



Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications¹

This standard is issued under the fixed designation F1476; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification provides the performance characteristics and qualification tests required for gasketed mechanical couplings including grooved-type mechanical couplings for grooved end pipe, mechanical restraint couplings for plain end pipe and mechanical compression couplings for plain end pipe. These couplings are for use at temperatures within the recommended temperature range of their respective gaskets. Consult manufacturer for details.

1.2 The values stated in metric units (SI) are to be regarded as the standard. The values given in parentheses (inch/pound) are provided for information purposes.

1.3 Measuring and test equipment (M&TE) used in the performance of the tests described herein shall be calibrated using equipment which is traceable to the National Institute of Standards and Technology (NIST) or calibrated in accordance with the requirements detailed in BS 5781 Part 1 against standards traceable to National Standards.

1.4 As this is not a dimensional standard, nor does it contain component dimensions, the intermixing of sub-components such as gaskets and housings between manufacturers is not recommended and constitutes non-conformance with this standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- A47/A47M Specification for Ferritic Malleable Iron Castings
- A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A135 Specification for Electric-Resistance-Welded Steel Pipe
- A153/A153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- A183 Specification for Carbon Steel Track Bolts and Nuts
- A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- A194/A194M Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- A325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A395/A395M Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
- A536 Specification for Ductile Iron Castings
- A563 Specification for Carbon and Alloy Steel Nuts
- A574 Specification for Alloy Steel Socket-Head Cap Screws
- A743/A743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- B26/B26M Specification for Aluminum-Alloy Sand Castings
- B88 Specification for Seamless Copper Water Tube
- B580 Specification for Anodic Oxide Coatings on Aluminum
- B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- D2000 Classification System for Rubber Products in Automotive Applications

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

F837 Specification for Stainless Steel Socket Head Cap Screws

2.2 ANSI, ANSI/ASQC, or ANSI/AWWA Standards:³

B 36.10 Welded and Seamless Wrought Steel Pipe

B 36.19 Stainless Steel Pipe

C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

C606 Grooved and Shouldered Joints

Z 1.4 Sampling Procedures and Tables for Inspection by Attributes

Z 540.1 Calibration Laboratories in Measuring Test Equipment

2.3 NFPA Standards:⁴

NFPA 13 Sprinkler Systems

2.4 British Standards:⁵

BS 1706 Method for Specifying Electro Plated Coatings of Zinc and Cadmium on Iron and Steel

BS 2494 Specification for Elastomeric Seals for Joints in Pipework and Pipelines

BS 5781 (IEC 550) Measurement and Calibration Systems

BS 6104 Mechanical Properties of Fasteners

BS 6105 (ISO 3506) Corrosion Resistant Stainless Steel Fasteners

3. Terminology

3.1 Definitions:

3.1.1 *class*—differentiates joint characteristics such as rigid, flexible, restrained and unrestrained.

3.1.2 *failure*—any leakage or joint separation, unless otherwise determined to be due to a pipe or fitting defect.

3.1.3 *fitting*—a device used to change pipe direction, size or adapt to other joining methods. This device is used with pipe or other fittings to create a working system. Shapes such as elbows, tees, crosses, reducers and special shapes are used as needed to fulfill system design specifications.

3.1.4 *flexible*—characteristic of a joint wherein there is available limited angular and axial pipe movement.

3.1.5 *gasketed mechanical coupling (GMC)*—a device used to join pipe to pipe, pipe to fitting, or fitting to fitting wherein an elastomeric (gasket) is used to seal the joint. Coupling may or may not provide mechanical restraint of the pipe or fitting.

3.1.6 *grade*—the joint working pressure as established by tests using representative pipe or tube and the gasketed mechanical coupling (GMC). Test pipe or tube shall be:

NPS—Standard Weight Steel Pipe per ANSI B 36.10 and Specification A53/A53M Grade B, or Specification A135 Grade B.

AWWA—Class 53 Ductile Iron Pipe per ANSI/AWWA C151/A21.51 for 3 to 16 in. For other sizes, consult manufacturer.

Tubing—Type K Copper Tube per Specification B88.

Other—As agreed to by GMC manufacturer and purchaser.

3.1.7 *grooved mechanical coupling (Type I)*—a device which consists of two or more housings, closure members such as sets of bolts and nuts or pins, and a pressure-responsive gasket. It is used to mechanically join and seal grooved pipe or fitting, forming a joint. Grooves conform to ANSI/AWWA Standard C606 – 87 as applicable. Groove dimensions for tubing and other sizes and types of pipes shall be as specified by the manufacturer. See Fig. 1.

3.1.7.1 *grooved mechanical coupling housing*—the structural parts of a grooved mechanical coupling which mechanically fit into pipe or fitting grooves providing mechanical pipe or fitting restraint and enclosure of the gasket.

3.1.8 *plain end mechanical coupling:*

3.1.8.1 (*Type II—Classes 1 and 2*)—Device consisting of gasket(s), housing(s), sleeve(s), end rings, threaded fasteners, pipe or fitting anchoring (gripping) features and seal retainers as applicable. These devices are used to create a seal and restrain plain end pipe or fittings. See Fig. 2 and Fig. 3.

3.1.8.2 (*Type II—Class 3*)—Device consisting of gasket(s), housing(s), sleeve, end rings and threaded fasteners as applicable. Tightening of the fasteners compresses the gasket(s), creating a seal on the outside of the plain end pipe. See Fig. 4.

3.1.9 *joint*—interface formed between pipe and pipe, pipe and fitting, or fitting and fitting where a GMC is used to seal within a specified working pressure this interface and where applicable, provide mechanical holding strength.

3.1.10 *joint pressure rating*—the working pressure for the joint on the pipe or fitting material and thickness to be used in the actual piping application.

3.1.11 *leakage*—the escape of fluid (gaseous or liquid) from any point of the specimen.

3.1.12 *penalty run*—a penalty run is performed with penalty run specimens when the original test specimen leaks or

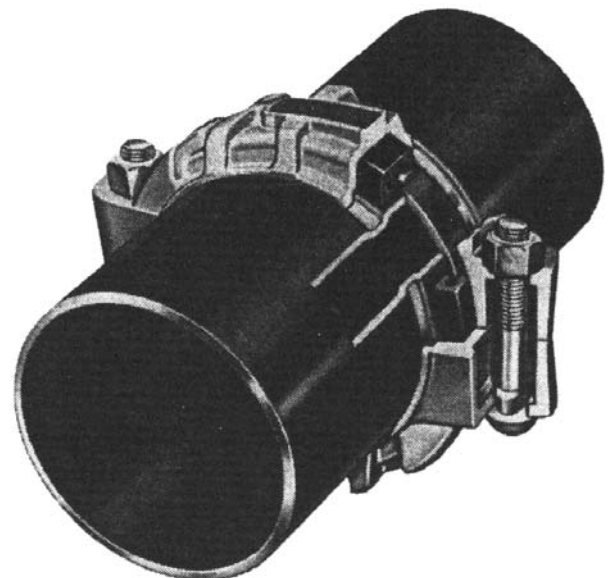


FIG. 1 Type I Typical Construction

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁴ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁵ Available from British Standards Institute (BSI), 389 Chiswick High Rd., London W4 4AL, U.K., <http://www.bsi-global.com>.

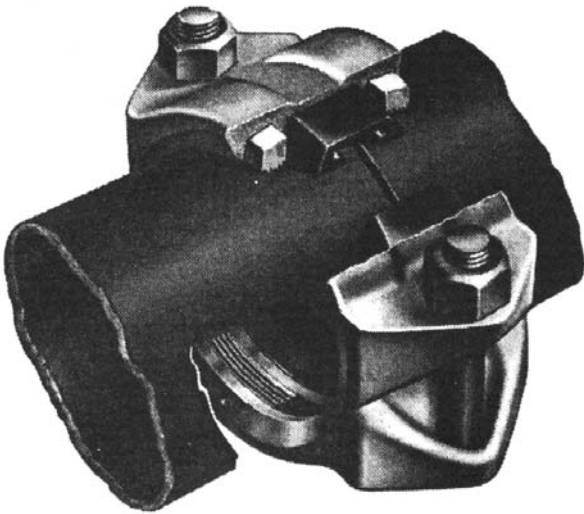


FIG. 2 Type II—Class 1 Typical Construction

capabilities; that is, additional pressure results in additional force between the gasket and the surface to which it is sealing.

3.1.16 *restrained*—characteristic of the joint wherein thrust loads generated by internal pressure or external means are absorbed within the joint.

3.1.17 *rigid*—characteristic of a joint where there is essentially no available free angular or axial pipe movement.

3.1.18 *specimen*—a prepared assembly consisting of the test joint including GMC and pipes or fittings. The specimen is placed into a controlled environment and tested to determine if the joint performs to the standards established by the test.

3.1.19 *type*—differentiation of kind of pipe or fitting which gasketed mechanical couplings (GMC) are used to join (that is, grooved or plain end).

3.1.20 *unrestrained*—characteristic of a joint wherein thrust generated by internal pressure or external means is not absorbed by the joint but by other means such as pipe anchors or thrust blocks.

4. Classification

4.1 Gasketed mechanical couplings (GMC) are classified into the following design types:

4.1.1 Type I grooved mechanical couplings.

4.1.2 Type II plain end mechanical couplings.

4.2 The gasketed mechanical couplings (GMC) are classified into various grades based on successful completion of testing defined herein. Grades range from approximately 100 psi to 4000 psi and vary by GMC manufacturer. Consult GMC manufacturer for specific grades available.

4.3 The gasketed mechanical couplings (GMC) are classified by the following joint characteristics:

4.3.1 Class 1—rigid and restrained.

4.3.2 Class 2—flexible and restrained.

4.3.3 Class 3—flexible and unrestrained.

5. Ordering Information

5.1 Orders for GMC (Gasketed Mechanical Couplings) under this specification shall include the following:

5.1.1 ASTM designation, title, number and year of issue,

5.1.2 Quantity (number of gasketed mechanical couplings),

5.1.3 Size and appropriate suffix (examples: 8 in. NPS, 76.1 mm OD),

5.1.4 Type (I, II),

5.1.5 Grade (consult GMC manufacturer),

5.1.6 Class (joint characteristic),

5.1.7 Housing material and finish,

5.1.8 Gasket material,

5.1.9 Bolt (stud) and nut material and finish,

5.1.10 Supplementary requirements, if any,

5.1.11 Other requirements agreed to between purchaser and GMC manufacturer.

5.2 *Optional Ordering Requirements:*

5.2.1 Certification requirements,

5.2.2 Special marking requirements.



FIG. 3 Type II—Class 2 Typical Construction

separates during testing as a result of any cause which is not related to the design of the GMC being qualified.

3.1.13 *penalty run specimens*—additional specimen(s) which are tested in the place of the original specimen(s). These additional specimen(s) are assembled using the same methods along with additional GMC's of the same type, grade, class, and configuration; and additional pipes or fittings with the same sizes, nominal wall thickness material and material condition as the original test specimen.

3.1.14 *pipe*—hollow tubular products conforming to ANSI B 36.10 and B 36.19, ANSI/AWWA C151/A21.51 Nominal Dimensions, or O.D. tube sizes.

3.1.15 *pressure responsive gasket*—gasket design such that application of a pressure load to the gasket enhances its sealing



FIG. 4 Type II—Class 3 Typical Construction

6. Materials and Manufacture

6.1 Type I—Grooved Mechanical Coupling:

6.1.1 Grooved Mechanical Coupling Housings:

6.1.1.1 *Ferrous Materials*—Housings shall be constructed of ductile iron in accordance with Specification **A395/A395M** Grade 60–40–18 or 65–45–15, Specification **A536**, Grade 65-45-12 or malleable iron in accordance with Specification **A47/A47M**, Grade 32510 or 35018.

6.1.1.2 Grooved mechanical coupling housings shall be coated with the manufacturer's standard preparation and paint, or at the purchaser's option, hot-dip galvanized in accordance with Specification **A153/A153M**, or other finish as agreed upon between purchaser and manufacturer.

6.1.1.3 *Aluminum Alloy Materials*—Housings shall be constructed of aluminum alloy in accordance with Specification **B26/B26M**, Grade 356-T6 or A 356-T6.

6.1.1.4 Finish for aluminum alloy housings shall be bare, anodized in accordance with Specification **B580** or as otherwise agreed between purchaser and manufacturer.

6.1.1.5 *Iron-chromium-nickel, corrosion resistant material:* Housings shall be constructed of iron-chromium-nickel alloy in accordance with Specification **A743/A743M**, Grade CF-8 or Grade CF-8M.

6.1.1.6 Finish for iron-chromium-nickel shall be bare or otherwise agreed between purchaser and manufacturer.

6.1.2 *Grooved Mechanical Coupling*—Gaskets shall be of materials suitable for the intended service. Elastomers shall comply with Classification System **D2000**.

6.1.3 Grooved Mechanical Coupling—Bolting:

6.1.3.1 *Carbon Steel Material*—Bolts shall be in accordance with Specification **A183**, Grade 2, Oval Neck. Nuts shall be in

accordance with Specification **A194/A194M**, Grade 2. Finish shall be black or at the purchaser's option, zinc electroplated to Specification **B633**.

6.1.3.2 *Corrosion Resistant Material*—Bolts shall be in accordance with Specification **A193/A193M**, Grade B8, Class 2 (AISI Type 304) or Specification **A193/A193M**, Grade B8M, Class 2 (AISI Type 316). Nuts shall be in accordance with Specification **A194/A194M** Grade 8.

6.2 Type II—Plain End Mechanical Coupling:

6.2.1 *Plain End Mechanical Coupling Housings or Center Sleeves:*

6.2.1.1 *Cast Ferrous Materials*—Cast housings or center sleeves shall be constructed of ductile iron in accordance with Specification **A395/A395M** Grade 60–40–18 or 65–45–15, Specification **A536**, Grade 65-45-12 or malleable iron in accordance with Specification **A47/A47M**, Grade 32510 or 35018.

6.2.1.2 *Steel Materials*—End rings and sleeves made from carbon or stainless steel shall be made from material with a minimum yield strength of 172 MPa (25,000 PSI).

6.2.1.3 Plain end mechanical couplings shall be coated with the manufacturer's standard preparation and paint or other finish as agreed upon between the purchaser and manufacturer. Finish for iron chromium-nickel parts shall be bare or otherwise agreed upon between purchaser and manufacturer.

6.2.2 *Plain End Mechanical Coupling*—Gaskets shall be of materials suitable for the intended service (consult manufacturer for recommendation). Elastomer shall comply with Classification System **D2000** or BS 2494.

6.2.3 Plain End Mechanical Coupling—Bolting:

6.2.3.1 *Carbon Steel Material*—Bolts shall be in accordance with Specification **A183**, Grade 2, Oval Neck or Specification **A325**—Type 2 Heavy Hex; Cap screws shall be in accordance with Specification **A574** or BS 6104; Female threaded parts, other than nuts, shall be in accordance with Specification **A183**, Grade 2; Nuts, if required, shall conform to Specification **A183**, Grade 2 or Specification **A563**—Grade C₃ or DH₃, or as otherwise agreed by purchaser and manufacturer. Finish shall be zinc electroplated to Specification **B633** or BS 1706.

6.2.3.2 *Corrosion Resistant Material*—Bolts or threaded female parts other than nuts shall be in accordance with Specification **A193/A193M**, Grade B8, Class 2 (AISI Type 304) or Grade B8M, Class 2 (AISI Type 316); Cap screws shall be in accordance with **F837** or BS 6105; Nuts, if required, shall be in accordance with Specification **A194/A194M**, Grade 8 or as agreed upon by purchaser and manufacturer.

6.3 *Other Materials*—Where other materials are required, the material and mechanical properties of the product shall be as agreed upon by the GMC manufacturer and the purchaser.

6.4 Material Quality:

6.4.1 The material shall be of such quality and purity that the finished product shall have the properties and characteristics to meet the performance requirements of this standard.

6.4.2 The manufacturer is encouraged to use materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term “recovered materials” means: “Materials which have been collected or recovered from solid waste and reprocessed to become a source of raw material, as opposed to virgin raw materials.” Used or rebuilt products shall not be used.

7. Other Requirements

7.1 Testing Requirements:

7.1.1 GMC shall be subjected to the tests described in the Annex for the purpose of qualifying the GMC design.

7.1.2 These tests shall be repeated when changes are made in the design, material, or manufacturing process that degrade the performance of the GMC. Degradation determination is to be made by the manufacturer or at agreement between the manufacturer and purchaser.

7.2 Qualification Requirements:

7.2.1 GMC shall be qualified using specimens of the same type, grade and class. Each type, grade, and class shall be tested in order to qualify the design. Qualification of the GMC requires successful completion of required testing. Each GMC design is only qualified for use on the pipe or fitting material and wall thickness on which it was tested.

7.2.2 All GMC’s tested shall be comprised of an equal number of specimens from the smallest, most intermediate size, and largest sizes within the size range of the GMC being qualified.

7.2.3 Through reasonable interpolations between the GMC sizes tested, other sizes of GMC’s within the same type, grade and class will be considered qualified if the specimens according to **7.2.2** pass the testing requirements. Extrapolation shall not be used for qualification purposes.

7.3 Qualification Test Report:

7.3.1 Upon completion of testing, a qualification test report shall be written and maintained on file during the life cycle of the design. A copy of this report shall be made available for inspection at the manufacturer’s facility.

7.3.2 Any failure during qualification testing shall be analyzed and the failure analysis and corrective action shall be included in the qualification test report.

7.3.3 A retest as specified in Section **11** (number of tests and retests) may be allowed when failure to the original joint occurs during qualification testing. When retesting is permitted, the failure analysis and corrective action shall be included in the qualification test report specified in **7.3.1**.

7.4 Test Equipment and Inspection Facilities:

7.4.1 Test equipment and inspection facilities shall be of sufficient accuracy and quality to permit performance of required inspections and tests.

7.4.2 *Calibration System Requirements*—The testing and inspection facilities shall maintain a calibration system for Measuring and Test Equipment (M&TE) in accordance with ANSI Z 540.1 with traceability to the National Institute of Standards and Technology (NIST), or shall maintain a calibration system in accordance with the requirements detailed in BS 5781 Part 1 against standards traceable to National Standards.

7.5 Test Conditions:

7.5.1 Test pressures as specified within each test shall be used.

7.5.2 Fluid used in the testing of GMC shall be water or air, as specified.

7.5.3 Unless otherwise specified herein, GMC shall be tested within the temperature range stated by the type of test being performed.

NOTE 1—When no temperature is specified within a test, the test shall be conducted at ambient conditions.

7.6 Performance Requirements:

7.6.1 Pass criteria for each test shall require meeting or exceeding the performance requirements specified in each test.

8. Dimensions, Mass, and Permissible Variations

8.1 GMC Dimensions:

8.1.1 Type I GMC dimensions shall be as specified by the manufacturer and shall provide the degree of axial and angular deflection (as applicable) specified by the manufacturer when used on pipe grooved in accordance with ANSI/AWWA C606 – 87, as applicable, or manufacturer’s recommendation(s).

8.1.2 Type II GMC dimensions shall be as specified by the manufacturer. Type II Class 2 shall provide angular deflection as specified by the manufacturer. Type II Class 3 GMC shall provide axial movement and angular deflection as specified by the manufacturer.

9. Workmanship, Finish, and Appearance

9.1 GMC Machined Surfaces:

9.1.1 Machined surfaces shall be free from burrs, cracks, laps, and seams which would affect the suitability for the intended service.

9.1.2 Machined surface finishes shall be as specified by the manufacturer.

9.2 *Unmachined Surfaces:*

9.2.1 Unmachined surfaces, such as forging or casting surfaces, shall be free from scale, blisters, fins, folds, seams, laps, segregations and cracks which would affect suitability for the intended service.

10. Sampling

10.1 *In-Process Inspection Sampling of GMC Products:*

10.1.1 Inspection samples of GMC being manufactured or processed shall be selected in accordance with ANSI/ASQC Z 1.4. Level of inspection and acceptable quality level (AQL) shall be in accordance with the GMC manufacturer’s quality assurance procedures. Other inspection or sampling plans may be used upon mutual agreement between the manufacturer and the purchaser.

10.2 *Lot Acceptance:*

10.2.1 Lot acceptance shall be based upon meeting the sampling and pass/fail requirements of ANSI/ASQC Z 1.4. Other inspection or sampling plans may be used upon mutual agreement between the manufacturer and the purchaser.

11. Number of Tests and Retest, for Qualification Testing

11.1 *Number of Test Specimens:*

11.1.1 Each test shall be performed on specimens as denoted in **Table A1.1**.

11.2 *Replacement of Test Specimens:*

11.2.1 When untested specimens are rejected as a result of inferior workmanship or materials, or assembly, the specimens shall be dispositioned in accordance with the manufacturer’s quality assurance procedures.

11.2.1.1 New test specimens of the same type, grade, and class, and pipe or fittings of the same O.D. size and wall thickness shall be prepared in accordance with Section 12.

11.3 *Penalty Runs:*

11.3.1 In the event of not passing a test, the manufacturer shall proceed with one of the following options:

11.3.1.1 If the leak or separation is determined to be design related, the manufacturer shall redesign the GMC and start all tests from the beginning.

11.3.1.2 If the leak or separation is determined to be unrelated to the design, the test specimen shall be rerun. A replacement test specimen shall be prepared in accordance with the requirement specified in 11.2.

11.3.1.3 If the leak or separation cannot be shown to be either design related or non-design related, the manufacturer shall test three (3) additional penalty specimens. The requirements specified in 11.3.2 shall apply.

11.3.2 Penalty run specimens shall be prepared when GMC has failed any of the tests specified in the Annex.

11.3.2.1 The GMC’s used for penalty run(s) shall be of the same type, grade, and class as the failed GMC being replaced.

11.3.2.2 The pipe or fitting used in penalty runs shall be of the same material, O.D., and wall thicknesses as the pipe or fitting being replaced.

11.3.2.3 Preparation of the penalty run specimens shall be in accordance with Section 12.

11.3.2.4 Penalty run specimens shall be identified in accordance with 12.3 and 11.3.2.5.

11.3.2.5 In addition to the part number and test specimen number, a designator shall be placed after the test specimen number which allows the specimen to be identified as a penalty run specimen. The method used to identify penalty run specimens shall be at the manufacturer’s option.

12. Specimen Preparation

12.1 *Specimen Preparation and Installation:*

12.1.1 Specimen preparation and installation on appropriate testing apparatus shall be in accordance with the manufacturer’s recommended procedures.

12.2 *Assembly of Specimens:*

12.2.1 GMC qualified under the requirements of this specification shall be tested and qualified as a completed assembly; that is, joint.

12.2.2 The intermixing of sub-components of the same type, grade, and class, but of different brands or trade name, constitutes non-compliance with this standard.

12.2.3 Test specimens used in testing shall be assembled using a GMC of a single type, grade and class.

12.2.4 The wall thickness and O.D. size of the pipe or fitting shall be as specified for the GMC joint being qualified.

12.3 *Identification of Test Specimens:*

12.3.1 Each test specimen shall be identified with a unique number to provide traceability back to the test records.

12.3.2 Identification of test specimens shall be permanent. In those cases where size or design does not permit permanent markings, tagging or bagging may be used.

12.3.2.1 When, as a result of testing, a test specimen is sectioned into two (2) or more pieces, each piece shall be marked with the original unique identification number.

12.4 Test specimens may be disposed of following approval of the qualification test report by the GMC manufacturer.

13. Test Methods

13.1 Standard Qualification Tests for GMC shall be as specified in the Annex. The following tests described herein are required for GMC qualification as applicable to the type, grade and class.

Name of Test	Annex
Performance Tests for GMC	Annex A1
Examination of Specimen	Annex A2
Pneumatic Proof Test	Annex A3
Vacuum Test	Annex A4
Hydrostatic Proof Test	Annex A5
Flexibility Test	Annex A6
Hydrostatic Burst Test	Annex A7
Rigidity Test	Annex A8
Bending Moment Proof Test	Annex A9
Bending Moment Ultimate Test	Annex A10

13.2 *Certification of Test Results:*

13.2.1 When specified in the purchase order or the contract, the purchaser shall be furnished certification that samples representing the GMC have been tested as directed in this specification and the requirements have been met. When