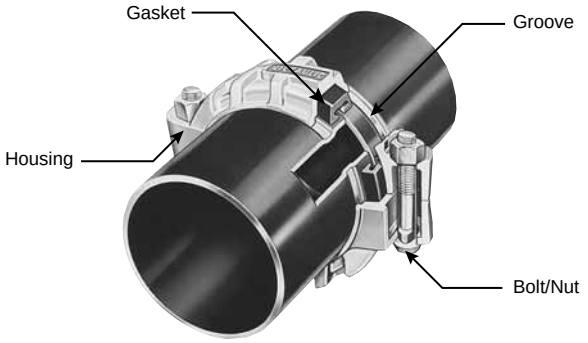
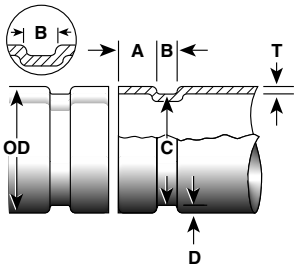
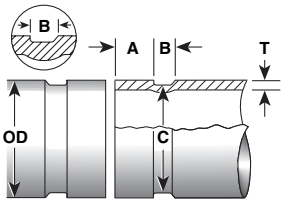
ANATOMY OF A GROOVED PIPE JOINT



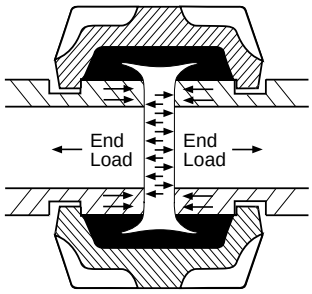


Standard Groove

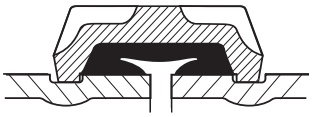


Exaggerated for Clarity

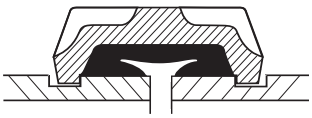
AGS Advanced Groove System Groove



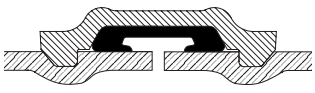
Standard Roll Grooved



Cut Grooved



AGS Roll Grooved



Exaggerated for Clarity

The grooved piping system has been around for over 80 years, providing fast, easy, reliable piping assembly. While technology has changed application parameters – cut grooving to roll grooving, standard pipe to light wall pipe, joints only to a complete system – the basic nature of grooved joint construction has stood the test of time.

In 1925, as now, there were four basic components – the groove, the gasket, the housings and the bolts/nuts.

The initial development of the “grooved system” began with the manufacturing of pipe with an expanded end or shoulder. The shoulder provided, as does the groove, an area for the coupling to fully engage the pipe. The manufactured pipe end was satisfactory for long military field runs but did not lend itself to commercial uses.

With the advent of Victaulic Company of America in 1925, specifications were set for cutting a groove in the pipe and redesigning housings to the smaller size, also necessary to move from metric Imperial to NPS sizes. Definitive guides were set for the “A” dimension (gasket seating area), “B” dimension (groove width) and the critical dimension “C” or groove diameter.

Each dimension was calculated based on practical engineering considerations. The “A” area had to accommodate the full width of the gasket seat with an allowance for movement allowed by the “B” dimension. The groove had to be sufficiently back from the pipe end to provide full end load strength and accommodate longitudinal and lateral stress from internal pressure and external forces.

The “B” dimension was largely sized to easily accommodate the housing key section. This is the coupling area that engages the groove around the full circumference to prevent separation of the pipes under pressure. It also was sized wider than the key section to allow limited pipe movement (expansion/contraction/deflection) with the Style 77 flexible coupling which was the standard until the 1980’s.

As mentioned, the “C” dimension is critical. This must be concentric with the pipe O.D., sufficiently deep to provide proper engagement of the coupling key for end load restraint and shallow enough to not weaken the pipe. Working from existing threading standards, the depth of which were set for the same reasons, a standard was set at slightly less depth than the thread located just outside a fitting.

In 2005, Victaulic Company developed the Advanced Groove System (AGS), specifically designed for 14 – 24" (350 – 600 mm) piping systems. The wider, deeper groove design of AGS and a two-piece coupling housing combine to provide consistent, higher pressure performance.

Pipe Materials

The standards for groove dimensions were established in the 1940’s, however, it was not until 1978 that a committee of the American Water Works Association (AWWA) accepted and published standards for both NPS (steel, aluminum, brass and others) and AWWA-sized cast and ductile iron pipe. This was subsequently revised to include roll groove dimensions and codified as ANSI/AWWA C-606 Standard for Grooved and Shouldered Joints.

The Victaulic system is applicable to a wide variety of pipe materials including: steel (Schedule 5, 10, 20, 40, 80) both black and galvanized, also rubber lined, glass lined or coated; stainless steel (Schedule 5S, 10S, 40S); various steel alloys; aluminum – alloy grades 6061 T4/6064 T4 (Schedule 80 cut and Schedule 40 roll or cut grooved); PVC plastic - ASTM D-1785, Type 1, Grade I (PVC 1120) at +100°F maximum; FRP plastic with adapting collar; HDP high density polyethylene – ASTM D-2447, D-3000, D-3035 or F-714, SDR 35 to 7.3 at +70°F; copper (CTS) Type K, L, M or DWV; AWWA ductile – Class 53 and heavier, to ANSI/AWWA C-606. For others, contact Victaulic.

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Canada • Phone: 905-884-7444 • Fax: 905-884-9774 • e-mail: viccanada@victaulic.com
Europe • Phone: 32-9-381-1500 • Fax: 32-9-380-4438 • e-mail: viceuro@victaulic.be
UK • Phone: 44(0)1438741100 • Fax: 44(0)1438313883 • e-mail: viceuro@victaulic.be
Central and South America • Phone: 610-559-3300 • Fax: 610-559-3608 • e-mail: vical@victaulic.com
Australasia • Phone: 86-21-58855151 • Fax: 86-21-58851298 • e-mail: vicap@victaulic.com

THE GASKET

The unique, C-shaped, pressure-responsive gasket design has been the heart of the grooved system since its inception. Relying on compound resiliency and the initially flared design, the gasket seals on the “A” dimension of the pipe O.D. This design accommodates the pipe movement noted, while sealing under both pressure and vacuum.

During assembly, the gasket is slightly stretched over the pipe ends, applying the natural compression of the angled lips as well as the resiliency of the entire gasket body. (It is important to note that grooved coupling gaskets always should be lubricated on the lips and the outside back before assembly. See the specific product submittals and installation instructions for further details.) This places the lips in immediate sealing compression on the pipe O.D.

Assembly of the coupling housing over the gasket mates it closely to the gasket back, fully encasing the gasket with a backbone of ductile iron. With the bolt pads fully tightened this adds additional compressive force without full compression, leaving the natural resiliency as an active sealing force within the joint. The full encasement of the gasket prevents any extrusion of the rubber under high pressure.

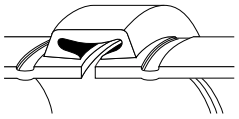
The final sealing factor is the pressure (or vacuum) in the line. Pressure tends to press the lips more securely onto the pipe O.D. Likewise, vacuum draws on the center of the gasket also forcing the lips to a tighter seal. (Under vacuum service greater than 10" of mercury, a metal liner insert or FlushSeal® gasket is recommended to control the drawing action.)

Gaskets are carefully molded in patterns conforming closely to the inside containment area of the housing. This allows the separate components to mate to form an integral coupling unit with the combination of efficient sealing and effective end load resistance to handle pressures as high as 4000 psi (27576 kPa).

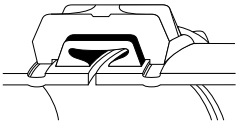
Originally molded of natural rubber, the gasket was excellent for ambient water and abrasive systems, often encountered in the early mining, military and municipal water applications. The gradual advent of more synthetic rubber compounds during and after World War II expanded the potential for the grooved system.

Available rubber compounds now include the standard gasket EPDM (ethylene propylene diene monomer) for water (to +230°F/+110°C) and a nitrile compound gasket for oil services (to +180°F/+82°C). Special gaskets include fluoroelastomer, neoprene, silicone, white nitrile and epichlorohydrin.

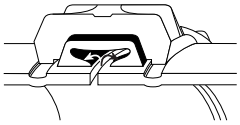
Unique C-shaped gasket forms a triple seal.



Seals between the pipe ends and the groove.



Surrounded, reinforced and slightly compressed by the housing.



Seal is enhanced by pressure or vaccum in the line.

THE HOUSING

Style 07 Rigid

Style 77 Flexible

AGS Coupling

Standard coupling housings are cast of ductile iron to ASTM A- 536, Grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request. Ductile iron was chosen because of its special combination of better physical characteristics and relative ease of manufacturing to demanding standards. The 65-45-12 refers to the 65,000 psi (448110 kPa) minimum tensile strength, 45,000 psi (310230 kPa) minimum yield strength and 12% minimum elongation. This compares favorably with A53ERW steel pipe having minimum tensile of 60,000 psi (413640 kPa), 35,000 psi (241290 kPa) yield and 25% elongation (typical).

Housings are normally two identical castings for couplings through 24" (600 mm) sizes. From 26" (650 mm) up through 102" (2600 mm) sizes, coupling housings are cast in multiple identical segments for assurance of concentricity and ease of handling.

Regardless of the style and pressure ratings, certain basic criteria remain for all grooved pipe couplings. The housing is designed to provide the optimum combination of pressure and end load conditions while maintaining reasonable weight and manufacturing characteristics. Every grooved pipe “coupling”, be it a flange adapter, reducing coupling, outlet, rigid or flexible coupling has a similar key section. This engages fully into the groove tying the joint integrally to the pipe.

Housing Materials
Testing

Product testing is thorough and continuous during the manufacturing process and after, to assure final product performance. Quality control starts with testing raw materials with spectrochemical and physical analysis, computerized spectrographic and carbon-sulphur analysis. Daily tensile, metallographic and impact tests are performed.

Finished casting integrity is checked by hydrostatic, air bend and Brinell testing, as well as radiography and magnetic particle testing. Products are gauged and, where appropriate, precision dimensions are verified on our optical comparator.

Finished product checks include 100% hydrostatic testing of all valves. Flow tests are run on appropriate products on our own test loop which is calibrated to NBS standards. Test loops have been in operation since 1970 to simulate 24 hour field operating conditions for various temperatures and fluids.

STANDARD PRODUCT MATERIALS

Victaulic piping products are available in a variety of materials for assembling pipe of widely varied types. While basic couplings, fittings, valves and accessories are cast of ductile iron, many options are available as outlined below. Always check specific product submittal data for full materials specifications. For gasket materials, refer to the Gasket Selection, Section 05.01.

Ductile Iron

Standard ductile iron to ASTM A-536 (Grade 65-45-12) is the primary metal used for casting couplings, housings, fittings, valves, valve discs and accessory bodies.Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

- Standard coating – alkyd enamel paint
- Optional coating – hot dip galvanizing to ASTM A-153 or zinc electroplating to ASTM B-633 (depending on product)

NOTE: Certain specialized castings may optionally be supplied in malleable iron to ASTM A-47 (Grade 32510); specialized fittings may be forged steel conforming to ASTM A-234 Grade WPB or segmentally welded carbon steel pipe conforming to: $^{3}/_{4}$ - $3^{1}/_{2}$" (20 - 90 mm) ASTM, A-53, Type F; 4- 10" (100 - 250 mm) ASTM A-53, Type E or S, Grade B; 12 - 24" (300 - 600 mm) 0.375" wall to ASTM A-53, Type E or S, Grade B.

Bolts and nuts are heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

Stainless Steel

Stainless steel couplings and valve bodies are cast of Type 316 stainless steel, conforming to ASTM A-351, A-743, A-744, Grade CF-8M.

- Optional – Type 304 stainless steel, conforming to ASTM A-351, Grade CF-8

Bolts and nuts are Type 316 stainless steel, oval neck track bolts and heavy hex nuts with chemical and physical properties of ASTM F-593, Group 2, Condition CW.

Fittings are Schedule 10 316 (Schedule 5 or 40 and Type 304 available options), made from material conforming to ASTM A-403. Certain configurations requiring fabrication are made from pipe to ASTM A-312.

Aluminum

Aluminum couplings are cast of aluminum alloy 356-T6 to ASTM B-26.

Fittings are cast of aluminum alloy 356-T6 to ASTM B-26 or segmentally fabricated from aluminum pipe conforming to ASTM B-241, alloy 6061-T6, Schedule 40; nipples to ASTM B-210 alloy 6061-T6 or 6063-T6, Schedule 40.

Copper (CTS)

Copper tubing (CTS) coupling housings are cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) and ASTM A-395 (Grade 65-45-15) with a copper colored alkyd enamel coating.

Fittings are made from drawn seamless copper tube conforming to ASTM B-75 C 12200 or fabricated from ASTM B-152 C 11000 or bronze sand castings conforming to ASTM B-584 copper alloy C83600 (85-5-5-5).

Valve bodies are cast bronze per alloy C83600 (85-5-5-5).

AWWA

AWWA couplings and fittings are cast of ductile iron with plated bolts and nuts as above.

Fittings conform to specific requirements as outlined in the AWWA Products Section 23.05.

BOLTS AND NUTS

The bolts/nuts secure the entire joint together. Unlike flanged systems, the bolts are not taking the primary load, nor are they functional in the sealing process. The bolts hold the coupling housings into the grooves and contain the gaskets. Once tightened (metal-to-metal, with an offset on rigid couplings), the bolts require no further tightening. There are no torque specifications for most grooved couplings as with flange bolts.

The standard bolt head is an oval-neck configuration conforming to openings in the housing bolt pads. This permits tightening the nuts from one side without a backup wrench.

Track head bolts and nuts conform to ASTM A-183 minimum tensile 110,000 psi (758340 kPa). Plated (to ASTM B-633) bolts and nuts are standard on most couplings.

Metric bolts/nuts are available for most coupling styles. Metric bolts are gold chromate color coded to differentiate from standard U.S. bolts.

Specify “Metric Plated Bolts & Nuts” when desired. Standard U.S. bolts/nuts are identified as: “UNC Plated Bolts & Nuts” or “UNC Black Bolts & Nuts”.