



Standard Waterborne Basecoat Purge Equipment Configuration and Test Method

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This procedure describes the standard equipment configuration and test method for line purge and bell cup cleaning of waterborne primer and basecoat using low Volatile Organic Compounds (VOC) and low Hazardous Air Pollutants (HAP) purge solvent solutions.

The procedure can also be applied, on an as needed basis, for the cleaning capability testing of solventborne basecoats using higher VOC purge materials per 9984037 and 9984304.

The purpose of a line purge and bell cup wash cycle is to clean out the paint line and the fluid tip and to remove any paint overspray which has collected on the exterior surfaces of the bell cup during the normal paint application process.

This test procedure should be performed during the development of new purge materials prior to submission of proposals to GM.

Note: It should be noted that this test procedure does not represent actual production conditions, but rather represents a screening method that provides a relative comparison of the cleaning effectiveness between a known and/or verified baseline purge material and one (1) or more test materials by comparing the build-up left on an applicator after a given number of test cycles.

1.2 Applicability. Dependent upon the objective of the testing, the baseline purge material can be a solution of butyl cellosolve/amine, as indicated in the Test Equipment section of this test procedure, a solution of a specified concentration of a current production material, or a solution of a given concentration of a material specified by GM responsible engineer.

1.2.1 All proposed purge materials for the cleaning of waterborne primer and basecoat should first be tested by the supplier using the solution of butyl cellosolve/amine as a baseline test to verify that the proposed purge material is at least as effective as a butyl cellosolve/amine solution.

1.2.2 After verification with butyl cellosolve/amine, contact GM responsible engineer for the baseline purge material that has demonstrated process stability for a specific plant for further testing.

1.2.3 More buildup on the applicator after completion of the specified number of spray/purge cycles for the test purge vs. the buildup achieved for the baseline material after the completion of a given number of cycles would indicate that the test purge is not as effective as the baseline purge, while less buildup on the applicator vs. the baseline purge after the completion of a specified number of cycles would indicate that the test purge is more effective than the baseline purge.

1.2.4 The standard equipment configuration is composed of a stationary rotary atomizer mounted vertically within a down draft or side draft spray booth. Because the procedure does not incorporate the use of a bell wash station, cleaning of the bell cup interior and exterior surfaces is accomplished through direct contact of the purge solvent solution with any paint overspray or buildup.

1.2.5 This equipment configuration is required for the evaluation of the cleaning capabilities of new or proposed purge materials relative to a standard baseline solution when tested with approved waterborne or solventborne primer and basecoat technologies specified by GM responsible engineer.

1.2.6 The test procedure can be applied in determining the cleaning capabilities of purge materials relative to a standard baseline solution for both bell and gun cleaning applications.

1.2.6.1 A proposed change in purge formulation or purge supplier at a given facility will require that the current production purge be compared with the proposed test purge according to this test method or that the change be approved by GM responsible engineer.

1.2.6.2 A change in primer or basecoat at a given facility will require that the current production purge be evaluated according to this test method or that the change be approved by GM responsible engineer.

1.2.6.3 A change in applicator at a given facility will require that the current production primer or basecoat and purge system be evaluated under plant specific parameters to verify adequate cleaning capabilities or that the change be approved by GM responsible engineer.

1.3 Remarks. Not applicable.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

9984037	9984482	9986329	9986475
9984304	9986328	9986474	

2.3 Additional References.

None.

3 Resources

3.1 Facilities. Unless specified, any deviation with respect to this equipment must be approved by GM responsible engineer prior to the start of any testing.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Rotary Atomizer. Behr (Durr) EcoBell rotary atomizer with 65 mm aluminum bell cup and 1.1 mm injector stainless steel fluid tip or equivalent.

3.2.1.1 A rotary atomizer (bell) applicator, with or without electrostatics, must be capable of atomizing waterborne primer or basecoat according to typical production conditions (refer to Appendix A, Figure A1 for an example).

3.2.1.2 Each portion of the test must be conducted with consistent fluid flow rate, bell speed, shaping air, and voltage level, if applicable.

3.2.1.3 If the purge solvent evaluation requires that sprayouts be directed toward a vertical carrier on a conveyor, each portion of the testing must also be conducted with consistent bell to carrier distance and carrier line speed.

3.2.1.4 The recommended rotary atomizer and purge cycle setup are based on the test stand developed by Systems; Auburn Hills, MI (refer to Appendix A, Figure A2). See responsible engineer for details and requirements.

3.2.2 Bell Speed Control. Manually regulated turbine air with speed monitoring or equivalent (refer to Appendix A, Figure A1).

3.2.3 Paint Supply System. Paint pressure pot (19 L minimum) with manual paint regulation and paint flow rate feedback (refer to Appendix A, Figure A1).

3.2.4 Purge Solvent Supply System. The purge solvent supply system should be a solvent tank (19 L) with diaphragm pump for circulating purge solution through a heater and solvent flow meter with display for monitoring purge solvent delivery rates. The pump must be capable of circulating purge materials at temperatures of up to 60 °C (140 °F).

3.3 Test Vehicle/Test Piece.

3.3.1 Control Purge Solution. The control purge solvent shall be a solution of 98% to 99% butyl cellosolve and 1% to 2% amine diluted to a concentration of 10% by volume with deionized water. The purge solution should be maintained at a mix temperature specified by the responsible engineer or, as a starting point, the control solution shall be maintained at a mix temperature of $49\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($120\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$) in the solvent tank.

3.3.1.1 If specified by the responsible engineer, a control purge consisting of a lower concentration butyl cellosolve/amine solution or a current production blend shall be used in addition to or in place of the 10% butyl cellosolve/amine solution.

3.3.1.2 For the evaluation of the cleaning capability of solventborne basecoat with conventional higher VOC purge materials, a control purge solution consisting of a current production blend shall be used as the control.

3.3.2 Control Primer or Basecoat Material. Production samples of white waterborne primer or basecoats from the current GM basecoat suppliers shall be used as the control material for the purge solution evaluations. Primer and Basecoat technology requirements and control material(s) shall be designated by GM responsible engineer based on current production or targeted plants.

For the evaluation of the cleaning capability of solventborne basecoat with conventional higher VOC purge materials, a sample of a (white) current production basecoat technology shall be used as a control.

3.3.3 Test Material. The test material is a low VOC/low HAP purge solvent and/or cap cleaner for conventional waterborne basecoat per 9984482 or three (3) Wet: Non-Compressed BCP per 9986328 and BC per 9986329 and Semi-Compress BCP per 9986474 and BC per 9986475. The material may be supplied as a concentrate, but requirements for cleaning capability are based on ready-to-use solutions in deionized water. The predicted optimum ready-to-use concentration in deionized water, along with solution temperature, shall be specified by the supplier.

For the characterization of solventborne basecoat purge materials, the test material is a purge solvent per 9984304, or as specified by GM responsible engineer.

3.4 Test Time.

Calendar time: 1 d per test

Test time: 2 h

Coordination time: $\frac{1}{2}$ d

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. A person who has completed training on the use of laboratory purge line and bell cup operation.

4 Procedure

4.1 Preparation. See detailed steps from 4.2 through 4.9.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 Booth Parameter Equilibration. Allow the booth conditions to equilibrate to a temperature of $26\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and a relative humidity of $60\% \pm 3\%$. Set downdraft flow rate to $1.7\text{ m}^3/\text{minute}$ ($60\text{ ft}^3/\text{minute}$).

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

Allow the control or test purge solvent to equilibrate to the specified or recommended temperature in the solvent tank.

4.4 Bell Parameter Settings. Adjust bell parameters to the following settings for the flow of the specified primer or basecoat through the system:

- Conveyor: 4 m (12 ft)/minute.
- Flow Rate: 60 cc/minute.
- Shape Air: 60 standard L/minute.

- Bell Turbine Speed: 30 000 rpm.
- Target Distance (Bell to Conveyor): 25.4 cm (10 in), if applicable.
- Electrostatics: 300 μ A (approximately 70 kV), if applicable.

4.5 Purge Cycle Settings. Program the purge and bell wash according to the following cycle:

4.5.1 Total Cycle (0 to 1050).

- 10.5 s (0 to 1050).

4.5.2 Solvent/Air Chop (0 to 900).

- 1.5 s Solvent (1 to 150).
- 1.5 s Air (170 to 320).
- 1.0 s Solvent (340 to 440).
- 1.5 s Air (460 to 610).
- 1.0 s Solvent (630 to 730).
- 1.5 s Air (750 to 900).

4.5.3 Recovery (0 to 770).

4.5.4 Main Needle Open (700 to 900).

4.5.5 Bell Wash (900 to 1050).

4.5.5.1 One and a half seconds (1.5 s) (900 to 1050).

4.5.6 The bell parameter settings or the purge cycle settings may be modified, as required, in order to produce an appropriate signal with the baseline material (i.e., the bell parameters may be increased or decreased or the cycle may be shortened or lengthened in order to provide buildup with the baseline material so that this buildup can be compared to the test material when evaluated at the same settings).

4.5.6.1 Figure 1 indicates a cup tested with the baseline purge and a purge cycle that is too severe. There is no residual buildup on the cup following the fifteen (15) cycles. In order to produce a signal, the purge cycle should be shortened (the solvent on time should be reduced) in order to produce more residual buildup on the cup tested with the baseline purge. A signal is required with the baseline purge so that it can be compared with the test purge. See Figure 1.



**Figure 1: Cup Tested with Baseline Purge:
No Residual Buildup (No Signal, Cleaning Cycle is too Severe)**

4.5.6.2 Figure 2 indicates a cup tested with the baseline purge and a purge cycle that is not severe enough. There is excessive residual buildup on the cup following the fifteen (15) cycles. The purge cycle should be increased (the solvent on time should be increased) in order to produce less residual buildup on the cup tested with the baseline purge. A signal is required with the baseline purge so that it can be compared with the test purge. The amount of buildup on this cup, however, is excessive. See Figure 2.



**Figure 2: Cup Tested with Baseline Purge:
Excessive Residual Buildup (No Signal) Cleaning Cycle is not Severe Enough**

4.5.6.3 Figure 3 through Figure 5 indicate cups tested with the baseline purge and purge cycles that are acceptable. There is noticeable, but not excessive, residual buildup on the cup following the fifteen (15) cycles that can be compared with a test purge in order to determine the relative effectiveness of the test purge vs. the baseline purge.



Figure 3: Cup Tested with Baseline Purge: Noticeable, but Not Excessive Residual Buildup



Figure 4: Cup Tested with Baseline Purge: Noticeable, but Not Excessive Residual Buildup



Figure 5: Cup Tested with Baseline Purge: Noticeable, but Not Excessive Residual Buildup

4.5.7 Cups tested with baseline purge. Acceptable residual buildup (visible signal) cleaning cycle is acceptable.

4.6 Purge Usage Verification. Conduct a purge and bell wash cycle to verify purge solvent usage with the line loaded with the specified primer or basecoat technology. Total usage for the purge cycle should range from 90 cc to 110 cc and total usage for the bell wash should range from 15 cc to 20 cc.

4.6.1 Because this usage will be dependent upon the line pressure of the test facility, adjustments to the purge cycle solvent on to time may be required to achieve these purge usage levels. Attempts should be made to modify the purge cycle to achieve these levels. If this is not possible, the actual usage for the given purge cycle should be recorded.

4.6.2 For a system where the purge cycle has been modified in order to produce an appropriate signal, these usage levels may not be possible. For these cases, the actual usage volumes required to produce the appropriate signal should be recorded.

4.7 Manual Bell Clean. Remove bell cup from atomizer and manually clean any residual buildup on the fluid tip or bell exterior with the control solvent. Manually clean the bell cup with the control purge solvent. Photograph the fluid tip, replace the bell cup, and photograph the bell cup face and side. Figure 3 through Figure 5 represent the baseline (before testing) photographs.

4.8 Purge Temperature Measurement at the Fluid Tip. As a result of heat loss due to the heat sink capacity of the bell, the temperature of the purge solution at the fluid tip will be less than the purge temperature in the purge solvent supply system. Measure and record the purge solution temperature after a spray cycle and after a simulated downtime according to the following procedure:

4.8.1 Purge Measurement After a Spray Cycle.

4.8.1.1 Trigger approximately 200 cc purge through the fluid tip.

4.8.1.2 Allow for a 2 minute ambient dwell.

4.8.1.3 Capture the next 50 cc into beaker and measure the solution temperature with a digital probe.

4.8.2 Purge Measurement After a Downtime:

4.8.2.1 Trigger approximately 200 cc purge through the fluid tip.

4.8.2.2 Allow for a 10 minute ambient dwell.

4.8.2.3 Capture the next 50 cc into a beaker and measure the solution temperature with a digital probe.

4.9 System Clean. Conduct a system clean (super purge) to remove any residual paint from the paint line by flushing the control solvent through the system.

4.10 Primer or Basecoat Spray and Purge Cycle. Conduct a series of fifteen (15) spray cycles with a purge cycle after every three (3) spray cycles.

4.10.1 Following each set of three (3) spray cycles and one (1) purge cycle, photograph the bell cup face. In addition, photograph the bell cup side after fifteen (15) cycles. The spray and purge procedure is outlined in Appendix B.

4.10.2 A single cycle requires a 30 s bell spray onto the carrier followed by a 2 minute ambient dwell (with the bell spinning). Photographs should be taken following purge cycle after every three (3) spray cycles. For the last set of three (3) cycles, a 15 minute dwell should be allowed prior to the final purge.

4.10.3 Sample photographs are provided in Appendix C, Figure C1 through Figure C25.

4.10.4 If an appropriate signal cannot be achieved with these spray and dwell times, the times can be increased or decreased, as required, in order to produce an adequate signal.

4.11 Fluid Tip and Bell Cup Inspection. After the completion of the fifteen (15) primer or basecoat spray and purge cycles, remove the bell cup from the bell and photograph and inspect the fluid tip for paint buildup.

Indicate the percent basecoat buildup coverage on the fluid tip, if applicable, and describe the texture of the buildup (i.e., wet, tacky, etc.) Disassemble the bell cup and photograph the mating surfaces of the bell cup as indicated in Appendix C3.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. This standard material and equipment configuration does not require evaluation and rating. Instead, an evaluation of the residual buildup on the face of the bell cup and fluid tip for both the baseline material and the test material should be conducted.

5.2.1 As stated in the Introduction of this procedure, more buildup on the applicator after completion of the specified number of spray/purge cycles for the test purge vs. the buildup achieved for the baseline material after the completion of a given number of cycles would indicate that the test purge is not as effective as the baseline purge, while less buildup on the applicator vs. the baseline purge after the completion of a specified number of cycles would indicate that the test purge is more effective than the baseline purge.

5.2.2 An equivalent amount of buildup on the bell cup face following a given number of cycles would indicate the baseline purge and the test purge are comparable.

Review of the test results by the responsible engineer at GM will verify the purge cleaning capabilities relative to the baseline purge material results tested under equivalent conditions.

5.3 Test Documentation. Supplier must provide GM written reports and photographs of equipment setup, equipment spray parameters, purge test parameters, baseline solvent sprayout results, and test material sprayout results as specified in Appendix C.

Sample photographs are provided in Appendix C. These sample photographs indicate residual buildup on the face of the bell cup for several baseline tests. It must be noted that the residual buildup for the baseline purge, whether it be a solution of butyl cellosolve/amine or the current production material, may or may not be represented by these photographs.

In addition, booth temperature and humidity conditions for each test cycle, along with purge temperature measurement in the purge solvent tank and at the fluid tip after a spray cycle and after a simulated downtime, must be provided.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

HAP	Hazardous Air Pollutants
O/E	Optical to Electrical
Reg	Regulator
VOC	Volatile Organic Compounds