEE Program Manager	Quality Review Report	As Required
EPA ETV CCEP Project Manager	*CTC*	On-Site Visit	At Least Once per Year
Special Occurrence	Initiator	Recipient	Mechanism/ Frequency
Schedule or Financial Variances	NDCEE Program Manager or ETV CCEP Project Manager	EPA ETV CCEP Project Manager	Telephone Call, Written Follow-up Report as Necessary
Major (will prevent accomplishment of verification cycle testing) Quality Objective Deviation	NDCEE Program Manager or ETV CCEP Project Manager	EPA ETV CCEP Project Manager	Telephone Call with Written Follow-up Report

In addition, the individuals listed in Table 8 will have certain responsibilities during the testing phase:

Table 8. Responsibilities During Testing

Position	Responsibility
ETV CCEP Project Manager	Overall coordination of testing
ETV CCEP QA Officer	Audits of verification testing operations and laboratory analyses
ETV CCEP Project Leader	Overall coordination of reporting and data review
Statistical Support	Coordinates interpretation of test results

4.0 QUALITY ASSURANCE OBJECTIVES

4.1 General Objectives

The overall objectives of this ETV CCEP TQAPP are to verify the pollution prevention benefit of the LPH400-LV spray gun by establishing the TE improvement over a CAS baseline and by documenting finish quality. These objectives will be met by controlling and monitoring the critical and non-critical factors, which are the specific QA objectives for this TQAPP. Tables 2 and 3 list the critical and non-critical control factors, respectively.

The analytical methods that will be used for this verification are adapted from ASTM Standards, or equivalent. The QA objectives of the project and the capabilities of these test methods for product and process inspection and evaluation are synonymous because the methods were specifically designed for evaluation of the technology under investigation. The methods will be used as published, or as supplied, without major deviations unless noted otherwise. The specific methods to be used for this project are attached to this document as Appendix F (ASTM Methods).

4.2 Quantitative Quality Assurance Objectives

Quality assurance parameters such as precision and accuracy are presented in Tables 9 and 10. Table 9 presents the manufacturers' stated capabilities of the equipment used for measurement of non-critical control factors. The precision and accuracy parameters listed are relative to the true value that the equipment measures. Table 10 presents the precision and accuracy parameters for the critical response factors. The precision and accuracy are determined using duplicate analysis and known standards and/or spikes and must fall within the values found in the specific methods expressed.

The Statistical Support Staff, ETV CCEP QA Officer, and laboratory personnel will coordinate efforts to calculate and interpret the test results.

Table 9. QA Objectives for Precision, Accuracy and Completeness for All Non-Critical Control Factor Performance Analyses

Measurement	Method	Units	Precision	Accuracy	Completeness
Product Involved in Testing	Standard Test Panels	N/A	N/A	N/A	100%
Pretreatment Analysis	ASTM B 767	g/m^2	±0.005	±0.01	90%
Surface Area	Ruler	cm^2 (ft^2)	±0.025 (±0.0036)	±0.025 (±0.0036)	90%
Ambient Factory Relative Humidity	Thermal Hygrometer	%	±3% of full scale	±3% of full scale	90%
Ambient Factory Temperature	Thermal Hygrometer	°C	±3% of full scale	±3% of full scale	90%
Booth Relative Humidity	Thermal Hygrometer	%	±3% of full scale	±3% of full scale	90%
Booth Temperature	Thermal Hygrometer	°C	±3% of full scale	±3% of full scale	90%
Spray Booth Air Flow	per ACGIH	m/s (ft/min)	±0.03* (±5)	±0.03* (±5)	90%
Temperature of Panels as Coated	IR Thermometer	°C	±0.5%	±1.0%	90%
Distance to Panels	Ruler	cm (in.)	±0.15 (±0.06)	±0.15 (±0.06)	90%
Horizontal Gun Traverse Speed	Stopwatch	cm/s (in./s)	±5%	±5%	90%
Vertical Drop Between Passes	Ruler	cm (in.)	±0.15 (±0.06)	±0.15 (±0.06)	90%
Dwell Time Between Passes	Stopwatch	seconds	±5%	±5%	90%
Volatile Content of Applied Coating	ASTM D 3960	g/L (lb/gal)	±0.6%	±1.8%	90%
Density of Applied Coating	ASTM D 1475	g/L (lb/gal)	±0.6%	±1.8%	90%
Wt.% Solids of Applied Coating	ASTM D 2369	%	±1.5%	±4.7%	90%
Coating Temperature, as Applied	Thermometer	°C	±0.5 °C	±0.2 °C	90%
Coating Viscosity as Applied	ASTM D 1200	seconds	±10%	±10%	90%
Cure Time	Stopwatch	Hours	±10%	±10%	100%

ACGIH - American Conference of Governmental Industrial Hygienists, Inc.
* *Accuracy and Precision stated by the manufacturer for velocities ranging from 20-100 ft/min*

Table 10. QA Objectives for Precision, Accuracy and Completeness for All Critical Response Factor Performance Analyses

Measurement	Method	Units	Precision	Accuracy	Completeness
Dynamic Inlet Air Pressure	Pressure Gauge	psig	±0.5 psig	±0.5%	90%
Dynamic Outlet Air Pressure	Pressure Gauge	psig	±0.5 psig	±0.5%	90%
Dry Film Thickness – Magnetic	ASTM B 499	mils(1)	20%	10% true thickness	90%
DFT Variation	N/A	N/A	N/A	N/A	N/A
Gloss	ASTM D 523	gloss units	20%	±0.3	90%
Visual Appearance	N/A	N/A	N/A	N/A	N/A
Transfer Efficiency	ASTM D 5286	%	25%(2)	rsd $\leq$ 20%(2,3)	90%

(1) 1 mil = 0.001 in.
(2) Unknown according to ASTM D 5286
(3) rsd =relative standard deviation
N/A = Not Applicable

4.2.1 Accuracy

Standard reference materials, traceable to national sources such as the National Institute for Standards and Technology (NIST) for instrument calibration and periodic calibration verification, will be procured and utilized where such materials are available and applicable to this project. For reference calibration materials with certified values, acceptable accuracy for calibration verification will be within the specific guidelines provided in the method if verification limits are given. Otherwise, 80-120 percent of the true reference values will be used (see Tables 9 and 10). Reference materials will be evaluated using the same methods as for the actual test specimens. Calculations for precision, accuracy, etc. are contained in Section 10.0.

4.2.2 Precision

The experimental approach of this TQAPP specifies the exact number of test panels to be coated. The analysis of replicate test panels for each coating property at each of the experimental conditions will occur by design. The degree of precision will be assessed based on the agreement of all replicates within a property analysis group.

4.2.3 Completeness

The laboratory strives for at least 90 percent completeness. Completeness is defined as the number of valid determinations expressed as a percentage of the total number of analyses conducted, by analysis type.

4.2.4 Impact and Statistical Significance Quality Objectives

All laboratory analyses will meet the accuracy and completeness requirements specified in Tables 9 and 10. The precision requirements also should be achieved; however, a non-conformance may result from the analysis of replicates due to limitations of the coating technology under evaluation, and not due to processing equipment or laboratory error. Regardless, if any non-conformance from TQAPP QA objectives occurs, the cause of the deviation will be determined by checking calculations, verifying the test and measurement equipment, and re-analysis. If an error in analysis is discovered, re-analysis of a new batch for a given run will be considered and the impact to overall project objectives will be determined. If the deviation persists despite all corrective action steps, the data will be flagged as not meeting the specific quality criteria and a written discussion will be generated.

If all analytical conditions are within control limits and instrument and/or measurement system accuracy checks are valid, the nature of any non-conformance may be beyond the control of the laboratory. If, given that laboratory quality control data are within specification, and non-conforming results occur, the results will be interpreted as the inability of the coating equipment undergoing testing to produce panels meeting the performance criteria at the given set of experimental conditions.

4.3 Qualitative QA Objectives: Comparability and Representativeness

4.3.1 Comparability

The LPH400-LV spray gun will be operated per Anest Iwata's recommendations. The data obtained will be comparable from the standpoint that the TE data from Runs 1 through 5 can be compared to a reasonable significance. In addition, other programs should be able to reproduce similar results using this technology-specific TQAPP. Coating and environmental performance will be evaluated using EPA, ASTM, and other nationally or industry-wide accepted testing procedures as noted in previous sections of this TQAPP. Process performance factors will be generated and evaluated according to standard best engineering practices.

Standard test panels used in these tests will be compared to the performance criteria and to other applicable end-user and industry specifications. The specifications will be used to verify the performance of the LPH400-LV spray gun. Additional assurance of comparability comes from the routine use of precision and accuracy indicators as described above, the use of standardized and accepted methods and the traceability of reference materials.

4.3.2 Representativeness

The limiting factor to representativeness is the availability of a large sample population. An experimental design has been developed so that this project will either have sufficiently large sample populations or otherwise statistically significant fractional populations. The tests will be conducted at optimum conditions based on the manufacturers' and the coating suppliers' literature and verified by setup testing. If the test data meets the quantitative QA criteria (precision, accuracy, and completeness) then the samples will be considered representative of the LPH400-LV spray gun and will be used for interpreting the outcomes relative to the specific project objectives.

4.4 Other QA Objectives

There are no other QA objectives as part of this evaluation.

4.5 Impact of Quality

Due to the highly controllable nature of the test panel evaluation methods and predictability of factors affecting the quality of the laboratory testing of panels, the quality control of test panel qualifications is expected to fall within acceptable levels. Comparison of response factors will be checked for run to run process variations.

5.0 SITE SELECTION AND SAMPLING PROCEDURES

5.1 Site Selection

This project will be executed at *CTC*, in Johnstown, Pa., and *CTC* personnel will perform all processing and testing. Application of the coating involves transporting test panels via an automatic conveyor through the OFL. The test panels will be coated in the first of the two wet spray booths. The experimental design involves applying a coating according to the manufacturers' recommended optimum conditions. The test panels will be sampled and analyzed to generate performance data.

5.2 Site Description

A diagram of the OFL is attached as Appendix A, which shows the location of the process equipment that will be used for this project. This project involves the use of the wet spray booth.

5.3 Sampling Procedures and Handling

Standard test panels will be used in this project. These will be pre-labeled by stamping their ID (identification) number on one side of the panels. The experimental design will coat 120 panels during the verification test (5 runs, 3 racks per run, 8 panels per rack). ETV CCEP staff will process the test panels according to a pre-planned sequence of stages, including those identified in Table 11.

Table 11. Process Responsibilities

Procedure	Operations Technician	Laboratory Analyst
Numbering of panels		X
Initial weight of panels		X
Arrange panels on the racks		X
Prepare the coating	X	
Setup the LPH400-LV spray gun	X	
Take coating samples and measurements		X
Load coating & prime gun	X	
Perform setup trials (before first run only)	X	
Initial weight of gun, cup, and coating container	X	X
Apply coating to panels	X	
Take process measurements		X
Cure panels	X	
Final weight of gun, cup, and coating container	X	X
Wrap and stack panels for transfer to the lab	X	X

A laboratory analyst will record the date and time of each run and the time each measurement was taken. When the panels are removed from the racks, they will be separated by a layer of packing material, and stacked for transport to the laboratory. The laboratory analyst will process the test panels through the laboratory login prior to performing the required analyses.

5.4 Sample Custody, Storage and Identification

The Standard Test Panels will be given a unique laboratory ID number and logged into the laboratory record sheets. The analyst delivering the Standard Test Panels will complete a custody log indicating the sampling point IDs, sample material IDs, quantity of samples, time, date, and analyst's initials. The Standard Test Panels will remain in the custody of *CTC*, unless a change of custody form has been completed. The change of custody form should include a signature from *CTC*, the Standard Test Panel ID number, the date of custody transfer, and the signature of the individual to whom custody was transferred.

Laboratory analyses may only begin after each test panel is logged into the laboratory record sheets. The laboratory's sample custodian will verify this information. Both personnel will sign the custody log to indicate transfer of the samples from the coating processing area to the laboratory analysis area. The laboratory sample custodian will log the test panels into a bound record book; store the test panels under appropriate conditions (ambient room temperature and humidity); and create a work order for the various laboratory departments to initiate testing. The product evaluation tests also will be noted on the laboratory record sheet. Testing will begin within several days of coating application.

6.0 ANALYTICAL PROCEDURES AND CALIBRATION

Information regarding facility and laboratory testing and calibration procedures, product quality procedures, standard operating procedures for calibrations, and non-standard methods that will be used for this project can be found in Section 6.0 of the HVLP GVP.

Process Measurements

Before each run, the temperature and viscosity of the coating batch will be measured. Coating samples will be shipped to the NDCEE Environment Coatings Laboratory for density, and percent solids analyses. In addition, a volatile content will be performed by ETV CCEP staff.

The ambient temperature and relative humidity is measured both near the spray area and the cure area. Also, the temperature of the Standard Test Panels is measured prior to starting each test run.

All equipment used in the above analyses are calibrated according to Table 11 of the HVLP GVP.

Finish Quality

A listing of the test methods for dry film thickness, visual appearance, and specular gloss can be found in Appendix F.

The equipment used for these analyses are calibrated according to Table 12 of the HVLP GVP.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

Information pertaining to raw data handling, preliminary data package validation, final data validation, data reporting and archival, and the Verification Statement can be found in Section 7.0 of the HVLP GVP.

8.0 INTERNAL QUALITY CONTROL CHECKS

Information pertaining to *CTC's* internal quality program, types of QA checks performed, and a summary of basic and specific QA checks to be performed can be found in Section 8.0 of the HVLP GVP.

In addition to the information found in the HVLP GVP, the following specific QC/QA checks will be performed during this test.

Internal QA audits will be performed of the coating application phase and laboratory analyses by the ETV CCEP QA Officer, who is independent of the ETV CCEP Project Manager. These audits will check that processes are completed as per the approved written documentation, both internal and external. The QA audits will also check that the laboratory data is handled properly.

The QC checks that are performed by the laboratory personnel may include analyzing un-coated Standard Test Panels for dry film thickness to verify that the instrument has not drifted from zero, performing duplicate analyses on the same samples, and performing calibration checks of the laboratory equipment. The calibration checks generally consist of calibrating the equipment (if applicable), checking the calibration against a secondary standard, analyzing samples, rechecking the calibration, analyzing more samples, etc. The calibration is also checked against the secondary standard at the completion of an analysis series. If at any time the equipment falls out of calibration, all samples analyzed since the last good calibration check will be re-analyzed after the equipment is re-calibrated.

9.0 PERFORMANCE AND SYSTEM AUDITS

Information pertaining to the performance and system audits to be performed can be found in Section 9.0 of the HVLP GVP.

10.0 CALCULATION OF DATA QUALITY INDICATORS

Information pertaining to the calculation of data quality indicators such as precision, accuracy, completeness and other project specific indicators can be found in Section 10.0 of the HVLP GVP.

11.0 CORRECTIVE ACTION

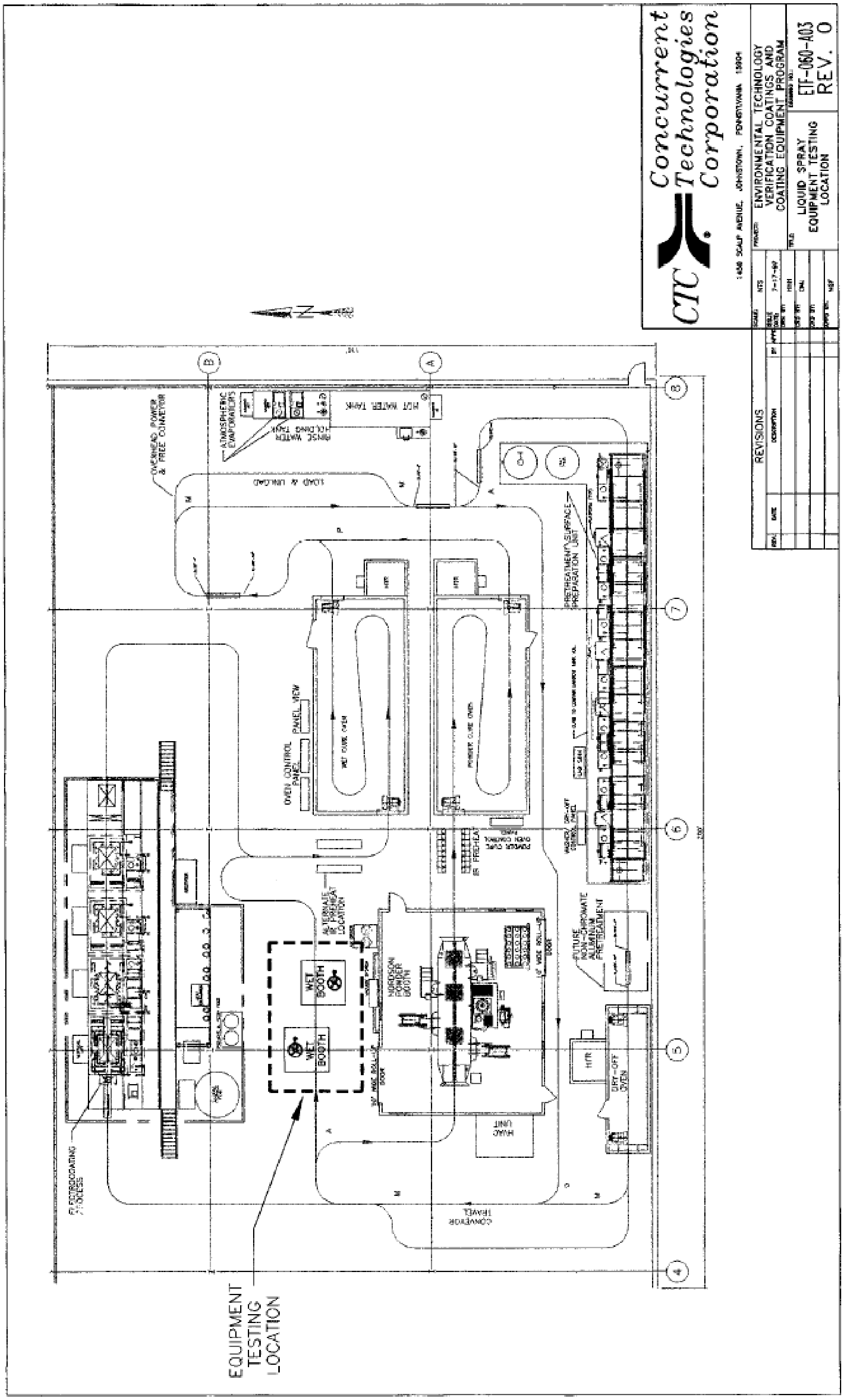
Information pertaining to routine and non-routine corrective actions that may be required during this project can be found in Section 11.0 of the HVLP GVP.

12.0 QUALITY CONTROL REPORTS TO MANAGEMENT

Information pertaining to the quality control reports that the ETV CCEP will deliver to Program Management can be found in Section 12.0 of the HVLP GVP.

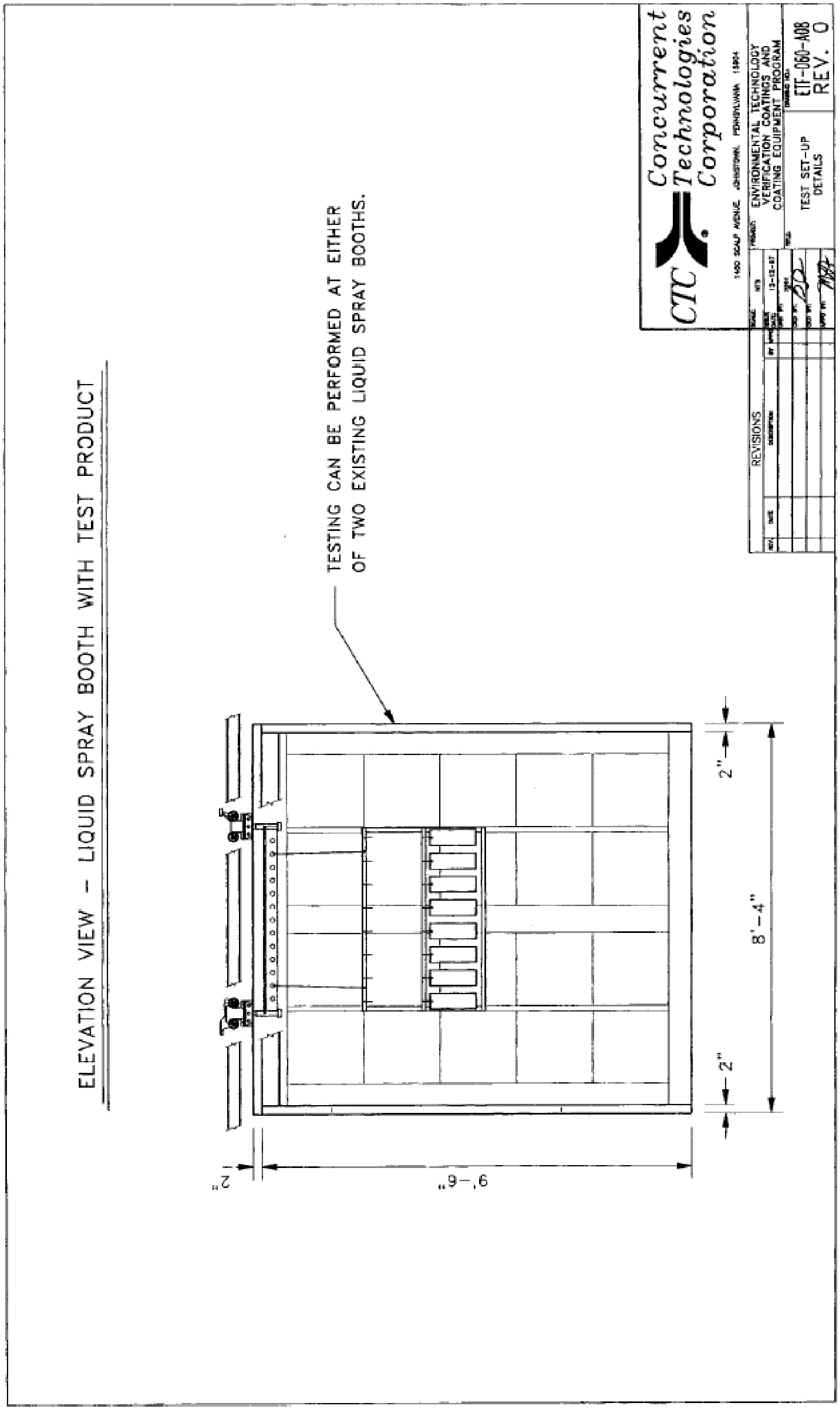
APPENDIX A

Test Location


Concurrent Technologies Corporation
CTC
1450 SCALP AVENUE, JOHNSTOWN, PENNSYLVANIA 15904
ENVIRONMENTAL TECHNOLOGY VERIFICATION COATINGS AND COATING EQUIPMENT PROGRAM
LIQUID SPRAY EQUIPMENT TESTING LOCATION
ETF-060-A03
REV. 0
REVISIONS
EQUIPMENT TESTING LOCATION
WET BOOTH
WET BOOTH
NORDSON POWDER BOOTH
ALTERNATE IR PREHEAT LOCATION
HVAC UNIT
DRY-OFF OVEN
FUTURE NON-CHROMATE ALUMINUM PRETREATMENT
PRETREATMENT/SURFACE PREPARATION UNIT
WET CURE OVEN
POWDER CURE OVEN
OVEN CONTROL PANEL
PANEL VIEW
HOT WATER TANK
RINSE WATER HOLDING TANK
ATMOSPHERIC EVAPORATORS
OVERHEAD POWER & FREE CONVEYOR
LOAD & UNLOAD
CONVEYOR TRAVEL
ELECTROCOATING PROCESS
IR PREHEAT
WASHER DRY-OFF CONTROL PANEL

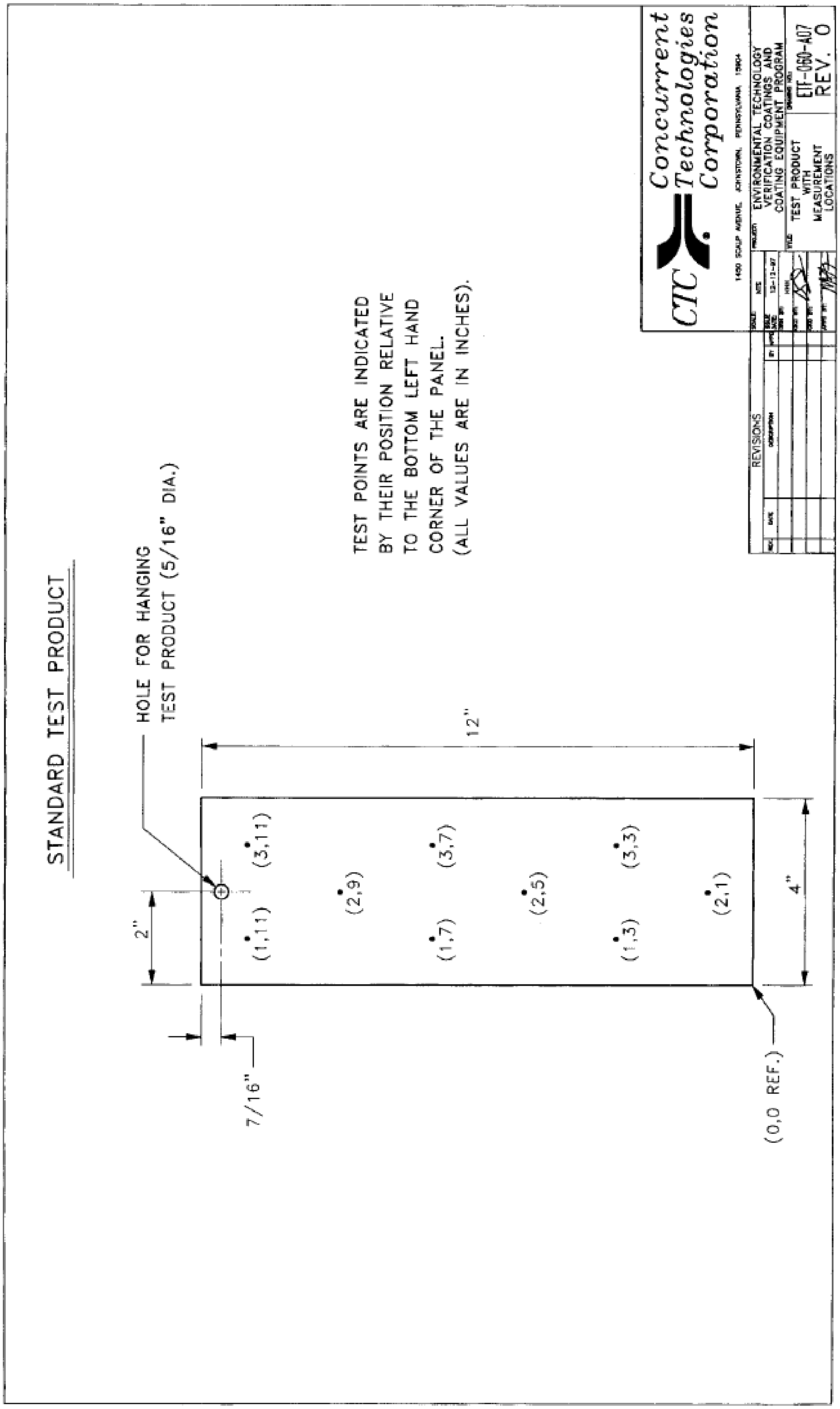
APPENDIX B

Apparatus Set-up


ELEVATION VIEW – LIQUID SPRAY BOOTH WITH TEST PRODUCT
TESTING CAN BE PERFORMED AT EITHER OF TWO EXISTING LIQUID SPRAY BOOTHS.
2"
8'-4"
2"
9'-6"
2"
CTC
Concurrent Technologies Corporation
ENVIRONMENTAL TECHNOLOGY VERIFICATION COATINGS AND COATING EQUIPMENT PROGRAM
TEST SET-UP DETAILS
ETF-060-A08
REV. 0
REVISIONS

APPENDIX C

Standard Test Panels


STANDARD TEST PRODUCT
HOLE FOR HANGING
TEST PRODUCT (5/16" DIA.)
TEST POINTS ARE INDICATED
BY THEIR POSITION RELATIVE
TO THE BOTTOM LEFT HAND
CORNER OF THE PANEL.
(ALL VALUES ARE IN INCHES).
12"
2"
4"
7/16"
(0,0 REF.)
(1,11)
(3,11)
(2,9)
(1,7)
(3,7)
(2,5)
(1,3)
(3,3)
(2,1)
CTC
Concurrent
Technologies
Corporation
1450 SCALP AVENUE, JOHNSTOWN, PENNSYLVANIA 15904
ENVIRONMENTAL TECHNOLOGY
VERIFICATION COATINGS AND
COATING EQUIPMENT PROGRAM
TEST PRODUCT
WITH
MEASUREMENT
LOCATIONS
ETF-060-A07
REV. 0
REVISIONS
12-12-97

APPENDIX D

LPH400-LV Product Data Sheets

(Available from Anest Iwata)

APPENDIX E

Coating Product Data Sheets

(Available from PPG Automotive Refinishing)

APPENDIX F

ASTM Methods

ASTM Methods

ASTM B 499 -- Standard Test Method for Measurement of Coating Thickness by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B 767 -- Standard Guide for Determining Mass per Unit Area of Electodeposited and Related Coatings by Gravimetric and other Chemical Analysis Procedures

ASTM D 523 -- Standard Test Method for Specular Gloss

ASTM D 1200 -- Standard Test Method for Viscosity by Ford Viscosity Cup.

ASTM D 1475 -- Standard Test Method for Density of Liquid Coatings, Inks, and Related Products.

ASTM D 2369 -- Standard Test Method for Volatile Content of Coatings

ASTM D 3960 -- Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings

ASTM D 5286 -- Standard Test Method for Determination of Transfer Efficiency Under General Production Conditions for Spray Application of Paint.

ASTM D 5767 -- Standard Test Method for Instrumental Measurement of Distinctness-of-Image Gloss of Coating Surfaces.