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Assessment of Conformity on New PVC Schedule 40 Type Fittings for DWV Markets

Overview

This document provides key findings of review and testing of novel PVC Schedule 40 Type fittings for application in drain, waste, and vent (DWV) markets. The supplier acknowledges that certain aspects of these new and innovative fittings are non-traditional for PVC schedule 40 fittings. Namely, these fittings are sold as a two-component system meant to be assembled in the field to create a custom fit angle by rotation of one of the two components followed by appropriate adhesive joining (see Figures A – C). In this report, the component meant to form the outer shell of the adhesively joined assembly is called the socket and is shown in Figure B. The primary objective of this document is to establish the status of important material and performance requirements for DWV markets to determine if the product “meets or exceed the performance requirements of ASTM D2665”.



Figure A – Insert component.

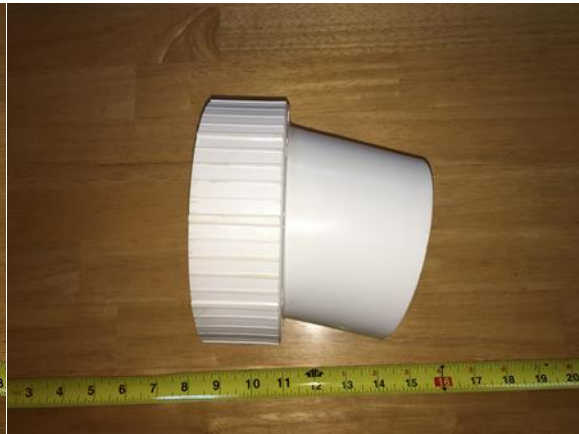


Figure B – Socket component.



Figure C – Pre-assembled components in a linear configuration.



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Results of Investigations and Testing

A. PVC Material

ASTM D2665 provides requirements for the PVC material from which either pipe or fittings can be manufactured in order to comply with the standard. Section 5.1 of D2665 relates to the properties of PVC Materials and states *“The fittings shall be made of virgin PVC compounds meeting or exceeding the requirements of Class 12344 as defined in Specification D1784, but with a tensile strength of not less than 6500 psi and a modulus of elasticity for not less than 380,000 psi”*. The manufacturer has indicated that the PVC material used in the manufacture of these fittings is Axiall LR-5009 White 24. I find that the NSF International website lists Georgia-Gulf LR 5009 White 24; <http://info.nsf.org/Certified/Plumbing/Listings.asp?Company=19560&Standard=014>.

The difference in the name of the company identified with this compound (ie. Georgia-Gulf vs. Axiall) relates to a 2013 merger of businesses and name change. The compound identified in the NSF website is the one used in manufacturing of these fittings. The NSF International website certifies that it has tested Georgia-Gulf LR 5009 White 24 for its D1784 cell classification in association with NSF/ANSI Standard 14 “Plastics Piping System Components and Related Materials” and found that its cell classification is 12454. The third digit, 4, indicates that this material has a tensile strength of not less than 7000 psi. The fourth digit, 5, indicates that this material has a modulus of elasticity not less than 400,000 psi. **This confirms that the materials used in manufacturing comply with the requirements of ASTM D2665.**

B. Rework

Section 5.2 of ASTM D2665 allows the use of rework material by stating *“The manufacturer shall use only his own clean pipe or fitting rework material, and the pipe or fittings produced shall meet all the requirements of this specification”*. The manufacturer reports that no rework was used in the manufacture of these fittings. **This confirms that the fittings manufactured comply with the rework requirements of ASTM D2665.**

C. Dimensional Compliance for PVC Schedule 40 Pipe Fittings

Section 6.2.2.2 of ASTM D2665 states *“The patterns, dimensions, and laying lengths of fittings, including adaptors, shall meet the requirements of Specification D3311 and Table 1”*. It is clear that ASTM D3311 does not include a descriptive drawing of the client’s fittings and that meeting this requirement will require a project at ASTM to revise D3311. This effort to revise ASTM D3311 should not start until the client has a granted US patent.

Table 1 of D2665 contains six dimensions. Dimension M relates only to threaded fittings. The other five dimensions are A – Average Socket Entrance Diameter, A’ - Out of Roundness, B – Average Socket Bottom Diameter, C – Minimum Socket Depth, and E – Minimum Wall Thickness. The out of roundness for these fittings was not measured and is



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therefore reported in Table A as not recorded (NR).

Table A. Dimensional requirements from ASTM D2665 for 4” fittings addressing five dimensional parameters.

Dimension in inches	Average Entrance Diameter Range	Maximum Out of Round	Average Bottom Diameter	Minimum Socket Depth	Minimum Wall Thickness
ASTM D2665	4.515 - 4.530	0.030	4.491 +/- 0.009	1.750	0.250
Socket	4.518	NR	4.492	2.541	0.253
Insert	4.518	NR	4.489	2.541	0.251

As documented in the test report, a single pair of fitting components were dimensioned in accordance with ASTM D2122. Since the pair of fitting components are designed to join in as an insert into a socket prior to interface with the pipe, the fitting components were designated “socket” and “insert” for the purpose of identification. For example, the Entrance Diameter values for the socket component was measured as ranging from 4.513 to 4.523 inches. The Average Entrance Diameter for the socket was reported as 4.518 inches which complies with the D2655 requirement. Similarly, the Average Entrance Diameter for the insert was also reported as 4.518 inches which complies with the D2655 requirement. The other measurements from the test report are summarized in Table A. In all cases reported, both fittings components were measured to meet the dimensional requirements of ASTM D2665 for Schedule 40 fittings. **This confirms that the fitting dimensions reported in Table A are appropriate for joining to Schedule 40 pipe.**

D. Crush Resistance Requirements

ASTM D2665 provides requirements for the crush resistance performance of fittings in section 6.3.2 and states “Individual fittings unassembled shall withstand a minimum load of 750 lbf/ft (11 kN/m) of centerline length without cracking or other visible evidence of failure when tested in accordance with 7.4”.

As documented in Test Report 16D0703, three sets of PVC joint components were assembled using heavy duty PVC cement in accordance with the manufacturer’s recommendations using solvent cement that complies with ASTM D2564. The relative joint configuration was in the 0 degree position resulting in a straight waterway. The joints were then conditioned for at least 24 hr. at room temperature. The three (3) PVC joined components were subjected to flattening testing in accordance with section 7.4 of D2665. In each case, the assembled joined PVC components did not show any evidence of cracking when 750 lbf/ft of force was applied. All samples passed. **This confirms that the fittings can be assembled into joints which meet or exceed the crush resistance requirements of ASTM D2665 when joined using heavy duty PVC cement in accordance with**



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manufacturers recommendations.

E. Impact Resistance Requirements

ASTM D2665 provides impact resistance requirements for the in section 6.4 and states “The minimum impact resistance of pipe and fittings, when tested at the time of manufacture, shall comply with Table 4. Test in accordance with Test Method D2444 using . . . Tup A and Holder B for fittings. . . Test fittings with a 12-lb (5-kg) Tup. Test couplings cemented to short pieces of pipe and allowed to dry for 24 h”.

As documented in Test Report 16D0703, ten sets of PVC joint components were assembled using heavy duty PVC cement in accordance with the manufacturer’s recommendations using solvent cement that complies with ASTM D2564. The relative joint configuration was in the 0 degree position resulting in a straight waterway. The joints were then conditioned for at least 24 hr. at room temperature. Each assembled joint was then connected to short lengths of PVC piping at both ends of the fitting using the same PVC cement and drying time. Impact testing in accordance with section 6.4 was then conducted with 9 of ten samples tested passing. The fittings meet the minimum impact requirements stated within section 6.4.1 of ASTM D2665 which states “When 9 or 10 specimens pass, accept the lot”. **This confirms that the fittings can be assembled into joints which meet or exceed the impact resistance requirements of ASTM D2665 when joined to pipe using heavy duty PVC cement in accordance with manufacturers recommendations.**

F. General Quality Control Inspection

Section 6.1 of ASTM D2665 contains language relating to workmanship. The fittings were inspected visually and found All sixteen (16) fitting pairs showed an identical micro-crack or surface scratch between the 5 and 10 degree marks in clockwise direction on the insert half of the fittings. The inspecting laboratory noted this surface feature as non-injurious to the fitting function and was not considered a failure. The fittings were otherwise homogeneous throughout and free from holes, foreign inclusions, or other injurious defects. The fittings were as uniform as commercially practical in color, opacity, density, and other physical properties. **This confirms that the fittings meet or exceed the workmanship requirements of ASTM D2665.**

A summary of the recommended test methods and the requirements are included as an attachment in Appendix A.



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Table A – Recommended Laboratory Testing and Details of Testing

Requirement	Test Method	Results
Fitting Dimensions	D2665 Table 1	All reported fitting dimensions meet requirements.
Crush Resistance	Section 6.3.2 of D2665	Pass
Impact Resistance	Section 6.4 of D2665	9 of 10 replicates passed resulting in a passing rating for the lot.
Workmanship Inspection	Section 5.2.1 of D2665	Surface scratches noted. No other flaws observed

Conclusions:

- The fitting product tested meets or exceed the performance requirements of ASTM D2665 when assembled using manufacturer’s instructions.
- The out-of-round dimensional compliance for the fittings was not measured by the testing laboratory.
- ASTM D3311 does not include a descriptive drawing of the client’s fittings required for full compliance with ASTM D2665. A project to revise D3311 to include the client’s fittings should be started once the client has a granted US patent.
- Product certification testing by an accredited laboratory should be undertaken upon the completion of the revision to ASTM D3311 so that the product can be labelled as fully conforming with ASTM D2665.

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