

May 04, 2016

Bryan Hauger  
Bryan Hauger Consulting, Inc.  
4129 San Marco Dr.  
Longmont, CO 80503

Dear Bryan Hauger,

Microbac Laboratories, Inc. Hauser Division completed work order 16D0703 on 5/4/16. Please find the final report on the following pages. Thank you for choosing Microbac Laboratories for your testing needs.

It is our preference to send all reports and invoices electronically when available. If you need any contact information updated or additional contacts added, please communicate your needs to our administrative staff at (720)406-4800 or [hauserlabs@microbac.com](mailto:hauserlabs@microbac.com).

To provide feedback concerning our services, please contact our Quality Department or Trevor Boyce, President of Microbac Laboratories, at [trevor.boyce@microbac.com](mailto:trevor.boyce@microbac.com).

Sincerely,



Daniel Villarreal  
Project Manager  
Microbac Laboratories, Inc. Hauser Division

**TEST REPORT**

- CLIENT:** Bryan Hauger Consulting Inc.  
4129 San Marco Dr.  
Longmont, CO 80503  
Attn: Bryan Hauger
- OBJECTIVE:** Test PVC fittings to establish if they meet or exceed the performance requirements set forth within ASTM D2665-14, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*.
- SAMPLES:** Sixteen (16) pairs of 4" PVC fittings were dropped off by the client on 4/20/2016. These fittings were 4" couplers that were all labeled as "www.HAINES MAC.com 4" PVC SCH 40 MADE IN U.S.A. PAT.PEN" directly on the insert half of the fitting pairs. The socket half of the fitting pairs were marked with numbers in a clockwise direction as follows: "0, 5, 10, 15, 20, 25, 20, 15, 10, 5".
- TESTING:** Select properties of the PVC fittings were tested for performance requirements per ASTM D2665-14, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*. All fitting pairs were labeled 1 – 16 arbitrarily by Microbac prior to any testing. One (1) pair of fittings were dimensioned using guidelines set forth within ASTM D2122-15, *Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings*. The dimensions of interest were the Average Socket Entrance Diameter, Average Socket Bottom Diameter, Minimum Socket Depth, and Minimum Wall Thickness. Dimensions were taken using calibrated micrometers and calipers. Dimensions are displayed below in Tables 1-4.
- The impact resistance was conducted on 10 fitting pairs with an impact energy of 15 ft-lbf. Each fitting pair was assembled together in the 0° orientation using heavy duty clear PVC solvent cement. Once the fitting pairs were assembled and dried, small 6" pieces of PVC pipe were then joined to each side of the fittings using the same heavy duty clear PVC solvent cement. All fitting assemblies were allowed to dry for more than 24 hours prior to testing. Testing was performed using guidelines set forth within ASTM D2444-99(2010), *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*. Testing was conducted using a 12 lb - Tup A at a height of 15 inches above the impact area of each fitting pair specimen. Samples were placed onto a type B flat plate holder with shims placed under both ends of the fittings in order to support the specimen directly under the drop tube without any free movement. Specimens were impacted at the top rigid area of the assembled fittings at 10 different locations along the fittings. Fittings were aligned and impacted at the degree indicators marked directly on the fittings. Impact locations were as follows: "0°, 5°, 10°, 15°, 20°, 25°, 20°, 15°, 10°, 5°". Detailed breakdown of the impact locations and test comments are displayed below in Table 5.
- Flattening tests were conducted on three (3) fitting pairs using a calibrated MTS servo-hydraulic test machine. Testing was performed using guidelines set forth within sections 6.3.2, *Fittings*, 7.4.2, *Fittings*, and 7.4.3, *Procedure* within ASTM D2665-14, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*. Each

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fitting pair was assembled together in the 0° orientation using heavy duty clear PVC solvent cement and allowed to dry for more than 24 hours prior to testing. Each fitting assembly was brought to contact with the platens and shimmed at both the top and bottom locations of the fittings to give a full centerline contact of the specimen before testing. Testing was performed using a test rate of 0.5 in. /min. Each fitting was loading in the compressive direction with the fitting in the upright position; with 0° towards the top platen and 25° resting on the bottom platen. Each fitting assembly was loaded until 750 lbf/ft of centerline length was achieved or first evidence of any cracking. Detailed flattening results are displayed below in Table 6.

**RESULTS:** All fitting pairs were inspected prior to any assembly or testing. All sixteen (16) fitting pairs showed an identical micro-crack/scratch between the 5° and 10° marks in the clockwise direction on the insert half of the fittings. This location was noted and not considered a failure in any of the testing performed.

**Dimensions: PASS**

All dimensions meet the tolerance of the required measurements as stated within Table 1 of ASTM D2665-14, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*.

Table 1: Dimensions of Socket half of fitting pair

Location	A. Socket Entrance Diameter	B. Socket Bottom Diameter
1	4.515	4.485
2	4.521	4.494
3	4.523	4.498
4	4.513	4.487
5	4.517	4.484
6	4.516	4.491
7	4.521	4.498
8	4.520	4.499
<b>Avg.</b>	<b>4.518</b>	<b>4.492</b>

Table 2: Dimensions of Socket half of fitting pair (cont.)

Location	C. Min Socket Depth	E. Minimum Wall Thickness
1	2.541	0.256
2	2.559	0.253
3	2.568	0.255
4	2.567	0.257
5	2.562	0.259
6	2.574	0.258
7	2.57	0.256
8	2.556	0.254
<b>Min.</b>	<b>2.541</b>	<b>0.253</b>

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Table 3: Dimensions of Insert half of fitting pair

Location	A. Socket Entrance Diameter	B. Socket Bottom Diameter
1	4.52	4.492
2	4.518	4.489
3	4.518	4.487
4	4.517	4.484
5	4.517	4.484
6	4.519	4.494
7	4.516	4.488
8	4.517	4.491
<b>Avg.</b>	<b>4.518</b>	<b>4.489</b>

Table 4: Dimensions of Insert half of fitting pair (cont.)

Location	C. Min Socket Depth	E. Minimum Wall Thickness
1	2.551	0.261
2	2.562	0.256
3	2.541	0.251
4	2.556	0.251
5	2.545	0.251
6	2.544	0.256
7	2.558	0.260
8	2.544	0.262
<b>Min.</b>	<b>2.541</b>	<b>0.251</b>

**Impact Resistance: PASS**

One (1) fitting assembly failed the minimum impact resistance of 15 ft – lbs. Nine (9) of the ten (10) total fitting assemblies passed the minimum impact resistance of 15 ft – lbs without any evidence of shattering, cracking, or breaks. The fittings meet the minimum impact requirements stated within section 6.4.1 of ASTM D2665-14, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*. The requirements within this section state: When 9 or 10 specimens pass, accept the lot.

Table 5: Impact Resistance Results

Test Replicate	Location	Observations
1	0°	Fail, micro fracture on insert half
2	5° Right	Pass
3	10° Right	Pass
4	15° Right	Pass
5	20° Right	Pass
6	25°	Pass
7	5° Left	Pass
8	10° Left	Pass

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9	15° Left	Pass
10	20° Left	Pass

**Flattening: PASS**

The fitting assemblies meet the minimum load of 750 lbf/ft of centerline length without any evidence of crushing, cracking, or breaking. All three (3) tests were terminated after 750 lbf/ft was reached as instructed in section 7.4.3, *Procedure* of ASTM D2665-14, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*.

Table 6: Loads at time of test termination

Specimen	lbf/ft
1	868.4
2	788.6
3	810.2

This lot of 4" PVC fittings meet the performance requirements of ASTM D2665-14, *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*.

**DATA REVIEWED AND  
REPORT WRITTEN BY:**

 Daniel Villarreal  
 Project Manager

**REPORT REVIEWED BY:**

 Doug Bert  
 Department Manager

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