

Water Closet Carrier with PVC Fitting

» Load/Flow Testing & the ASME Standard

The Closet Carrier Standard

The American Society of Mechanical Engineers (ASME) A112.6.1M standard establishes the minimum design and performance requirements for floor-mounted carrier systems that support wall-hung plumbing fixtures, including water closets. The standard is intended to ensure that fixture support systems (carriers) can safely withstand the loads imposed during normal public use without excessive movement, permanent deformation, or structural failure. It also describes testing procedures, so that all carriers can be rated based on consistent test parameters.

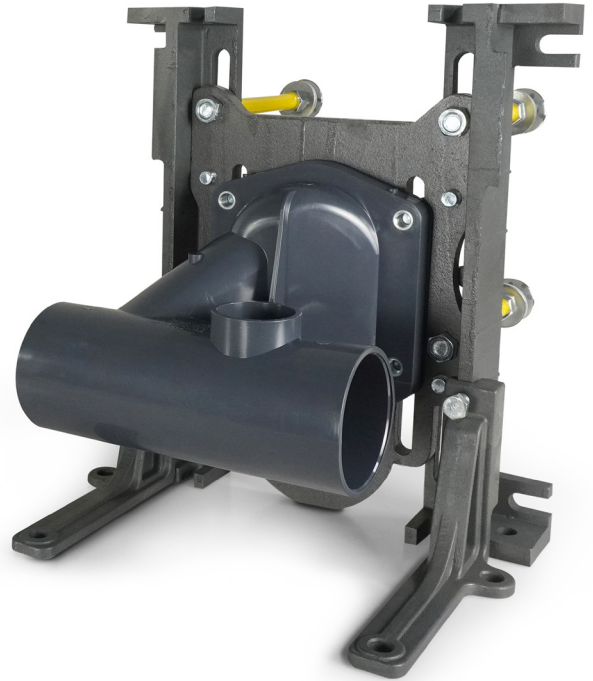
Strength and Deflection Requirements

For off-the-floor (wall-hung) water closet installations, important performance criteria are found in the Strength and Deflection section of the standard. These requirements are intended to verify that the carrier assembly, fixture attachment system, and supporting structure can adequately support occupant loads while maintaining fixture stability. Closet carrier support systems are tested according to a specifically designed setup, described in this section of the standard.

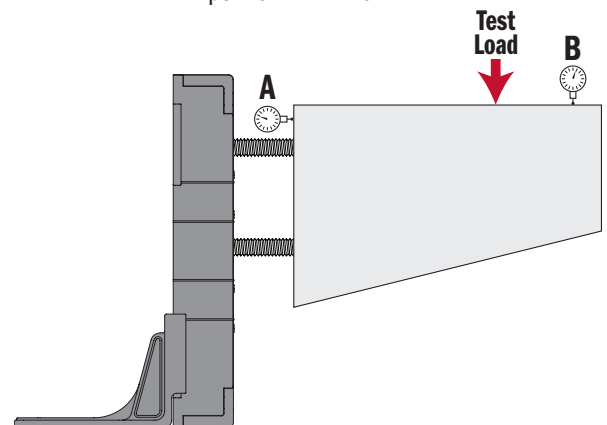
During testing, a static vertical load of 300 lbs. is applied to the fixture at a point 23" forward of the carrier faceplate, simulating the loading conditions imposed by a user seated on the fixture. Under this load, the assembly must satisfy all of the following criteria:

- No structural failure of the carrier, fittings, or attachment hardware.
- No permanent distortion or damage that would impair serviceability.
- Forward deflection at the rear of the fixture (Point A) does not exceed 0.125 in.
- Vertical deflection at the front edge of the fixture (Point B) does not exceed 0.375 in.

These limits are intended to control both the perceived stability of the fixture and the stresses transferred to the vitreous china bowl, carrier fittings, wall system, and building structure. Excessive movement can lead to fixture cracking, loosening of fasteners, seal failures, or occupant concerns regarding fixture safety.



Deflection Test Setup per ASME A112.6.1M



» Strength & Deflection Test Criteria		
Test Load	Max Deflection	
	Point [A]	Point [B]
300 lbs. (136 kg)	0.125" (3.2 mm)	0.375" (9.5 mm)

Practical Significance

These criteria establish the *minimum* structural performance expected of water closet carrier systems and remain the benchmark for carrier design. Compliance with ASME A112.6.1M demonstrates that a water closet carrier system has been tested as a complete support assembly and can safely support the prescribed loading conditions while maintaining acceptable rigidity.

Note: The standard does not evaluate the strength of the wall structure itself and proper installation in accordance with the manufacturer's instructions and applicable building and plumbing codes remains essential to achieve the intended performance.

Beyond the Standard

While the strength and deflection test described in the standard uses a load of 300 lbs. for water closet carriers, many manufacturers have gone above this – applying heavier loads, and rating their carrier systems for 500 lbs. and even 1,000 lbs. for bariatric applications. Carrier systems rated to these higher loads are held to the same performance requirements described earlier.

Sioux Chief Design

Sioux Chief developed the industry's first polymer fitting for use with closet carrier systems in an effort to improve carrier installations and to reduce the overall weight (and imported materials) associated with carriers.

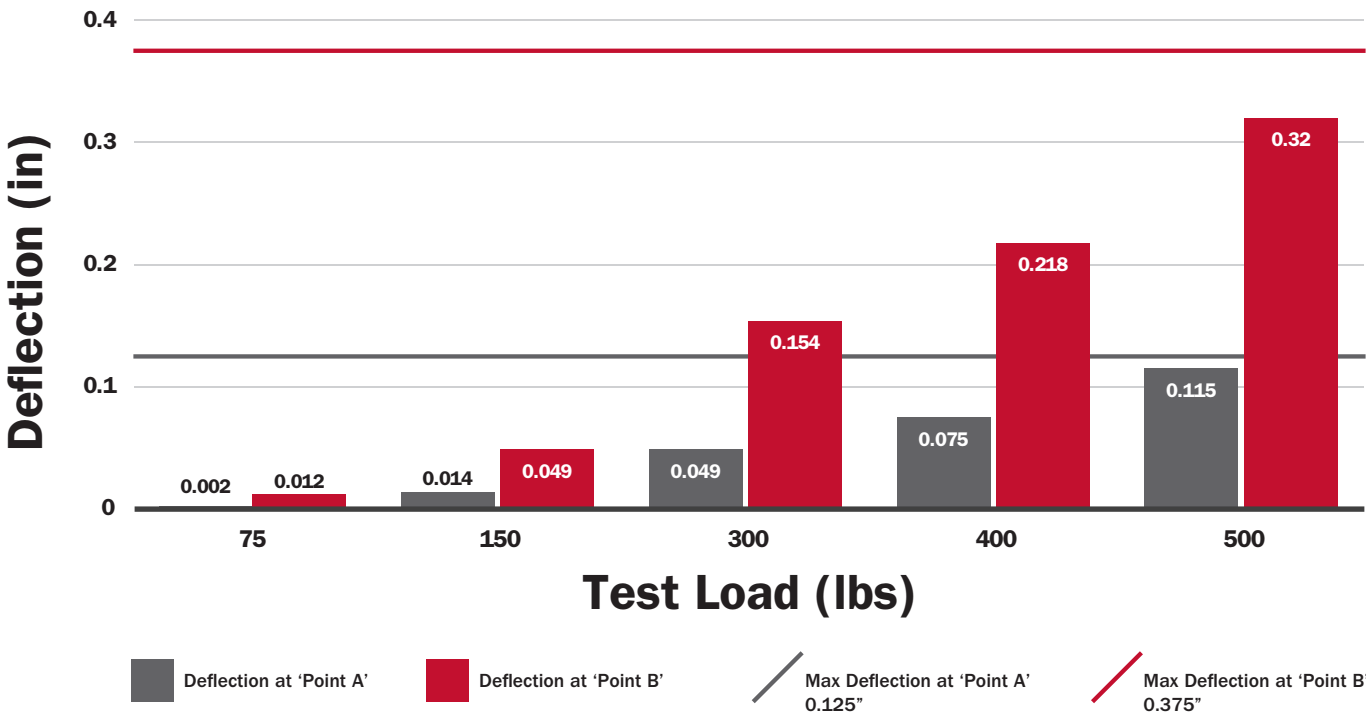


The Sioux Chief carrier system is designed specifically for use with this patented¹ PVC fitting. The cast iron support components are engineered to withstand the applied loads without the use of a rear anchor. Unlike most cast iron fittings that include a lug on the backside for a rear anchor, the PVC carrier fitting is not designed to attach to a rear anchor - which would create undue stress on the fitting and connections. This means when a PVC fitting is used, the load must be supported completely by the legs and faceplate. Sioux Chief designed the carrier legs to be strong and rigid, with multiple anchoring points.

1 US Patent No. 12,644,269

Fig. 1

Deflection Test Results
Sioux Chief Closet Carrier with PVC Fitting



'Point A' = Back of fixture, moving forward | 'Point B' = Front of fixture, moving down

The legs are also designed to be reinforced by gussets, which attach to the lower portion of the legs and anchor to the floor. The additional support provided by the gussets allows the carrier with PVC fitting to withstand the required loads, even without a rear anchor.

Load Testing the Design

The test results in Fig. 1 show the deflection amounts for the Sioux Chief carrier design with PVC fitting under increasing weight loads. Testing was performed per the ASME standard described earlier - with the faceplate, legs and gussets assembled and anchored to the floor.

As indicated by the chart, the amount of deflection at both measured points stays under the maximum allowed by standard for loads up to and including 500 lbs. These results allow Sioux Chief to approve the carrier system with PVC fitting for loads up to 500 lbs.

Load Test Comparison

Similar load testing was then conducted on five other manufacturers' standard carrier systems. These carrier systems all incorporated cast iron fittings and rear anchors. They were all subjected to the same test loads and methods as used to test the Sioux Chief design.

Fig. 2 compares the point of failure² for the five competitor systems and the Sioux Chief system. The Sioux Chief carrier with PVC fitting exceeded the maximum deflection for Point B at 515 lbs. The average load at the point of failure for competitor systems was 333.2 lbs., which is ~35% lower than the Sioux Chief system.

Flow Testing

Although the ASME Standard for closet carriers does not include requirements for toilet flow performance, collecting water/waste from the toilet and directing it into the drainage system is an important role for a carrier fitting. The smooth walls of the PVC carrier fitting can help perform this role better and more efficiently than traditional cast iron fittings.

The idea that PVC has better flow characteristics is based on the smoothness of the surface. PVC has a smoother surface than cast iron, and when measuring flow, the surface texture affects the result. Flow velocity in a drain pipe is usually



Gussets are attached to reinforce the legs and provide additional anchor points

Load Test Comparison

Sioux Chief Closet Carrier with PVC Fitting vs. Standard Competitor Systems

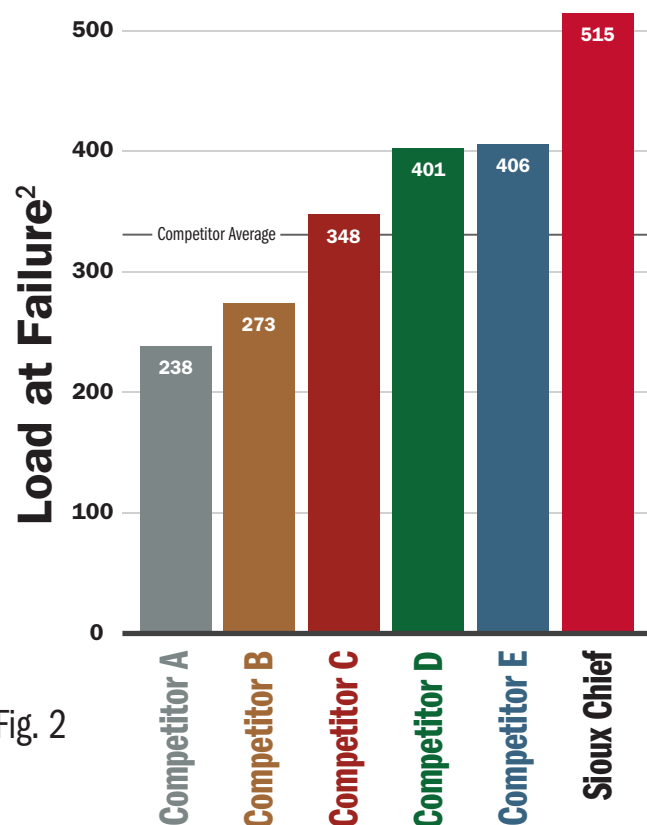


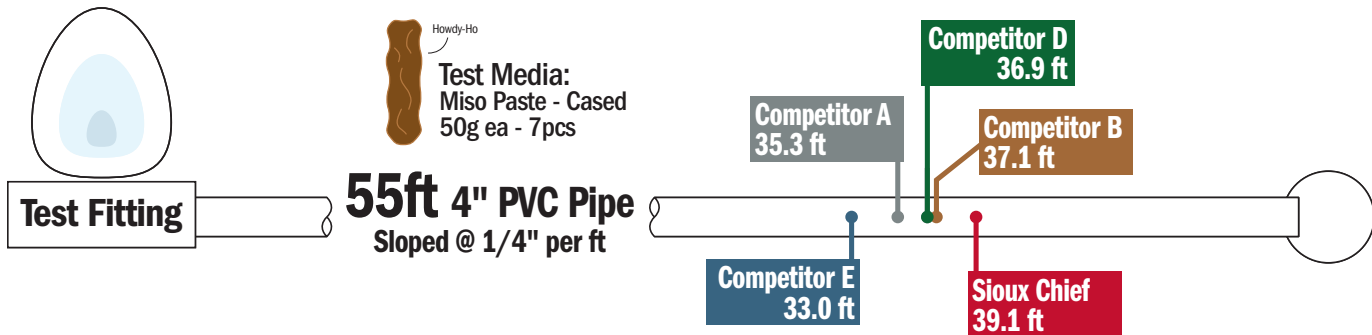
Fig. 2

Competitor results apply to the 'standard' models tested and should not be interpreted as representative of every product offered by other manufacturers

² Failure was considered the weight at which deflection at either Point A or Point B was greater than the max acceptable amount

Flow Comparison

Sioux Chief Closet Carrier with PVC Fitting vs. Standard Cast Iron Fittings



measured using Manning's Equation. One of the variables in that equation is a 'roughness coefficient', which represents the resistance created by the surface being flowed over. Below are commonly accepted roughness coefficients for cast iron and PVC (pipes), based on standard³ hydraulic references:

PVC = 0.009 – 0.011 = Very smooth interior
(0.009 is often used for new pipe)

Cast Iron (new, unlined) = 0.011 – 0.013
(Depends on surface quality)

Cast Iron (old) = 0.013 – 0.015+
(Accounts for corrosion, or buildup)

Although actual flow performance depends on fitting geometry and other conditions, in short, all else being equal, the lower roughness coefficient commonly assigned to PVC results in a higher calculated flow velocity than for cast iron.

To test the PVC carrier fitting's ability to effectively transport waste from the toilet to the drain line, comparison flow tests were conducted. Both the Sioux Chief PVC carrier fitting and cast iron carrier fittings from four other manufacturers were connected to a 1.6 gpf toilet. The fittings were then connected to 55 feet of 4" PVC drain pipe. Flow testing was done using test media as defined by (and purchased from) the Maximum Performance (MaP) testing program. During the test, 350 grams of media (seven pieces, 50 grams each) was

flushed and tracked through the drain system. The average distance the test media traveled down the drain pipe is reflected in the chart above. The smooth inner walls and engineered shape of the Sioux Chief PVC fitting helped deliver more of the test media farther along the drain line than the systems with cast iron fittings.

Additional Features

The PVC fitting also provides several benefits beyond the load and flow performance described earlier.

The PVC carrier fitting is substantially lighter than a cast iron counterpart, which reduces the overall weight of a closet carrier by 14%. This can make carriers easier to ship, handle, prefab, and install.

Sioux Chief PVC carrier fittings are injection-molded in Shawnee, Kansas. The tough, durable PVC material is corrosion-resistant, impervious to sewer gases, and rated V-0 per UL94.

Fittings also incorporate a 2" Sch. 40 hub vent connection. This makes connecting PVC vent pipe faster and easier, and eliminates the need for a No-Hub coupling.

More Information

For more information on the Sioux Chief PVC carrier fitting, please visit siouxchief.com, or contact your local Sioux Chief representative.

³ ASCE, FHWA, and engineering handbooks

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