

Piedmont

INSTALLATION & MAINTENANCE MANUAL

PIEDMONT GROOVED-END FLEXIBLE COUPLING



Piedmont Pacific Inc. (H2O Innovation)

330 St-Vallier St. East, Suite 340, Quebec City, Quebec
Canada G1K 9C5

Manual Doc. Ref.: E10-0001-11
(Rev. Date: February 2025)

TABLE OF CONTENTS

1. Introduction3

2. Coupling Components4

 2.1 Coupling Housing8

 2.2 Gasket9

3. Installation Instructions 11

 3.1 Initial Preparations..... 11

 3.1.1 Pipe preparation 11

 3.1.1.1 Pipe ovality (out of roundness): 13

 3.1.1.2 Grooved pipe / fittings material for SWRO Desalination high pressure applications: 13

 3.1.2 Pipe setup 13

 3.1.3 Lubrication 15

 3.2 Installation Steps 16

 3.2.1 Groove quality inspection 16

 3.2.2 Installing gasket on pipe ends 17

 3.2.3 Housing installation..... 18

 3.2.4 Fastener installation..... 19

 3.3 Installation Inspection 23

4 Instructions for Disassembly..... 23

5 Maintenance and Troubleshooting 24

 5.1 Probable Causes of Coupled Joint Failure and Preventive Measures 24

 5.1.1 Improper installation 24

 5.1.2 Wrong coupling selection 24

 5.1.3 External forces and pipe misalignment 24

 5.1.4 Failure due to corrosion 25

 5.2 Coupling Maintenance 25

 5.3 Failure Detection and Troubleshooting 27

6 Hydrostatic test 28

7 Spare parts 28

Appendix A: Bolt & Rods Size 29

Appendix B: Cut and Roll Groove Specifications 31

Appendix C: Allowable Pipe End Separation Gaps & Deflections 37

Appendix D: Maximum Allowable Torque Values 39

Appendix E: Nonconformity Form..... 41

 E.1 General Information 41

 E.2 Nonconformity/Failure 41

 E.3 Technical Questionnaire 42

Appendix F: END LOADS..... 43

Appendix G: ROLL GROOVE WORKING PRESSURES..... 45
Reference 47

1. INTRODUCTION

This manual provides important installation instructions for all Piedmont's grooved-end flexible couplings. It specifies pipe, nut and bolt requirements, coupling joint inspection, installation and maintenance procedures for couplings, and provides failure detection and troubleshooting procedures.

Awareness of the information included in this manual will assist in safe installation and long service life of the couplings; however, good judgement and proper safety practices must be followed by experienced and competent installation and supervisory personnel to prevent avoidable personal injury or equipment damage. Local health and safety regulations as well as best industry practices should also prevail.

Retain this manual for future reference, and if any doubt arises in how to execute installation and maintenance, contact Piedmont for assistance. Please also consult Piedmont for the latest version of this manual.

NOTE

- Piedmont can offer training sessions on proper flexible couplings installation. Please contact your local representative to learn more about this offer.

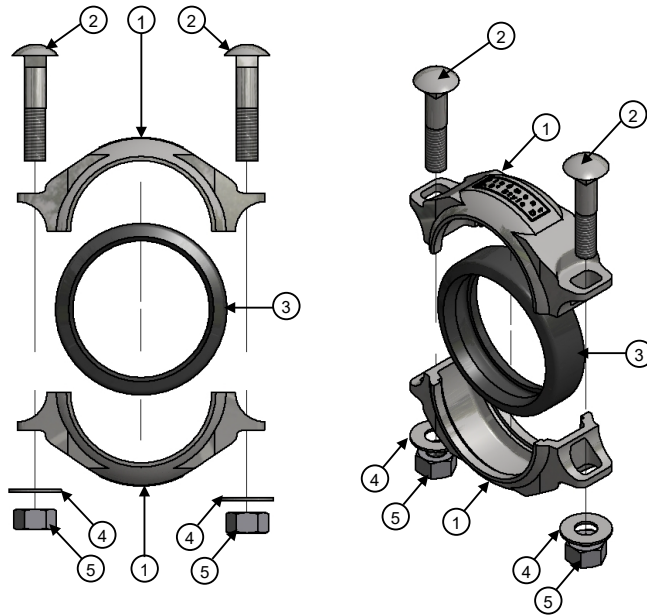
2. COUPLING COMPONENTS

Components of a typical coupling assembly include:

- Coupling housing: 2 Bolts (or rods): 2 Washers: 2 (4 when hexagonal bolts or rods used)
- Gasket: 1 Nuts: 2

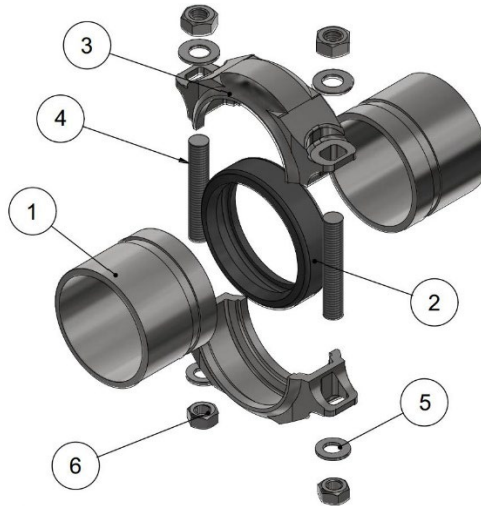
These components are identified in Fig. 1 and 2 for stainless steel alloy and composite plastic couplings respectively.

Figure 1a: Steel Coupling Assembly (Styles K, F, B, D, M, N, S-X and H)



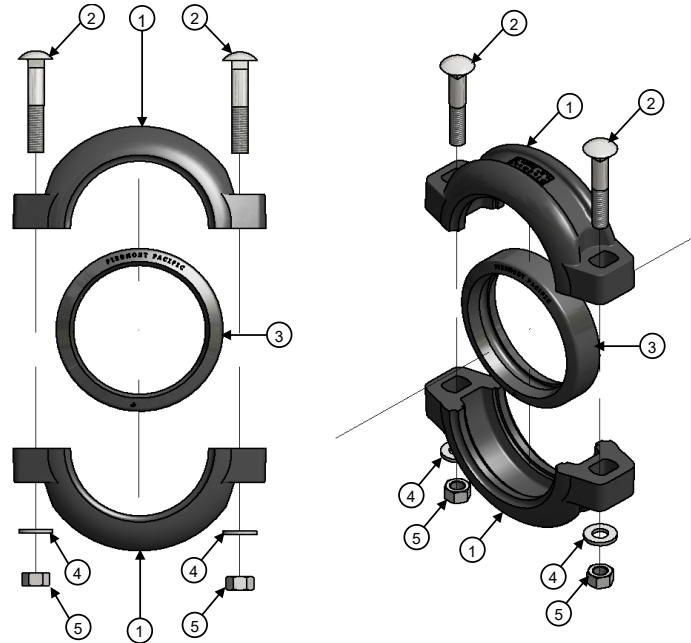
Item No.	Description	Material
1	Housing	316 (CF8M) or 316L (CF3M) / duplex (CE8MN or CD3MN) / superduplex (CE3MN or CE8MN) stainless steel
2	Round head oval neck track bolt (hexagonal bolts in some sizes)	316L stainless steel / duplex S32205 (2205) / super duplex S32750 (2507) / super duplex S32760
3	EPDM flexible coupling gasket	EPDM
4	Flat washer	316 stainless steel / duplex S32205 / super duplex S32750 (2507)
5	Hexagonal nut	316 stainless steel / duplex S32205 / super duplex S32750 (2507) / silicon bronze

Figure 1b: Steel Coupling Assembly with rods (Styles K, F, B, D, S, H and M)



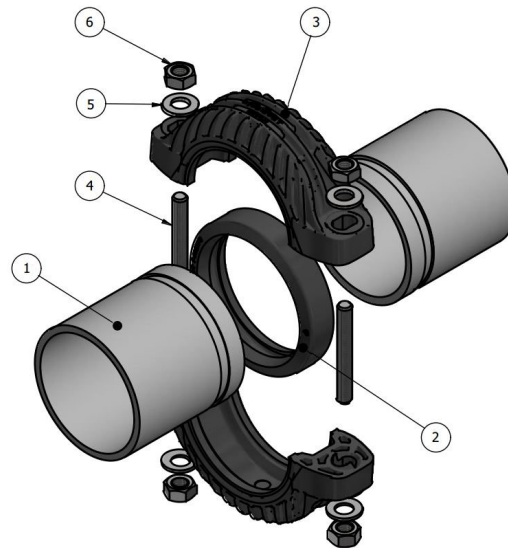
Item No.	Description	Material
3	Housing	316 (CF8M) or 316L (CF3M) / duplex (CE8MN or CD3MN) / superduplex (CE3MN or CE8MN) stainless steel
4	Threaded rod	316L stainless steel / duplex S32205 (2205) / super duplex S32750 (2507) / super duplex S32760
2	EPDM flexible coupling gasket	EPDM
5	Flat washer	316 stainless steel / duplex S32205 / super duplex S32750 (2507)
6	Hexagonal nut	316 stainless steel / duplex S32205 / super duplex S32750 (2507) / silicon bronze

Figure 2a: Composite Coupling Assembly (Style P)



Item No.	Description	Material
1	Housing	Glass reinforced thermoplastic composite
2	Round head oval neck track bolt (hexagonal bolts in some sizes)	316L stainless steel / duplex S32205 (2205) / super duplex S32750 (2507) / super duplex S32760
3	EPDM flexible coupling gasket	EPDM
4	Flat washer	316 stainless steel / duplex S32205 / super duplex S32750 (2507)
5	Hexagonal nut	316 stainless steel / duplex S32205 / super duplex S32750 (2507) / silicon bronze

Figure 2b: Composite Coupling Assembly with rods (Style P)



Item No.	Description	Material
3	Housing	Glass reinforced thermoplastic composite
4	Threaded rods	316L stainless steel / duplex S32205 (2205) / super duplex S32750 (2507)
2	EPDM flexible coupling gasket	EPDM
5	Flat washer	316 stainless steel / duplex S32205 / super duplex S32750 (2507)
6	Hexagonal nut	316 stainless steel / duplex S32205 / super duplex S32750 (2507) / silicon bronze

2.1 Coupling Housing

The coupling housing – the major structural component of a coupling assembly – is designed, manufactured and tested for specific pressure and environmental requirements. Different features of coupling housing are shown in Fig. 3.

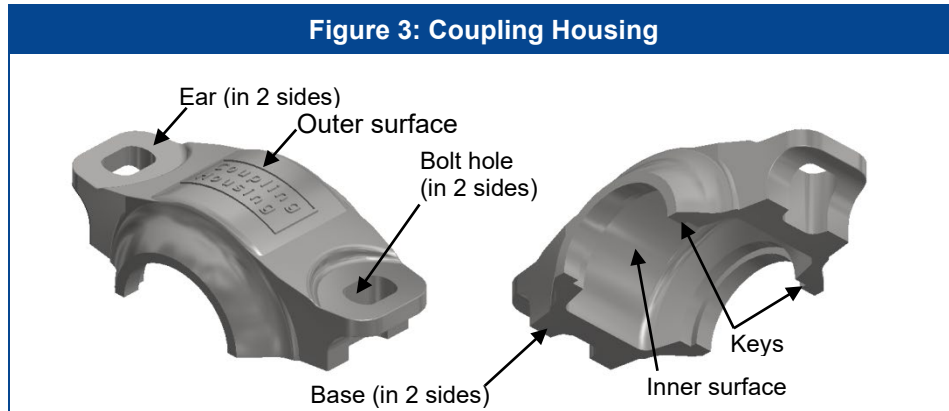
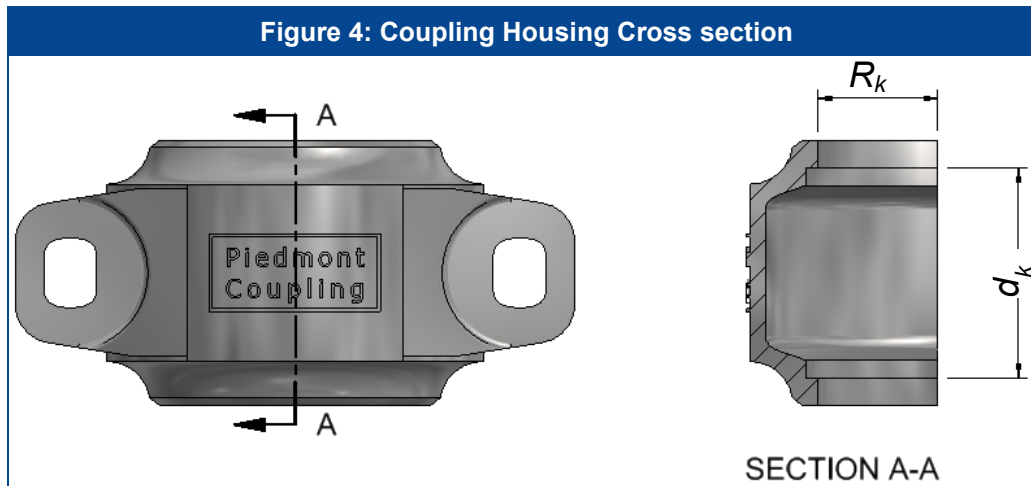


Fig.4 demonstrates the cross section of coupling housings along its width, followed by the illustrations of the exhibited dimensions. These dimensions are outlined in technical drawings of different couplings. For details visit <http://www.piedmontpacific.com/documentation>.



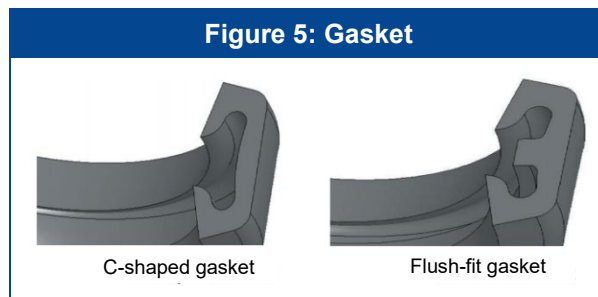
Dimensions	Name	Description
R_k	Key-radius	Key-radius refers to one half of the key-diameter of a coupling assembly involving 1-pair of couplings being attached together. More about groove and key diameter can be found in subsection 3.1.1 and 3.1.2 respectively.
d_k	Key-to-key distance	This dimension denotes the distance between the keys of a coupling housing. The dimension d_k determines the pipe end separation gap as well as relative angular deflection; these two parameters are detailed later in subsection 3.1.2.

Piedmont couplings are primarily categorized based on housing materials and pressure rating. Predominantly 316 (CE8M) or 316L (CF3M), duplex (CE8MN) or CD3MN, and super duplex (CE8MN/CE3MN) stainless steel alloys are used for housing materials, including styles namely K, F, B, D, S, H and M. Piedmont also manufactures a corrosion resistant composite housing made of fiber glass reinforced thermoplastic resins (style P). For more information on different styles of couplings for specific requirements – review the product data-sheet accessible at the Piedmont website (<http://www.piedmontpacific.com/>) or consult with Piedmont or your local Piedmont representative.

2.2 Gasket

The gasket is a static, radial seal. The sealing of the gasket is accomplished by the internal process pressure, forcing the two gasket lips tightly against the pipe end surface. The gland of gasket-seal reinforces and restrains its structure. It also positions the gasket between the two housing segments and the pipes to be connected.

Piedmont EPDM elastomer gaskets are ANSI 61 listed – suitable for both hot and cold water services. The normal operating temperature range of these gaskets is 10° F to 250° F (-12.2° C to 121° C). These are also compatible for minimum and maximum temperatures of -30° F (-34.4° C) and 300° F (149° C) respectively. However, continued exposure to this lowest/highest level of temperature may shorten gasket life. The EPDM elastomer is compatible with up to 2 to 3 mg/L mono-chloramine residual, many dilute acids, oil free air, and broad chemical services typically associated with water treatment and distribution systems. Both C shaped and flush-fit gaskets are available (see Fig. 5).



NOTE

- Expected shelf life of Piedmont EPDM gasket is 3-5 years (sulfur cured) or 5-10 years (peroxide cured)– provided that – proper storage guideline was followed. The gaskets should not be over-compressed and are to be stored indoor without any direct exposure to light.
- If any doubt about ‘fit for duty’ of a gasket arises from not storing according to guidelines or stored for over 3 years, a sample gasket can be sent for testing. Contact Piedmont for details information on gasket storage and tests.
- EPDM gaskets offered by Piedmont are not suitable for petroleum and other oil containing services.
- For specific requirements, such as applications with petroleum products, hydrocarbons, air with oil vapor, vegetable and mineral oil, etc. contact your Piedmont representative. We have Viton gaskets available upon request.
- For severe duty applications, such as high cycle vibrations, Nitrile material gaskets are available upon request. Contact your Piedmont representative.

2.3 Fasteners

The fasteners – constituting bolts, nuts and washers – retain the coupling housing halves together, maintaining the gasket in place for proper sealing. Piedmont fasteners used are as follows:


- Metric Series: round head oval neck track bolts, hexagonal nuts, and washers based on dimensional specifications stipulated in DIN-934 nuts, DIN-125 washers, and Piedmont oval neck track bolt design based on DIN-5903. In some specific couplings, DIN-931 / -933 hexagonal head bolts are used as well from M20 and bigger bolts sizes. Materials: 316SS, duplex S32205, and super duplex S32750 / S32760 stainless steel options available upon request.
- Inch Series hardware available upon request.

For some sizes of couplings, silicon bronze / nickel aluminium bronze nuts can be offered upon request. See Appendix A for detailed information on bolt sizes, nuts and washer requirements.

NOTE

- Do not substitute bolts supplied by Piedmont with the bolts of different characteristics. For specific requirements for bolts for a particular application, contact Piedmont.
- Using hardware not provided by Piedmont voids the coupling assembly warranty.
- The selection of the size, material, and the tensile strength (bolt classification) is an integral and essential aspect of the coupling assembly design. Do not substitute bolts of a different size, material, or industry standard grade or classification for those supplied by Piedmont, without the explicit approval of Piedmont engineering.
- It is imperative to recognize that these properties of a bolt determine the industry standard installation torque requirement to establish the correct pretension, and this installation torque is a characteristic of the bolt. Any person who performs maintenance on the system should be able to apply the correct SAE (Society of Automotive Engineers) – or other industry – standards for installation torque value for the size and grade classification of the installed bolt.
- If any bolt is substituted by a different size, material, or grade classification the integrity of the engineering of the coupling joint is compromised, which can directly result in personal injury and equipment damage.

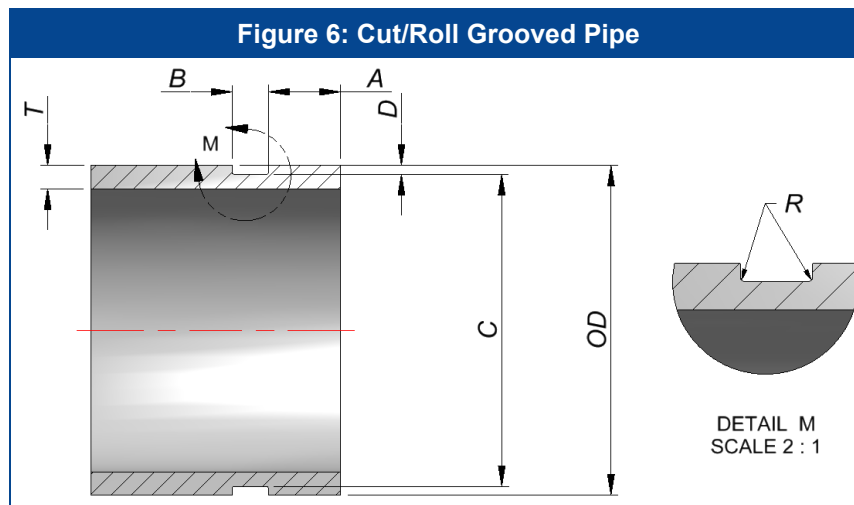
3. INSTALLATION INSTRUCTIONS

 WARNING	<ul style="list-style-type: none"> • Read all the instructions carefully prior to the installation of any Piedmont product. Noncompliance with any of these instructions may result in avoidable hazard, serious personal injury or loss of life, and/or equipment damage. • Clear understanding of the piping system’s functional requirements is essential. Select appropriate coupling to be installed for specific requirements of applications. • Piping systems must be depressurized and drained before the installation, removal and adjustment of any Piedmont products. • Wear appropriate Personal Protection Equipment (PPE). • Follow all the local health and safety regulations. • Contact your Piedmont representative should there be any doubts about the installation of Piedmont’s products.
---	--


3.1 Initial Preparations

3.1.1 Pipe preparation

As a basic preparatory step, pipes to be connected are grooved in order to accommodate the keys of coupling housing. A schematic representation of the longitudinal cross sections of a pipe segment detailing groove specifications is shown in Fig. 6, followed by the illustrations of these dimensions. Piedmont flexible couplings are designed for the application with the grooved pipes – prepared in accordance with ANSI/AWWA C606 standard [4]. Details about the groove specifications (shown in Fig. 6) can be found in Appendix B.



Dimensions	Dimensions name	Description
A	Gasket seat	This dimension is the distance between the pipe end and the edge of pipe groove, nearest to the pipe end. It delineates the portion of the pipe surface, where one half of the gasket is positioned and seals. The pipe surface of this seal area must be free of scoring, gouges, or indentations and free of debris, such as dirt, chips, rust, and scale that may interfere with proper gasket sealing.
B	Groove width	This dimension is the axial width of the pipe groove. The housing keys are retained by the opposing walls of this groove.
C	Groove diameter	It denotes the uniform diameter at the base of the groove, i.e. the uniform pipe outer diameter less the depth of the groove.
D	Groove depth	This is the dimension of the depth of the groove from the outermost surface of the pipe.
OD	Outer diameter	This is the uniform outer diameter of the pipe, which determines the size of the coupling to be installed.
T	Minimum pipe thickness	This thickness refers to the minimum allowable thickness for cut or roll grooves irrespective of pipe schedules
R	Radius of fillet	It represents the fillet between the groove side wall and the base surface

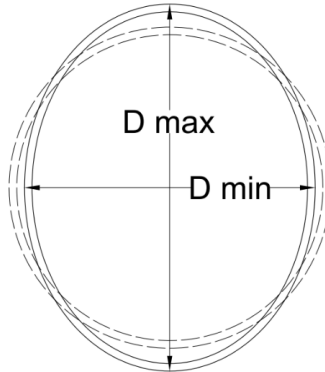
 WARNING	<ul style="list-style-type: none"> • Pipe and groove dimensions must be set within the tolerances outlined in Table B.1 – B.6 in Appendix B. Noncompliance with these specifications may result in joint failures, improper and hazardous coupling installation, serious personal injury or loss of life, and/or equipment damage. • Never coat the pipe and grooves with any products as it may modify the mechanical strength of the grooved end flexible coupling assembly.
---	--

NOTE

- Piedmont flexible couplings are tested and rated for sch. 40s or thicker pipes with cut grooved end. Consult Piedmont for the applications requiring roll grooves, thinner pipes (e.g. sch. 5s, 10s etc.) as well as pipe joints comprising two different schedules of pipes. Some roll grooves joint pressure ratings are shown in Appendix G.
- Gasket seat-A must be smooth and free of indentations, roll marks, scratches, imperfections and projections from end pipe to the groove in order to provide a proper sealing surface. Dimension A is to be measured from square-cut end of pipe. Beveled end pipe is not recommended.
- The seal surfaces and bottom of the groove must be free of dirt, chips and other impurities that may interfere with the sealing or coupling assembly.
- The groove must have uniform depths (shown as D in Fig. 6) throughout the pipe circumference.

3.1.1.1 Pipe ovality (out of roundness):

The grooved pipe spools ovality is acceptable provided the maximum and minimum measured diameters lay within the correspondent groove pipe OD tolerances listed in Appendix B.

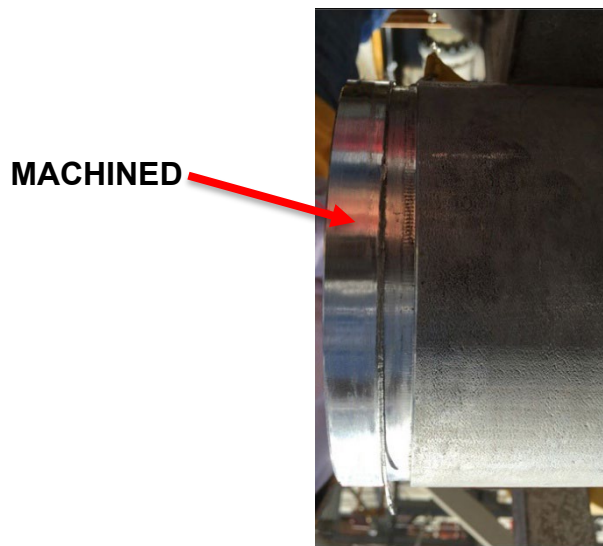


Cross-Section of Pipe Exhibiting Ovality

3.1.1.2 Grooved pipe / fittings material for SWRO Desalination high pressure applications:

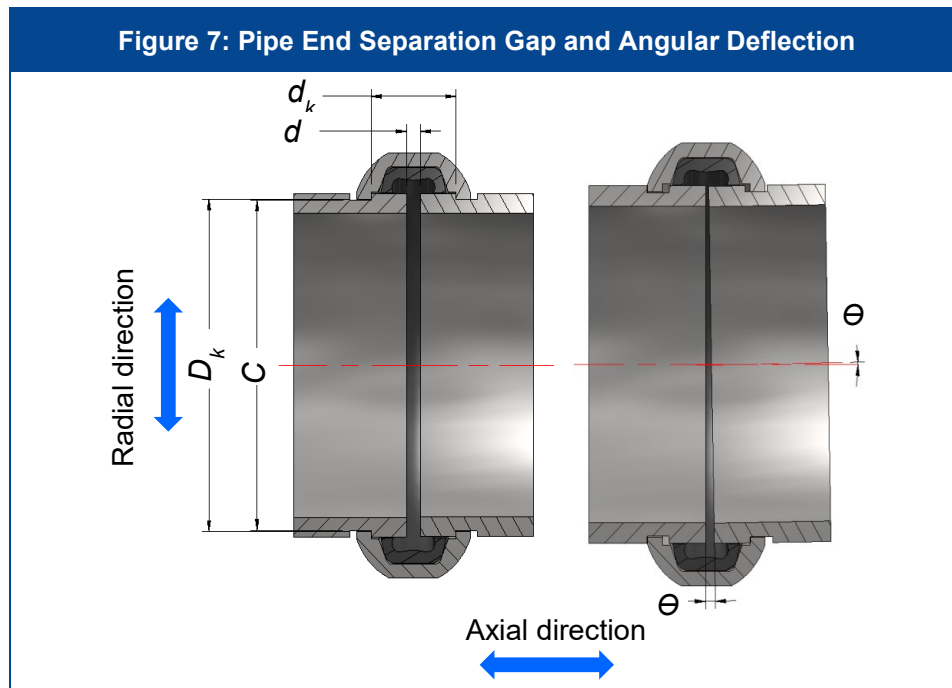
To improve against the crevice corrosion on the pipe / fittings ends under the coupling, some recommendations are:

- a) Super duplex material with PREN>40, for instance, such as S32750 (2507), S32760 (Zeron-100), 254SMO (6Mo) or AL6XN.
- b) Machining of the gasket seating area (A) removes any ovality and roughness, improving the surface condition, and reducing the possibility of local crevices to be formed:



3.1.2 Pipe setup

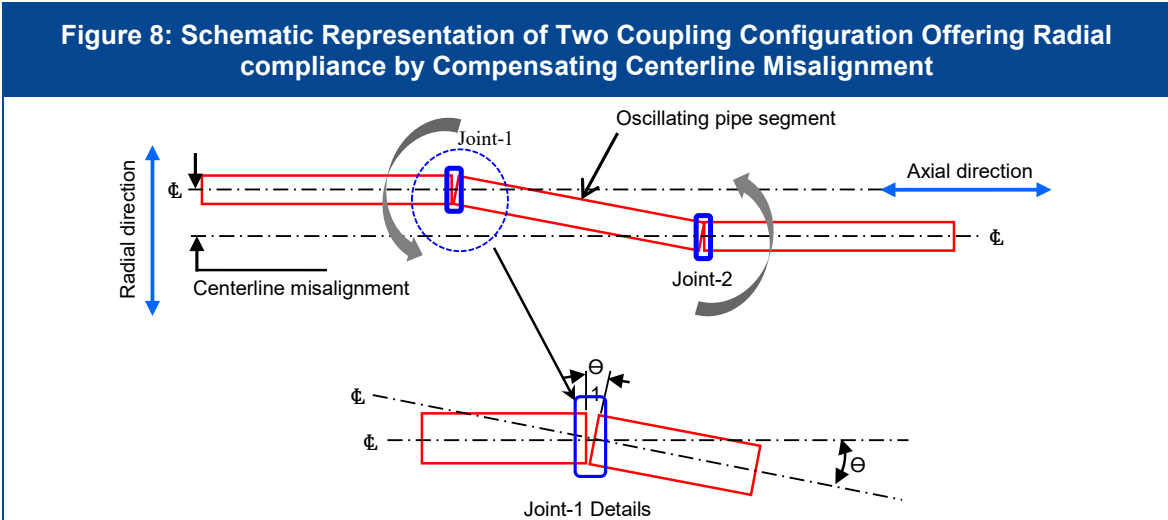
As the next step, grooved end pipes are to be placed together in order to construct a coupled joint using a flexible coupling. The internal structure of flexible coupling allows accommodating certain pipe end separation gap and angular deflection of grooved end pipes – enabling compensation of specific pipe displacement and angular deviation – in the axial direction (see Fig. 7). Table C.1 in Appendix C outlines these parameters for various nominal sizes of couplings.



Dimensions	Dimensions name	Description
D_k	Key-diameter	Key-diameter denotes the diameter of coupling assembly involving 1 pair of couplings being attached together. The key-diameter is slightly larger than the groove diameter of pipe, enabling coupling assembly to accommodate the pipes to be connected.
C	Groove diameter	See subsection 3.1.1.
d_k	Key-to-key distance	See section 2.1.
d	Pipe end separation gap	It represents the end-to-end gap between two grooved end pipes obtainable by a single coupling assembly. This gap compensates certain level of axial displacements of corresponding pipe components.
θ	Angular deflection of pipes	This parameter designates centerline angular deflections of grooved end pipes to be connected.

Point to be noted that a single coupled joint can compensate specific pipe end separation gap and angular deflection in the axial direction, but it does not retain a significant amount of radial compliance (see Fig. 7). The key diameter (D_k) of coupling is slightly larger than the groove diameter (C) allowing coupling assembly to accommodate the circumferential surface of grooves – but it is essentially not large enough to compensate radial displacement attributed by the centerline misalignment.

By using two or more couplings, radial offset or displacement can be compensated. This phenomenon is illustrated schematically in Fig. 8 by a two-coupling configuration. This offset mechanism is attained by coupling’s ability to cohere with certain level of angular deflections of centerlines (see Fig. 7). A configuration like the one shown in Fig. 8 will compensate larger radial misalignment or displacement without inducing stress on pipes and coupled joint.



The radial displacement of pipe components could be exerted by pressure thrust resulting from pressure vessel expansions, ERD systems, axial displacement pumps, thermal expansion of pipes, and so on. In all of these applications, addition of two or more couplings reduces the risk of joint or pipework assembly failures. Furthermore, it also accommodates added axial deflection by distributing it to associated coupled joints – facilitated by the intermediate oscillating segments.

Contact Piedmont if a pipework design includes radial misalignment.

3.1.3 Lubrication

Gasket lubrication: Prior to the installation of coupling, outer surface of the gaskets (including lips) (see Fig. 9a & 9b) has to be coated with a thin layer of Piedmont lubricants. Piedmont offers a glycerine based lubricant, specifically recommended for reverse osmosis (RO) systems. Proper lubrication prevents pinching of gasket upon the closure of coupling assembly. It also facilitates accurate fitting of gasket over pipe ends avoiding unnecessary stretching. In case of no glycerine available, other alternative lubricants in the market are: silicone lubricant (e.g. Dupont Molykote 111; Parker Super-O-Lube; Dow Corning® 7 Release Compound).



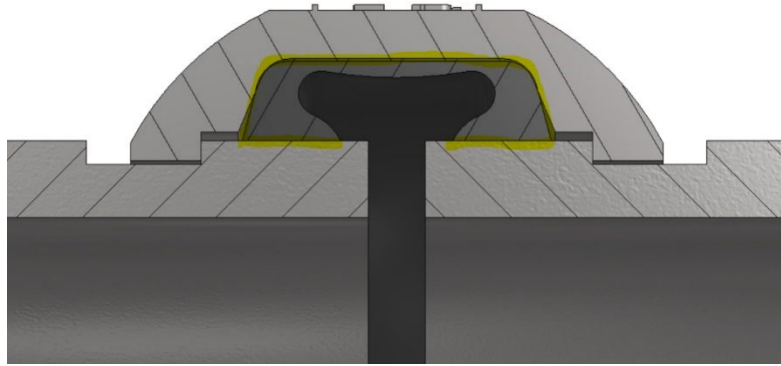


figure 9b

NOTE

- Non-water soluble lubricants, namely grease, oil, wax and vegetable oil are not recommended for Piedmont products because of potential detrimental effects to RO membranes, and unintentional contamination of other equipment surfaces. Consult with membrane manufacturer for compatibility information with other lubricants.

3.2 Installation Steps

3.2.1 Groove quality inspection

Prior to the installation of coupling, a rapid test can confirm the groove quality of the pipe in perspective of appropriate engagement of coupling keys with the grooves. Note that this inspection also evaluates the ovalities of corresponding grooved end pipes.

1. Bring the grooved end sides of the pipes to be connected together. Make sure that the allowable end-to-end separation distance and angular deflection between the pipes are maintained in accordance with the Piedmont's specifications (see Appendix C). For maximum flexibility of coupling assembly, pipes' ends must be in contact with each other with zero end-to-end separation distance and the centerlines of the pipes be aligned resulting in zero angular deflection.

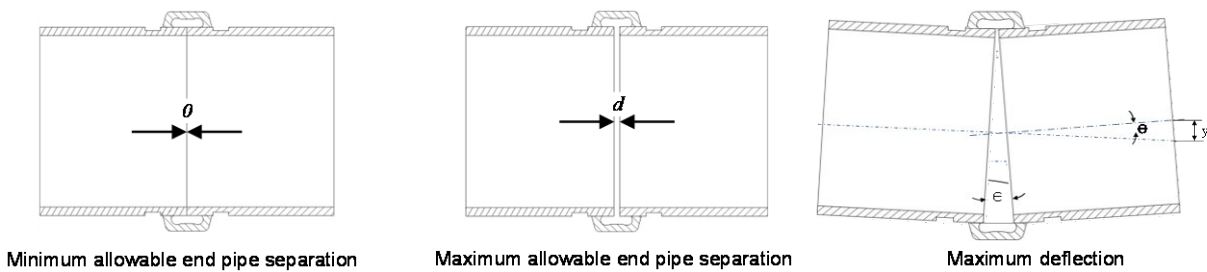



Fig. a

 <p>WARNING</p>	<ul style="list-style-type: none"> • Do not exceed the allowable end pipe separation and deflection under any circumstance. Additional external deflection of piping system – resulting in deflection at the coupled joint beyond allowable limit – is not permissible. Noncompliance with this instruction may lead to improper and hazardous coupling installation, premature failure of coupling housing, serious personal injury or loss of life, and/or equipment damage. • Select appropriate number of flexible couplings for radial displacement compliance of pipe components. Noncompliance with this instruction may lead to joint failure, serious personal injury or loss of life, and/or equipment damage.
---	--

2. Place the housing pair on the pipe joint (no gasket is required to be installed for this test). Make sure that the keys of the housings are in full engagement with the pipe grooves and bases of the housing have full contact with each other.

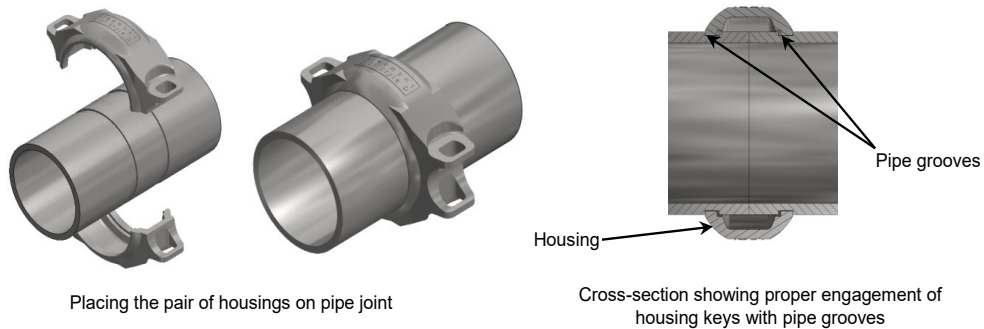


Fig. b

3. With the housing pair still placed on the pipe, rotate the coupling housings through 180° in two directions along the centerline axis by hands, as shown in Fig. c. An easy and free rotation of the housing halves, while maintaining proper engagement of keys with grooves along with metal-to-metal contact of the housing halves, will ensure proper engagement between the housing keys and corresponding pipe grooves.

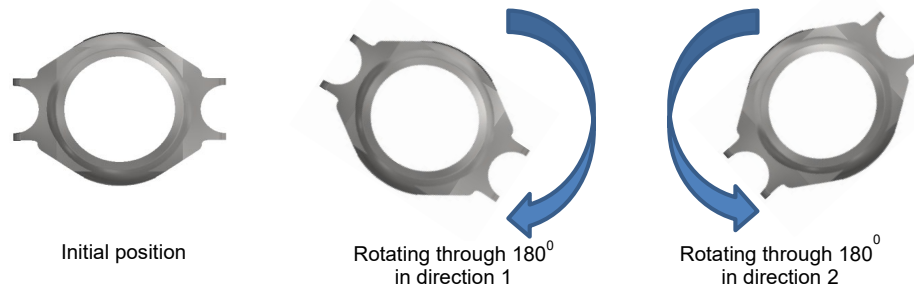


Fig. c

3.2.2 Installing gasket on pipe ends

4. Perform lubrication of the outer surface of the gaskets as discussed earlier.
5. Place the gasket over one of the grooved pipe ends and slide it over as shown in the Fig. d.



Fig. d

6. Align the two pipe ends and brings those to close proximity. Ensure proper end-to-end separation distance and angular deflection between the pipes (see Appendix C). For maximum flexibility of coupling assembly – pipes' ends must be in contact with each other and the centerlines of the pipes being aligned correctly.
7. Slide the gasket to the center of the joint in such way that no portion of the gasket extends into the groove on either side. At this point both pipes are connected through the gasket as shown in Fig. e.

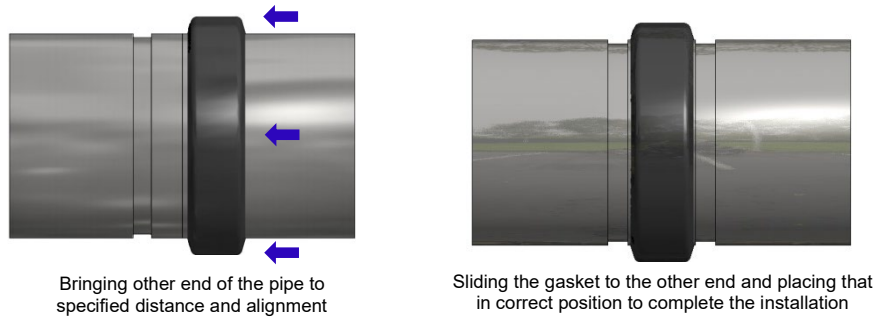


Fig. e

3.2.3 Housing installation

8. Install the housing pairs on the gasket. Make sure that the keys of the housing are engaged completely with the grooves of both pipe ends (see Fig. f and g for steel and composite housing respectively).

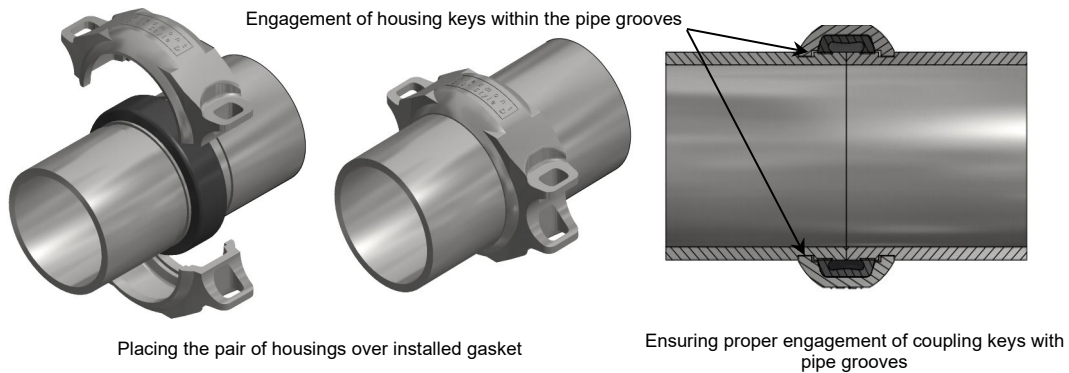


Fig. f

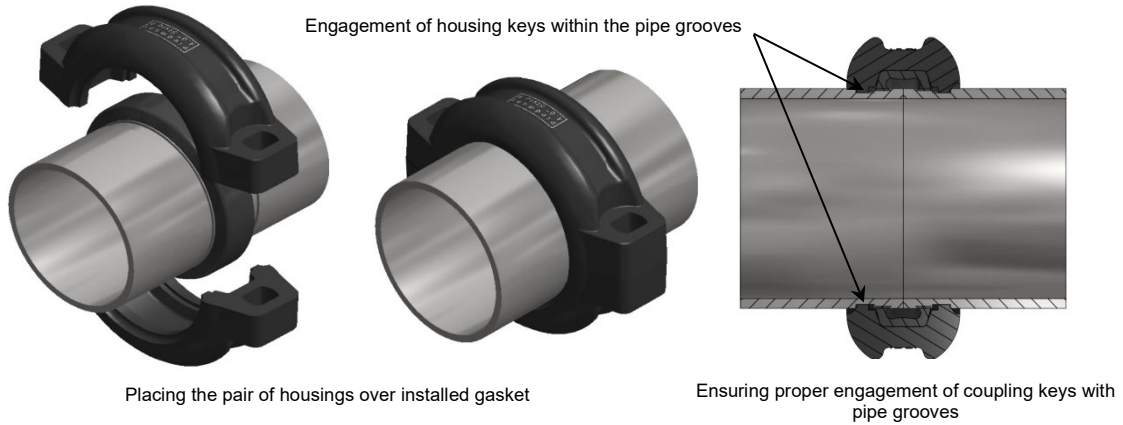


Fig. g



WARNING

Be careful not to damage the gasket by pinching or rolling while installing the housing pair. Noncompliance with this instruction may lead to gasket deteriorations causing leakages from the pipe joint.

3.2.4 Fastener installation

- 9. Fastener Lubrication: Apply anti-seize compounds on the bolt threads (unless paired with silicon bronze nuts), and under the bolt head. By lubricating the bolt head bearing surface it prevents from water chlorides salts deposits entering that crevice and enhances the performance against bolt corrosion. Insert the bolts through the bolt holes on coupling ears, place the washers (if recommended) and tighten the nuts by hands (see Fig. h). Piedmont offers dry lubricated bolts & nuts upon request. Couplings with silicon-bronze (SB) or nickel aluminium bronze (NAB) nuts do not require any lubrication.

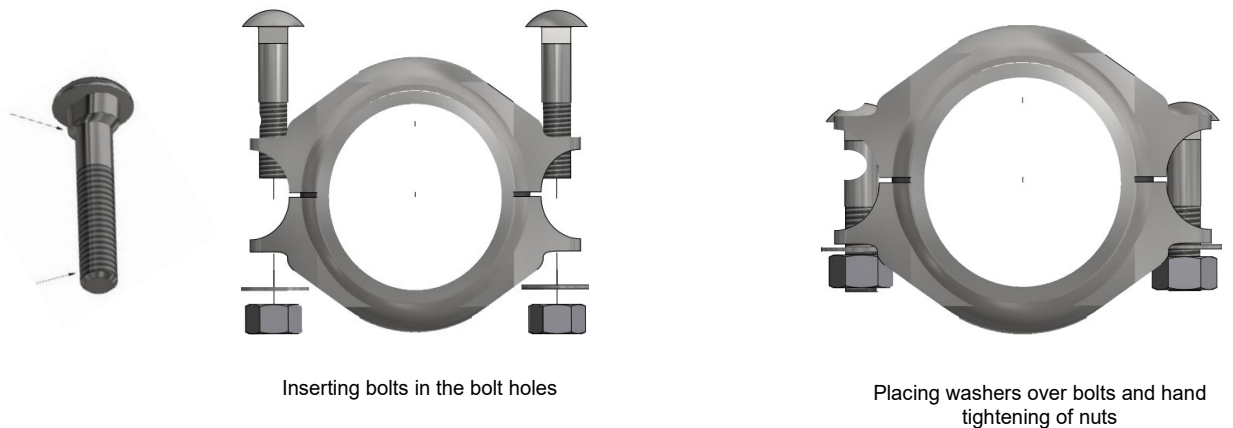


Fig. h

10. Housing pairs should fit evenly over the gasket such that the gap on each side is equal as shown in Fig. i. Complete the installation by tightening the nuts equally and evenly until the gap between the coupling housing is diminished and proper base to base contact is achieved. Use approximately 90% of the maximum torque as a general guideline. For maximum allowable torque, see Table D.1 and D.2 in Appendix D for dry and lubricated conditions respectively.

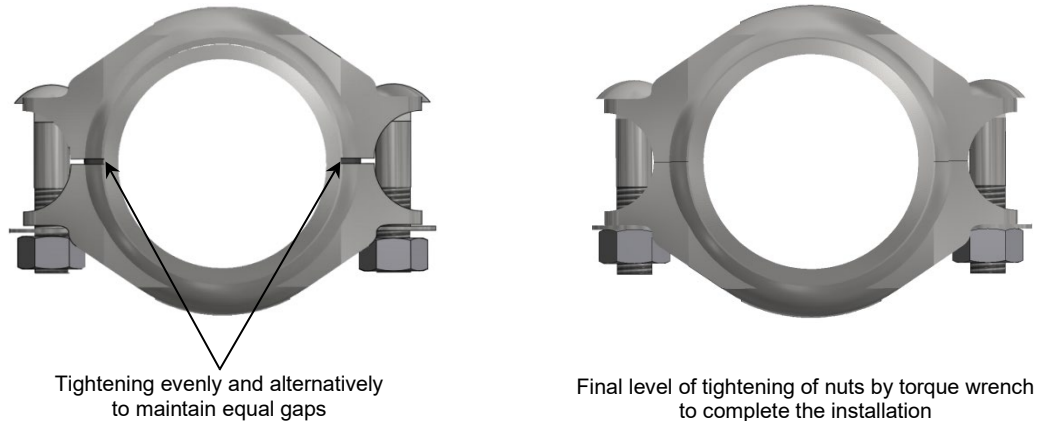


Fig. i

NOTE

- If stainless steel nuts are used with stainless steel bolts (SS316, 2205 Duplex, 2507 / S32760 Superduplex), commercial anti-seize compound should be applied to the mating surfaces of bolts and nuts (threads). For anti-seize compounds, Piedmont recommends molybdenum disulfide (MoS₂) based anti-seize formulations, or similar. Some food / drinking approved lubricants are available in the market. Contact Piedmont for details. For the bolt head bearing surface lubrication against chlorides stress corrosion cracking, Piedmont recommends zinc oxide based grease mixtures.
- Couplings with silicon-bronze nuts, or nickel aluminium bronze (NAB) nuts, do not require any anti-seize compound.

BOLT-NUT TORQUE PROCEDURE:

- For maximum allowable torque, see Table D.1 and D.2 in Appendix D for dry and lubricated conditions respectively.
- The installation torque values are selected to provide a design pretension for the bolt, and the applied torque is not a characteristic of the coupling or the flange, but rather a direct characteristic of the bolt.
- Adequate tightening torque is essential to induce sufficient bolt pretension. Too great tension can crush a gasket in a flanged piping joint, or cause non-elastic (plastic) deformation of coupling housing bolt pads, and subsequent similar deformation of the bolts themselves despite 'correct' torque application for the bolt. Too low tension will not apply the strength required by the joint despite 'correct' torque application for the bolt.
- We recommend tightening of the nuts by torque wrench, as first option, in order to avoid couplings components damages by excessive torquing.
- In case of using automatic impact torque drivers: it is important to develop a familiarity with the impact tool previously in order to avoid over-shifting and/or over-torquing, which may damage or fracture the bolts or the couplings's housings bolt pads during installation. We do not recommend impact torque tools since they do not provide the installer with direct "wrench feel" to judge the finally applied nut torque.

Same procedure is required to be followed for the installation of composite coupling (see Fig. j).



Fig. j

11. An ideally installed coupling assembly should have proper base to base contacts as shown in Fig. k.

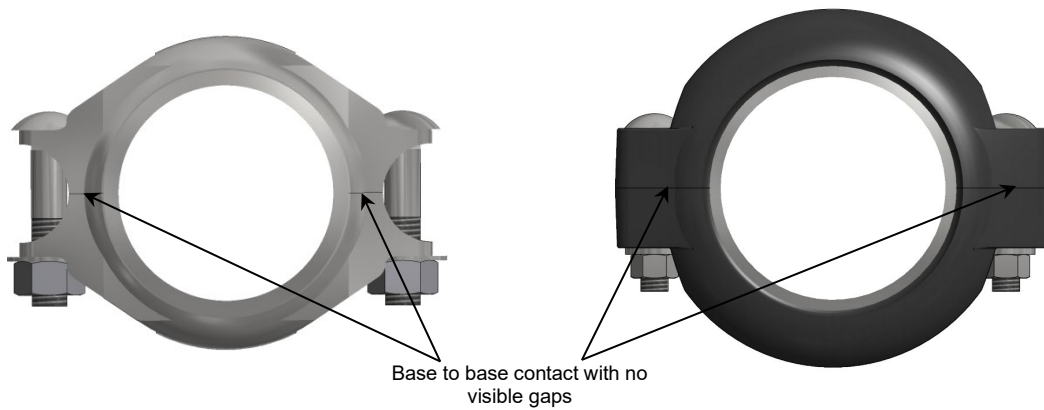
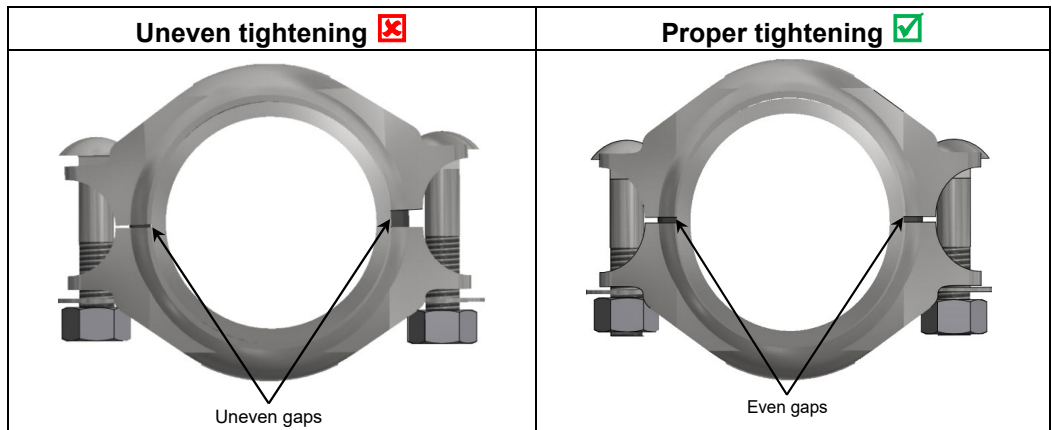


Fig. k




WARNING

- It is possible and normal that the housing halves bases are not completely touching over their full length. Small gaps may be seen around the mating edges of the housing pair (between the bases) or between the bolt head or nut and housing surface. As long as metal-to-metal contact is achieved and proper torque is applied, do not over-torque the assembly to try closing these small gaps
- Never tighten any nut to a torque value greater than the fastener ratings (see Appendix D). Over-torqueing can result in permanent deformation of bolts and housings, damage to fastener threads, and compromise the integrity of the coupling assembly.
- Couplings must be tightened evenly and alternately. Uneven tightening – causing uneven gap – can bend bolts, pinch and cut gaskets and compromise the coupling assembly integrity.



- Do not leave a partially complete installation of a coupling assembly. If a complete installation of any piping joint cannot be done, remove fasteners and couplings to eliminate the avoidable risk of incomplete assembly. Walking away from any partially assembled piping joint poses an unacceptable risk of personal injury and equipment damage from dropping hazard.


3.3 Installation Inspection

 WARNING	<ul style="list-style-type: none"> • Inspection of the coupling joints must be carried out prior to pressurization of the system. As a general safety requirement, always perform joint inspection at depressurized state of the system. Noncompliance with this instruction may result in serious personal injury, or loss of life, and/or equipment damage. • Ensure proper safety measures are taken.
---	--

After completion of installation and before running a proof test or pressurizing the system, it is important to inspect the joints in order to ensure safe and reliable services. In this context, the following conditions must be checked to ensure proper installation:

1. Ensure couplings were selected and installed as per the application requirements.
2. Pipe dimensions and groove specifications must be within the tolerances provided by Piedmont. It can be ensured by checking whether the coupling housings have proper engagement with the grooves or not.
3. Perform rigorous visual inspection to confirm gaskets are completely encapsulated by the housing pairs; housing keys are engaged fully with the pipe grooves; fasteners are correctly tightened without deformation; washers are installed (if applicable), and proper base to base contacts of housings are attained without significant visual gaps.

4 INSTRUCTIONS FOR DISASSEMBLY

 WARNING	<ul style="list-style-type: none"> • Piping systems must be depressurized and drained before attempting to remove and/or to perform adjustment of Piedmont couplings. Noncompliance this instruction may result in equipment damage, serious personal injury or loss of life. • Wear appropriate Personal Protection Equipment (PPE). • Do not leave a partially unassembled coupling to prevent drop hazard. • Follow all the local health and safety regulations.
---	---

1. After depressurizing and draining the system, untighten the nuts followed by removing the bolts (and washers if applicable). Carefully remove the housing pair. Take necessary precaution to avoid hazard that may result from dropping of housing or other coupling components.
2. Check the gasket to ensure that it is not deteriorated. Replace if necessary.
3. Check the hardware for corrosion or deformation. Replace if necessary.
If a grooved joint gets disassembled for any maintenance reasons, keep in mind that once the coupling assembly has been torqued and pipe pressurized, the hardware components (bolts, nuts and washers) should be replaced. Exceptionally, the low pressure Style P hardware maybe be re-used, no more than twice, provided the threads are in good condition, and have not been not long exposed to corrosion.
4. Check the pipe and groove condition.
5. Re-assemble the system following all of the instructions depicted in the previous section.

5 MAINTENANCE AND TROUBLESHOOTING

5.1 Probable Causes of Coupled Joint Failure and Preventive Measures

Ensuring a proper installation along with correct specifications and number of couplings, accessories and pipe, will significantly reduce the chances of premature failure. However, under certain circumstance couplings can fail because of the reasons depicted in the following subsections – which also underscore corresponding preventive measures.

5.1.1 Improper installation

Premature failure commonly results from not following the installation guidelines properly, which may include using erroneous pipe and coupling grooves specifications, misalignment of coupling housing resulting from design miscalculation, improper pipe deviations, inadequate or excessive tightening torque, lack of gasket lubrication, etc. Do not force the pipe ends to clamp the coupling housings since it will introduce additional damaging external forces.

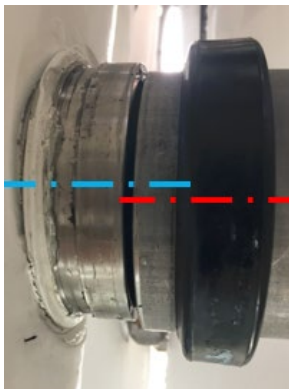
Improper installation may result in instantaneous failure of the joint or failure over a longer period of time. For instance, bolt may be subjected to plastic deformation due to over-torquing of nuts and may experience fatigue failure or premature corrosion. On the other hand, inadequate tightening will result in insufficient clamping force required for coupling assembly to be properly functional under the operating pressure, or loosening of the nut due to system vibration.

5.1.2 Wrong coupling selection

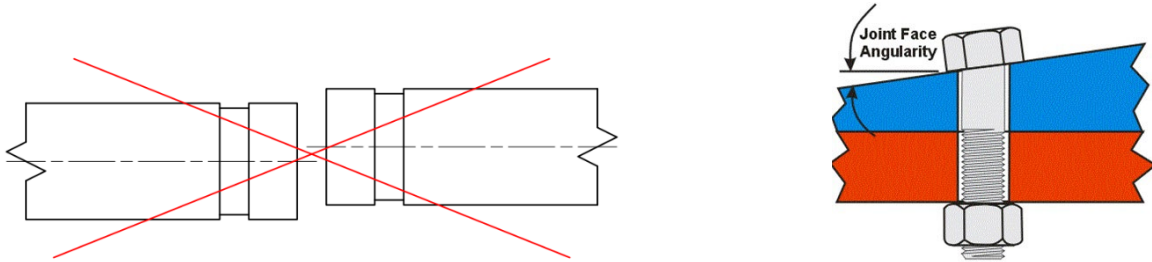
Using a coupling for unintended applications can result in failure of the coupling joint. Examples include: using a coupling in a corrosive environment which was not made of the material rated for that particular corrosion resistivity, using a coupling in petroleum services that was rated for water service, selecting the wrong coupling size, etc.

5.1.3 External forces and pipe misalignment

It is important to be aware of external forces, which may be applied to the pipework and the couplings. Such forces will induce pipe displacements and misalignments both in axial and radial directions. Coupling failure may take place if the system was not designed to accommodate these forces and displacements. The selection of an appropriate number of couplings, maintaining proper pipe separation gaps and deflections along with their orientations are critical. Contact Piedmont for guidance on systems subjected to axial and radial displacements of pipe components joined by grooved end flexible couplings.



The pipe ends excessive radial misalignments/offsets, or pipe OD diameter bigger than the tolerance listed (see Appendix B), may lead to extra forces on the bolt head once the coupling is assembled, and, consequently, premature bolt head failure by stress corrosion fatigue.



The total applied internal and external loads to the flexible couplings key groove walls should not exceed its correspondent design End Loads (Appendix F). Some example of external loads are:

- radial pipe ends misalignments/offsets
- vertical piping not properly supported
- axial piston pumps output flexible hoses excessive bending (not properly supported)
- excessive shock loads/pressure pulses (ERDs)

5.1.4 Failure due to corrosion

Corrosion agents like chloride ions are present in the humid air and the rain within a typical environment of a desalination plant near the seashore. These corrosion agents may enter in a confined zone within the coupling assembly and corresponding region may become susceptible to crevice corrosion. The condition may be further aggravated by system load and vibration. Additionally, over-tightening of fasteners may create crevice region leading to bolt head failure because of synergistic effects – resulting from crevice, stress cracking and fatigue corrosion, and loads from system.

The corrosion issue may be unavoidable for a given environmental condition. However, failure resulting from corrosion may be prevented by diligent system maintenance and adequate component replacement regime in line with the severity of the environment in which the plant operates.

Please kindly refer to our [Technical Bulletin ref.:E11-0002-01 Flexible coupling hardware corrosion](#)

Trouble shooting technical bulletin available upon request. Contact Piedmont for details (ref.: E11-0004-00).

5.2 Coupling Maintenance

Like any other mechanical parts and components, regular maintenance of coupling ensures its reliability and maximizes the functional life-cycle along with proper operation of the entire system. The maintenance of coupling comprises of few basic tasks, including:

1. Performing visual inspections to check signs of wear, cracks, mechanical deformation, leakages and rusts (particularly the nuts and bolts, and the area of housing underneath the bolt head and washer) during routine preventive maintenance of entire system. If corrosion is evident, take appropriate actions, such as replacement of fasteners and gaskets.

Please kindly refer to our [Technical Bulletin ref.:E11-0002-01 Flexible coupling hardware corrosion](#)



2. Every year perform visual inspection of all the coupled joints. If needed disassemble the joint following Piedmont guidelines and replace the bolts. The suggestive replacement period of gaskets and SS316 fasteners is 5 years. Note that general shelf life of Piedmont EPDM gasket is 3-5 years (sulfur cured) or 5-10 years (peroxide cured). Fasteners of duplex 2205 and superduplex 2507 / S32760 will last longer than SS316 ones in these corrosive environments.
3. Failure of bolt due to crevice corrosion can be anticipated from early signs of corrosion initiation in the visible region of bolt. Signs of corrosion in an open and aerated location – e.g. presence of small corroded spots on bolt head will almost always indicate that a more corroded region exists within the bolt.

Please kindly refer to our [Technical Bulletin ref.:E11-0002-01 Flexible coupling hardware corrosion](#)

4. The Piedmont couplings do not require any regular changing of lubricants unless the couplings are disassembled during preventive maintenance of other components – e.g. maintenance of pumps. In such a case, follow the procedure of disassembly as depicted earlier. For reinstallation, meticulously follow the installation instructions included above. Replace any fasteners and gaskets showing visible signs of damage.
5. We recommend to perform a regular fresh water cleaning / flushing of the couplings piping joints in order to decrease the potentially damaging salts/ and chlorides particles deposit on the surface and bolts crevices which may favor CSCC (chlorides stress corrosion cracking). And, to avoid as much as possible: leakages and stagnant water on the couplings.

5.3 Failure Detection and Troubleshooting

Premature failure of coupling joints can be detected by means of visual clues, such as:

- Any indication of component damage.
- Presence of rust (minimum sign of rust requires parts replacement).
- Component cracks or fractures.
- Leakage.
- Gap between the installed housing segments exposing gasket.

Other than these visually observable signs, the following external signs would indicate an occurrence of potential coupling failure:

- Loss of pressure within the piping system.
- Sudden noise, indicating loss of integrity of the piping system.

In case of any of the above, the following troubleshooting steps must be carried out:

1. Turn off the plant/skid followed by depressurization of piping systems.
2. Carefully disassemble the coupling assembly following the steps mentioned earlier.
3. Check the gasket and look for any visual leakage. Also check the quality of lubricants and verify the water content for assessing contaminations resulting from the leakage of gasket.
4. Typically, nuts and bolts will fail before the housing. Therefore, check if any mechanical deformation, such as a bent bolt, is evident.
5. Look for material deformation, cracks and fractures at different locations of coupling housing, i.e. ear of the couplings (area adjacent to the socket of coupling, where the bolts are inserted), base of coupling housing, coupling keys and both internal and external surfaces.
6. Check the condition of pipe grooves for any damage and deformation.
7. Replace housing, fasteners and gaskets as needed.
8. Record the incident, complete the nonconformity form included in Appendix E, and inform Piedmont or your local Piedmont representative.



WARNING

- For any sign of failure, turn off the system immediately followed by depressurization of the system. Noncompliance with this instruction may result in equipment damage, serious personal injury or loss of life.
- For disassembly and reassembly follow all the specified instructions meticulously.

6 HYDROSTATIC TEST

It is allowed a single coupling hydrostatic proof test at 1.5 x rating pressure before being put in operation at its rated pressure or less.

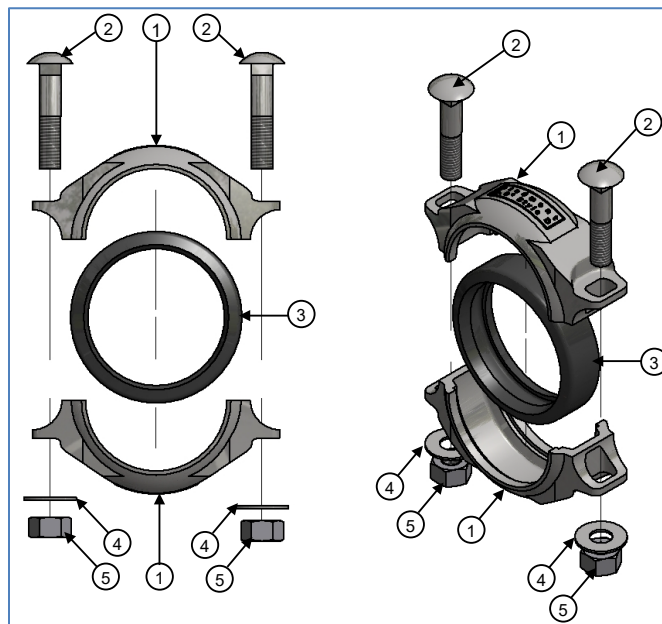
7 SPARE PARTS

The gaskets (3) and hardware components [bolt (2), nut (5) and washer (4)] are consumable components of the flexible couplings. They should be checked periodically and replaced when not in good condition:

--hardware: corrosion, deformation, leakages, threads wear.

--gaskets: deformation, punctures, leakages.

Contact Piedmont for spare parts.



APPENDIX A: BOLT & RODS SIZE

Table A.1: Bolt Sizes and Pitch for Different Styles of Couplings (Metric series)							
Coupling size (inch)	Style H	Style S	Style D	Style B	Style F / M	Style K / N	Style P
	High pressure applications			Medium pressure applications		Low pressure applications	
¾	-	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60	M8 - 1.25 x 50	M8 - 1.25 x 50	M8 - 1.25 x 50
1	M12 - 1.75 x 65	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60	M8 - 1.25 x 50	M8 - 1.25 x 50	M8 - 1.25 x 50
1 ¼	-	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60	M8 - 1.25 x 50	M8 - 1.25 x 50	M8 - 1.25 x 50
1 ½	M12 - 1.75 x 65	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60	M8 - 1.25 x 50	M8 - 1.25 x 50	M8 - 1.25 x 50
2	M16 - 2 x 65	M12 - 1.75 x 65	M12 - 1.75 x 65	M10 - 1.5 x 60	M8 - 1.25 x 50	M8 - 1.25 x 50	M8 - 1.25 x 50
2 ½	M16 - 2 x 65	M14 - 2 x 80	M14 - 2 x 65	M14 - 2 x 65	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60
3	M20 - 2.5 x 85	M14 - 2 x 80	M14 - 2 x 65	M14 - 2 x 65	M10 - 1.5 x 60	M10 - 1.5 x 60	M10 - 1.5 x 60
4	M20 - 2.5 x 85	M16 - 2 x 85	M16 - 2 x 85	M16 - 2 x 85	M14 - 2 x 80	M12 - 2 x 80	M12 - 1.75 x 80
5	-	-	M20 - 2.5 x 110	M20 - 2.5 x 110	-	-	-
6	-	-	M20 - 2.5 x 110	M20 - 2.5 x 110	M14 - 2 x 110	M14 - 2 x 110	M12 - 1.75 x 105
8	-	-	M22 - 2.5 x 130	M22 - 2.5 x 130	M16 - 2 x 130	M16 - 2 x 130	M12 - 1.75 x 105
10	-	-	M27 - 3 x 170	M27 - 3 x 170	M16 - 2 x 130	M16 - 2 x 130	-
12	-	-	M27 - 3 x 170	M27 - 3 x 170	M16 - 2 x 130	M16 - 2 x 130	-
14	-	-	M27 - 3 x 170	M27 - 3 x 170	M27 - 3 x 170	M27 - 3 x 170	-
16	-	-	M27 - 3 x 170	M27 - 3 x 170	M27 - 3 x 170	M27 - 3 x 170	-

NOTE

- Inches series bolting available upon request
- Available materials: SS316L / SS316, duplex S32205 (2205) and super duplex S32750 (2507) bolts, nuts and washers. Silicon-bronze nuts upon request.
- Longer bolts maybe used in some cases, upon Piedmont approval. For instance, M16x85mm instead of M16x65mm for Style H.
- Hexagonal bolts also used in M20 and bigger sizes.
- D18" coupling bolt: M27-3 x 170. D20" coupling bolt: M30 - 3 x 150. KL076 coupling bolt: M10x60 (since 2023). X6" coupling bolt: M20x110.
- M10 - 1.5 x 60mm replaces 50mm bolt length (since 2023)

Table A.2: Rods Sizes Pitch for Different Styles of Couplings (Metric series)							
Coupling size (inch)	Style H	Style S	Style D	Style B	Style F	Style K	Style P
	High pressure applications			Medium pressure applications		Low pressure applications	
¾	-	TR M10 -75 / -65	TR M10 -75 / -65	TR M10 -75 / -65	TR M8 -65	TR M8 -65	TR M8 -65
1	TR M12 -80 / -90	TR M10 -75 / -65	TR M10 -75 / -65	TR M10 -75 / -65	TR M8 -65	TR M8 -65	TR M8 -65
1 ¼	TR M12 -80 / -90	TR M10 -75 / -65	TR M10 -75 / -65	TR M10 -75 / -65	TR M8 -65	TR M8 -65	TR M8 -65
1 ½	TR M12 -80 / -90	TR M10 -75 / -65	TR M10 -75 / -65	TR M10 -75 / -65	TR M8 -65	TR M8 -65	TR M8 -65
2	-	TR M12 -80 / -90	TR M12 -80 / -90	TR M10 -75 / -65	TR M8 -65	TR M8 -65	TR M8 -65
2 ½	-	TR M14 -89 / -90	TR M14 -80 / -89 / -90	TR M14 -80 / -89 / -90	TR M10 -75 / -65	TR M10 -75 / -65	TR M10 -75 / -65
3	-	TR M14 -89 / -90	TR M14 -80 / -89 / -90	TR M14 -80 / -89 / -90	TR M10 -75 / -65 TBC	TR M10 -75 / -65	TR M10 -75 / -65 TBC
4	-	TR M16 -100	TR M16 -100	TR M16 -100	TR M14 -80 / -90	TR M14 -80 / -90	TR M12 -90
5	-	-	TR M20 -135	-	-	-	-
6	-	-	TR M20 -135	TR M20 -135	TR M14 -115	TR M14 -115	-
8	-	-	-	-	-	-	-
10	-	-	TR M27 -180	TR M27 -180	-	-	-
12	-	-	TR M27 -180	TR M27 -180	-	-	-
14	-	-	TR M27 -180	TR M27 -180	TR M27 -180	TR M27 -180	-
16	-	-	-	-	TR M27 -180	TR M27 -180	-

NOTE

- TRM: Threaded rods metric (DIN-976)

APPENDIX B: CUT AND ROLL GROOVE SPECIFICATIONS

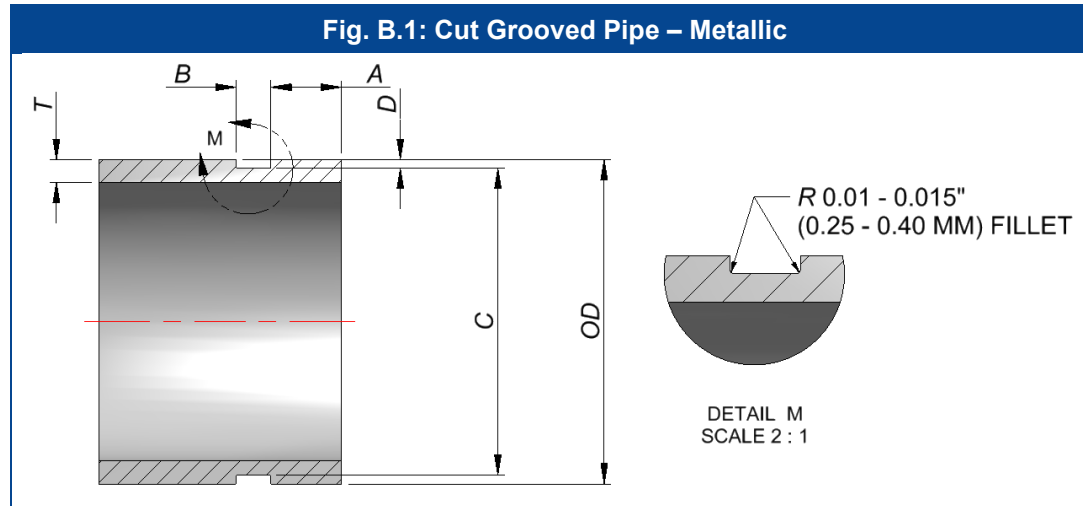


Table B.1: Cut Groove Specifications for Metallic Pipes in Standard Unit

Nominal pipe size, NPS (in.)	OD and tolerance (in.)			A (in.) (± 0.031")	B (in.) (+0.031",-0)	C (in.)		D (in.)	Min. T (in.)
	Dia.	Tol. (+)	Tol (-)			Dia.	Tol (+0)		
¾	1.050	0.010	0.010	0.625	0.312	0.938	-0.015	0.056	0.113
1	1.315	0.013	0.013	0.625	0.312	1.190	-0.015	0.063	0.133
1 ¼	1.660	0.016	0.016	0.625	0.312	1.535	-0.015	0.063	0.140
1 ½	1.900	0.019	0.019	0.625	0.312	1.775	-0.015	0.063	0.145
2	2.375	0.024	0.024	0.625	0.312	2.250	-0.015	0.063	0.154
2 ½	2.875	0.029	0.029	0.625	0.312	2.720	-0.018	0.078	0.188
3	3.500	0.035	0.031	0.625	0.312	3.344	-0.018	0.078	0.188
4	4.500	0.045	0.031	0.625	0.375	4.334	-0.020	0.083	0.203
5	5.563	0.056	0.031	0.625	0.375	5.395	-0.022	0.084	0.203
6	6.625	0.062	0.031	0.625	0.375	6.455	-0.022	0.085	0.219
8	8.625	0.062	0.031	0.750	0.438	8.441	-0.025	0.092	0.238
10	10.750	0.062	0.031	0.750	0.500	10.562	-0.027	0.094	0.250
12	12.750	0.062	0.031	0.750	0.500	12.531	-0.030	0.109	0.279
14	14.000	0.062	0.031	0.938	0.500	13.781	-0.030	0.109	0.281
16	16.000	0.062	0.031	0.938	0.500	15.781	-0.030	0.109	0.312

Table B.2: Cut Groove Specifications for Metallic Pipes in Metric Unit									
Diameter Nominal, DN (mm)	OD and tolerance (mm)			A (mm)	B (mm)	C (mm)		D (mm)	Min. T (mm)
	Dia.	Tol. (+)	Tol. (-)	(± 0.78 mm)	(+0.78 mm,-0)	Dia.	Tol (+0)		
20	26.67	0.25	0.25	15.88	7.92	23.83	-0.38	1.42	2.87
25	33.40	0.33	0.33	15.88	7.92	30.23	-0.38	1.60	3.38
32	42.16	0.41	0.41	15.88	7.92	38.99	-0.38	1.60	3.56
40	48.26	0.48	0.48	15.88	7.92	45.09	-0.38	1.60	3.68
50	60.33	0.61	0.61	15.88	7.92	57.15	-0.38	1.60	3.91
65	73.03	0.74	0.74	15.88	7.92	69.10	-0.46	1.98	4.78
80	88.90	0.89	0.79	15.88	7.92	84.94	-0.46	1.98	4.78
100	114.30	1.14	0.79	15.88	9.53	110.08	-0.51	2.11	5.16
125	141.30	1.42	0.79	15.88	9.53	137.03	-0.56	2.13	5.16
150	168.28	1.57	0.79	15.88	9.53	163.96	-0.56	2.16	5.56
200	219.08	1.57	0.79	19.05	11.13	214.40	-0.64	2.34	6.05
250	273.05	1.57	0.79	19.05	12.70	268.27	-0.69	2.39	6.35
300	323.85	1.57	0.79	19.05	12.70	318.29	-0.76	2.77	7.09
350	355.60	1.57	0.79	23.83	12.70	350.04	-0.76	2.77	7.14
400	406.40	1.57	0.79	23.83	12.70	400.84	-0.76	2.77	7.92

NOTE

- Pipe ends are to be square cut and shall be neat and free from imperfections that may affect durability, operability and safety. Metal shall be free from fins, burrs and sharp/rough edges; flame cutting is not permitted. Break all the corners with 0.01 – 0.03 inch (0.25 – 0.75 mm) chamfer unless otherwise specified. In the event of a conflict between these notes and references cited in the drawings, except for detail specifications, these notes shall take precedence.
- Contact Piedmont for the D18” and D20” cut groove specification. Available in the correspondent technical drawing
- This cut groove specification is also valid for HDPE and GRP piping couplings joints.

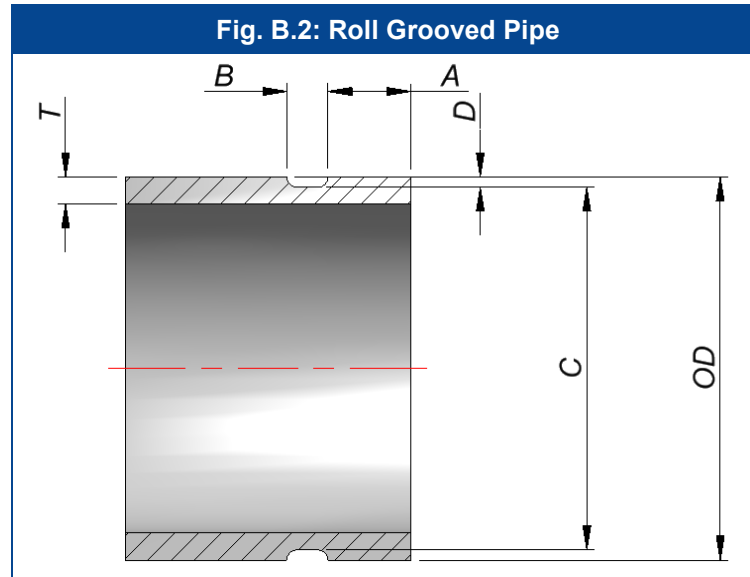


Table B.3: Roll Groove Pipe Specifications in Standard Unit

Nominal pipe size (in.)	OD and tolerance (in.)			A (in.) (+0.015", -0.030")	B (in.) (+0.031", -0.015")	C (in.)		D (in.)	Min. T (in.)
	Dia.	Tol. (+)	Tol. (-)			Dia.	Tol (+0)		
¾	1.050	0.010	0.010	0.625	0.281	0.938	-0.015	0.056	0.065
1	1.315	0.013	0.013	0.625	0.281	1.190	-0.015	0.063	0.065
1 ¼	1.660	0.016	0.016	0.625	0.281	1.535	-0.015	0.063	0.065
1 ½	1.900	0.016	0.016	0.625	0.281	1.775	-0.015	0.063	0.065
2	2.375	0.024	0.016	0.625	0.344	2.250	-0.015	0.063	0.065
2 ½	2.875	0.029	0.016	0.625	0.344	2.720	-0.015	0.078	0.083
3	3.500	0.030	0.018	0.625	0.344	3.344	-0.015	0.078	0.083
4	4.500	0.035	0.020	0.625	0.344	4.344	-0.015	0.083	0.083
5	5.563	0.056	0.022	0.625	0.344	5.395	-0.015	0.084	0.109
6	6.625	0.050	0.024	0.625	0.344	6.455	-0.015	0.085	0.109
8	8.625	0.050	0.024	0.750	0.469	8.441	-0.020	0.092	0.109
10	10.750	0.050	0.025	0.750	0.469	10.562	-0.025	0.094	0.134
12	12.750	0.050	0.025	0.750	0.469	12.531	-0.025	0.109	0.156
14	14.000	0.060	0.025	0.938	0.469	13.781	-0.025	0.109	0.156
16	16.000	0.060	0.025	0.938	0.469	15.781	-0.025	0.109	0.165

Table B.4: Roll Groove Pipe Specifications in Metric Unit									
Diameter Nominal, DN (mm)	OD and tolerance (mm)			A (mm) (+0.38 mm, -0.76 mm)	B (mm) (+0.78 mm, -0.38 mm)	C (mm)		D (mm)	Min. T (mm)
	Dia.	Tol. (+)	Tol. (-)			Dia.	Tol (+0)		
20	26.67	0.25	0.25	15.88	7.14	23.83	-0.38	1.42	1.65
25	33.40	0.33	0.33	15.88	7.14	30.23	-0.38	1.60	1.65
32	42.16	0.41	0.41	15.88	7.14	38.99	-0.38	1.60	1.65
40	48.26	0.41	0.41	15.88	7.14	45.09	-0.38	1.60	1.65
50	60.33	0.61	0.41	15.88	8.74	57.15	-0.38	1.60	1.65
65	73.03	0.74	0.41	15.88	8.74	69.09	-0.38	1.98	2.11
80	88.90	0.76	0.46	15.88	8.74	84.94	-0.38	1.98	2.11
100	114.30	0.89	0.51	15.88	8.74	110.34	-0.38	2.11	2.11
125	141.30	1.42	0.56	15.88	8.74	137.03	-0.38	2.13	2.77
150	168.28	1.27	0.61	15.88	8.74	163.96	-0.38	2.16	2.77
200	219.08	1.27	0.61	19.05	11.91	214.40	-0.51	2.34	2.77
250	273.05	1.27	0.64	19.05	11.91	268.27	-0.64	2.39	3.40
300	323.85	1.27	0.64	19.05	11.91	318.29	-0.64	2.77	3.96
350	355.60	1.52	0.64	23.83	11.91	350.04	-0.64	2.77	3.96
400	406.40	1.52	0.64	23.83	11.91	400.84	-0.64	2.77	4.19

NOTE

- Pipe ends must be neat and free from imperfections that may affect durability, operability and safety. Metal shall be free from fins, burrs and sharp/rough edges; flame cutting is not permitted. Break all corners with 0.01 – 0.03 inch (0.25 – 0.76 mm) chamfer unless otherwise specified. In the event of a conflict between these notes and references cited in the drawings, except for detail specifications, these notes shall take precedence.
- Some roll grooves joint pressure ratings are shown in Appendix G.

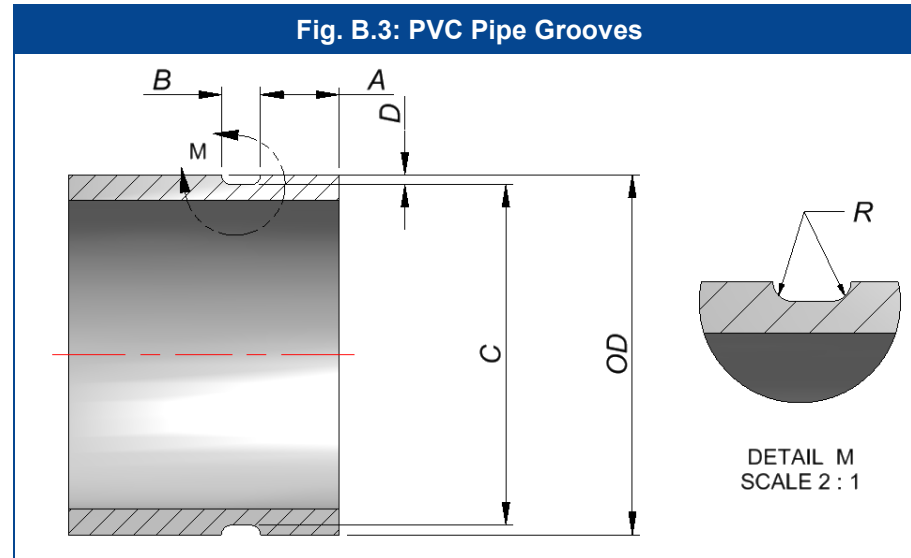


Table B.5: PVC Pipe Groove Specifications in Standard Unit

Nominal pipe size, NPS (in.)	OD (in.)	A (in.) (± 0.032")	B (in.) (± 0.032")	C (in.)		D (in.)	R (in)
				Dia.	Tol (+0)		
¾	1.050	0.625	0.312	0.938	-0.015	0.056	0.056
1	1.315	0.625	0.312	1.190	-0.015	0.063	0.062
1 ¼	1.660	0.625	0.312	1.535	-0.015	0.063	0.062
1 ½	1.900	0.625	0.312	1.775	-0.015	0.063	0.062
2	2.375	0.625	0.312	2.250	-0.015	0.063	0.062
2 ½	2.875	0.625	0.312	2.720	-0.018	0.078	0.078
3	3.500	0.625	0.312	3.344	-0.018	0.078	0.078
4	4.500	0.625	0.375	4.334	-0.020	0.083	0.083
5	5.563	0.625	0.375	5.395	-0.022	0.084	0.083
6	6.625	0.625	0.375	6.455	-0.022	0.085	0.085
8	8.625	0.750	0.438	8.441	-0.025	0.092	0.092
10	10.750	0.750	0.500	10.562	-0.027	0.094	0.094
12	12.750	0.750	0.500	12.531	-0.030	0.109	0.109
14	14.000	0.938	0.500	13.781	-0.030	0.109	0.109
16	16.000	0.938	0.500	15.781	-0.030	0.109	0.109

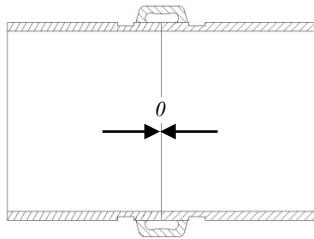
Table B.6: PVC Pipe Groove Specifications in Metric Unit

Diameter Nominal, DN (mm)	OD (mm)	A (mm) (± 0.78 mm)	B (mm) (± 0.78 mm)	C (mm)		D (mm)	R (mm)
				Dia.	Tol (+0)		
20	26.67	15.88	7.92	23.83	-0.38	1.42	1.42
25	33.40	15.88	7.92	30.23	-0.38	1.60	1.57
32	42.16	15.88	7.92	38.99	-0.38	1.60	1.57
40	48.26	15.88	7.92	45.09	-0.38	1.60	1.57
50	60.33	15.88	7.92	57.15	-0.38	1.60	1.57
65	73.03	15.88	7.92	69.10	-0.46	7.70	1.98
80	88.90	15.88	7.92	84.94	-0.46	1.98	1.98
100	114.30	15.88	9.53	110.08	-0.51	2.11	2.11
125	141.30	15.88	9.53	137.03	-0.56	2.13	2.11
150	168.28	15.88	9.53	163.96	-0.56	2.16	2.16
200	219.08	19.05	11.13	214.40	-0.64	2.34	2.34
250	273.05	19.05	12.70	268.27	-0.69	2.39	2.39
300	323.85	19.05	12.70	318.29	-0.76	2.79	2.77
350	355.60	23.83	12.70	350.04	-0.76	2.77	2.77
400	406.40	23.83	12.70	400.84	-0.76	2.79	2.77

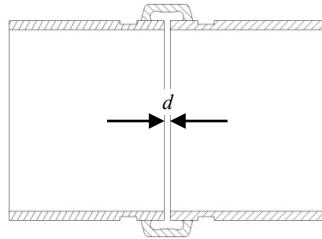
NOTE

- Pipe ends must be neat and free from imperfections, dents, cracks, which may affect durability, operability and safety. In the event of a conflict between these notes and references cited in the drawings, except for detail specifications, these notes shall take precedence.
- Check the PVC pipe manufacturer pressure rating limit not be exceeded. The PVC pipe working pressure limit may be lower than the coupling pressure rating to be installed.

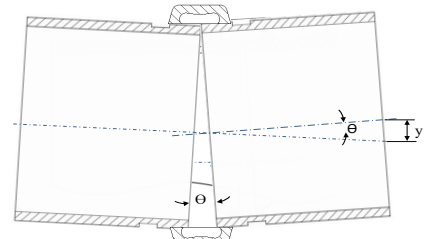
APPENDIX C: ALLOWABLE PIPE END SEPARATION GAPS & DEFLECTIONS



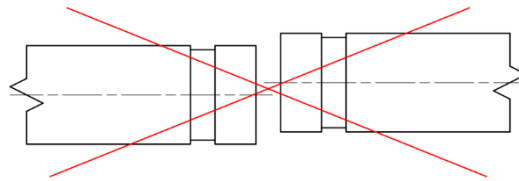
Minimum allowable end pipe separation



Maximum allowable end pipe separation



Maximum deflection



By design, the radial misalignment / offset is not allowed in flexible couplings. It should be kept to a minimum.

Table C.1: Allowable Pipe End Separations and Deflections

NPS (inch) DN (mm)	Maximum allowable pipe end separation (inch) (mm)		Maximum deflection	
	Cut grooves	Roll grooves	θ (degree)	y (inch/ft) (mm/m)
3/4 20	0.10 2.53	0.06 1.60	3.44°	0.72 60
1 25	0.12 2.94	0.06 1.60	2.72°	0.57 48
1 1/4 32	0.10 2.53	0.06 1.60	2.15°	0.45 38
1 1/2 40	0.10 2.53	0.06 1.60	1.91°	0.40 33
2 50	0.10 2.53	0.06 1.60	1.53°	0.32 27
2 1/2 65	0.10 2.53	0.06 1.60	1.24°	0.26 22
3 80	0.10 2.53	0.06 1.60	1.05°	0.22 18
4 100	0.25 6.40	0.13 3.20	1.62°	0.34 28
5 125	0.25 6.34	0.13 3.20	1.32°	0.27 22
6 150	0.25 6.40	0.13 3.20	1.10°	0.23 19
8 200	0.25 6.40	0.13 3.20	0.86°	0.18 15
10 250	0.25 6.40	0.13 3.20	0.62°	0.13 11
12 300	0.25 6.40	0.13 3.20	0.53°	0.11 9
14 350	0.25 6.40	0.13 3.20	0.74°	0.15 13
16 400	0.294 7.44	0.18 4.57	0.64°	0.14 11

NOTE

- The allowable pipe end separation gaps and angular deflections are applicable for cut/roll grooved metallic pipes – prepared as per Piedmont Pacific groove pipe specifications.
- End separation gaps presented in Table C.1 are applicable for nominal values of pipe gasket seat dimension and coupling key-to-key to distance. Contact Piedmont for higher requirement of end separation gaps.
- The angular deflections are calculated based on maximum allowable separation gaps for roll grooves. For higher angular deflections, consult with Piedmont.
- Gasket seat dimension is to be measured from square-cut end of pipe. Beveled end pipe is not recommended.
- Pipe ends are to be square cut, shall be neat and free from imperfections that may affect durability, operability and safety. Pipe structure shall be free from fins, burrs and sharp/rough edges; flame cutting is not permitted.
- Contact Piedmont for the D18" and D20" allowable pipe end separation gaps. Available in the correspondent technical drawing.

APPENDIX D: MAXIMUM ALLOWABLE TORQUE VALUES

Table D.1: Torque Values for Dry Conditions (when installing silicon / NAB bronze nuts)						
NPS (inch) DN (mm)	Torque (ft.lb) N.m					
	Style S / C	Style D	Style B	Style F / N	Style K / M	Style P
¾ 20	(18.0) 24.0	(18.0) 24.0	-	(11.0) 15.0	(11.0) 15.0	(5.0) 7.0
1 25	(18.0) 24.0	(18.0) 24.0	(20.0) 27.0	(11.0) 15.0	(11.0) 15.0	(5.0) 7.0
1 ¼ 32	(18.0) 24.0	(18.0) 24.0	(20.0) 27.0	(11.0) 15.0	(11.0) 15.0	(5.0) 7.0
1 ½ 40	(18.0) 24.0	(18.0) 24.0	(20.0) 27.0	(11.0) 15.0	(11.0) 15.0	(5.0) 7.0
2 50	(40.0) 54.0	(40.0) 54.0	(20.0) 27.0	(11.0) 15.0	(11.0) 15.0	(5.0) 7.0
2 ½ 65	(40.0) 54.0	(40.0) 54.0	(45.0) 61.0	(20.0) 27.0	(20.0) 27.0	(7.5) 10.0
3 80	(40.0) 54.0	(40.0) 54.0	(45.0) 61.0	(20.0) 27.0	(20.0) 27.0	(7.5) 10.0
4 100	(96.0) 130.0	(96.0) 130.0	(96.0) 130.0	(45.0) 61.0	(45.0) 61.0	(10.0) 14.0
5 125	-	(131.0) 177.0	-	-	-	-
6 150	-	(131.0) 177.0	(131.0) 177.0	(45.0) 61.0	(45.0) 61.0	(10.0) 14.0
8 200	-	(202.0) 273.0	(202.0) 273.0	(96.0) 130.0	(96.0) 130.0	(10.0) 14.0
10 250	-	(299.0) 405.0	(299.0) 405.0	(96.0) 130.0	(96.0) 130.0	-
12 300	-	(299.0) 405.0	(299.0) 405.0	(96.0) 130.0	(96.0) 130.0	-
14 350	-	(299.0) 405.0	(299.0) 405.0	(299.0) 405.0	(299.0) 405.0	-
16 400	-	(299.0) 405.0	-	(299.0) 405.0	(299.0) 405.0	-

NOTE (Table D.1.a)

- Silicon bronze nuts are provided upon request. Although they are not recommended for severe SWRO piping racks corrosion environments. Please kindly refer to our [Technical Bulletin ref.:E11-0002-01 Flexible coupling hardware corrosion](#)
- Couplings with silicon-bronze (SB) / nickel aluminium bronze (NAB) nuts do not require any anti-seize compound.

Table D.2: Torque Values for Lubricated Conditions

(when installing SS316, duplex 2205 or superduplex 2507 nuts)

NPS (inch) DN (mm)	Torque (ft.lb) N.m						
	Style H	Style S / C	Style D	Style B	Style F / N	Style K / M	Style P
¾ 20	-	(17.0) 23.0	(17.0) 23.0	-	(10.0) 14.0	(10.0) 14.0	(5.0) 7.0
1 25	(38.0) 51.0	(17.0) 23.0	(17.0) 23.0	(17.0) 23.0	(10.0) 14.0	(10.0) 14.0	(5.0) 7.0
1 ¼ 32	-	(17.0) 23.0	(17.0) 23.0	(17.0) 23.0	(10.0) 14.0	(10.0) 14.0	(5.0) 7.0
1 ½ 40	(38.0) 51.0	(17.0) 23.0	(17.0) 23.0	(17.0) 23.0	(10.0) 14.0	(10.0) 14.0	(5.0) 7.0
2 50	(82.0) 111.0	(38.0) 51.0	(38.0) 51.0	(17.0) 23.0	(10.0) 14.0	(10.0) 14.0	(5.0) 7.0
2 ½ 65	(82.0) 111.0	(38.0) 51.0	(38.0) 51.0	(38.0) 51.0	(17.0) 23.0	(17.0) 23.0	(7.5) 10.0
3 80	(111.0) 150.0	(38.0) 51.0	(38.0) 51.0	(38.0) 51.0	(17.0) 23.0	(17.0) 23.0	(7.5) 10.0
4 100	(111.0) 150.0	(82.0) 111.0	(82.0) 111.0	(82.0) 111.0	(38.0) 51.0	(38.0) 51.0	(10.0) 14.0
5 125	-	-	(111.0) 150.0	-	-	-	-
6 150	-	-	(111.0) 150.0	(111.0) 150.0	(38.0) 51.0	(38.0) 51.0	(10.0) 14.0
8 200	-	-	(172.0) 233.0	(172.0) 233.0	(82.0) 111.0	(82.0) 111.0	(10.0) 14.0
10 250	-	-	(254.0) 344.0	(254.0) 344.0	(82.0) 111.0	(82.0) 111.0	-
12 300	-	-	(254.0) 344.0	(254.0) 344.0	(82.0) 111.0	(82.0) 111.0	-
14 350	-	-	(254.0) 344.0	(254.0) 344.0	(254.0) 344.0	(254.0) 344.0	-
16 400	-	-	(254.0) 344.0	-	(254.0) 344.0	(254.0) 344.0	-

NOTE (Table D.2.a)

- If stainless steel nuts (SS316, duplex 2205, superduplex 2507) are used with stainless steel bolts, commercial anti-seize compound should be applied to the mating surfaces of bolts and nuts (threads), and under the bolt head to increase against crevice chlorides corrosion. For anti-seize compounds, Piedmont recommends molybdenum disulfide based anti-seize formulations. Contact Piedmont for details.
- There is no need to add lubrication on top in case that the hardware has been already ordered (and supplied) with dry lubrication from factory (Gleitmo 615 or similar).
- D18" lubricated bolt torque: 344 N*M max.
- D20" lubricated bolt torque: 465 N*M max.

APPENDIX E: NONCONFORMITY FORM

The client should complete the nonconformity form for any occurrence of coupling failure. Please use an additional page if the space below is not adequate. Additional references, pictures and documents can be added to this form accordingly. A proper investigation to determine the root cause may require more information.

E.1 General Information

Client's name		Date	
Project Name (if applicable)		PO No. / SO No.	

E.2 Nonconformity/Failure

Coupling style (s) and sizes		Quantities (specify separately for different styles)	
Description of the defect/failure			

E.3 Technical Questionnaire

<p>Operating pressure:</p> <p>Stipulate the operating pressures of the failed component(s).</p>	
<p>Installation time-line :</p> <p>State how long the coupling(s) was operational after installation, before the failure took place.</p>	
<p>Installation information:</p> <p>Specify about installation torque</p>	
<p>Type of water and environmental condition:</p> <p>Describe briefly the type of water (seawater, brackish water, wastewater, etc.), and environmental condition (corrosive, acidic, etc.)</p>	
<p>Location of coupled joint:</p> <p>Specify the location of the joint that failed with respect to overall system. Identify any major system components (if applicable), such as: axial piston pumps, ERD device, pressure vessels, etc. adjacent to the coupled joint. Please use proper description along with pictures and required system diagrams.</p>	

APPENDIX F: END LOADS

The coupling keys are subjected to pressure thrust, commonly known as end load, resulting from internal pressure. At high working pressure, a flexible coupling will move axially to its maximum allowable pipe end separation gap because of the thrusts exerted by end loads. The bearing wall of the groove is pulled against the inside face of the coupling key preventing the pipes from separation (Fig.1):

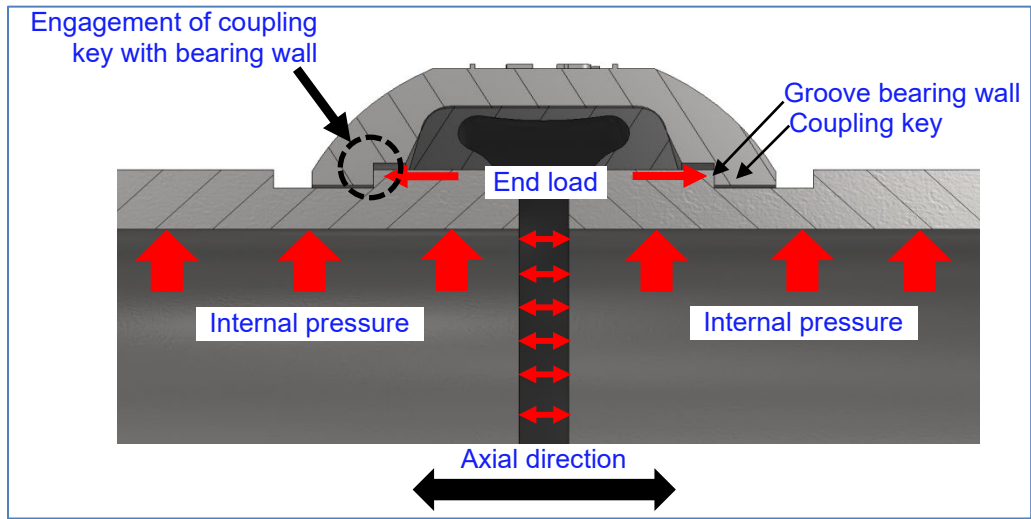


Fig.1 – Coupling key engagement.

The piping must be supported in accordance with good piping practice such that the pipe joints are not subject to bending, shear or any other external loads. It is specially prohibited to suspend or hang any operating device from a coupled pipe joint. Special attention should be taken to big size ($\geq 10''$) flexible couplings in vertical piping applications, and branch connections not properly supported close to change of flow directions. Contact Piedmont for details.

Please find attached the maximum **end load** from all internal and/or external forces, to which the flexible coupling joint should be subjected under working conditions (Table 1; Fig.2). This is populated by multiplying the coupling's pressure rating by the cross-sectional area of the pipe of interest.

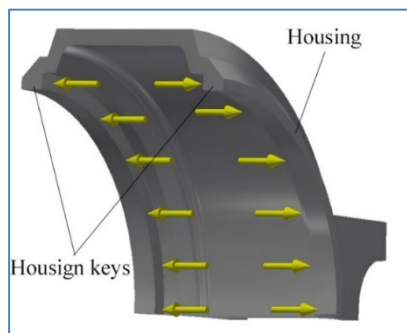


Fig 2: End load acting on coupling keys

E-210323-01 rev. 07/03/2023

TABLE 1: FLEXIBLE COUPLINGS ALLOWABLE END LOADS



Nominal Pipe size NPS (in)	Style D couplings: psi (lbf/in ²)		Style B couplings: psi (lbf/in ²)		Style S couplings: psi (lbf/in ²)		Style H couplings: psi (lbf/in ²)		Style F couplings: psi (lbf/in ²)		
	Working rated pressure:	1200	Working rated pressure:	600	Working rated pressure:	1500	Working rated pressure:	2000	Working rated pressure:	600	End Load (lbf)
3/4	1.050	1039	3/4	520	3/4	1299			3/4	600	520
1	1.315	1630	1	815	1	2037		2716	1	600	815
1 1/4	1.660	2597	1 1/4	1299	1 1/4	3246			1 1/4	600	1299
1 1/2	1.900	3402	1 1/2	1701	1 1/2	4253		5671	1 1/2	600	1701
2	2.375	5316	2	2658	2	6645		8860	2	600	2658
2 1/2	2.875	7790	2 1/2	3895	2 1/2	9738		12984	2 1/2	600	3895
3	3.500	11545	3	5773	3	14432		19242	3	600	5773
4	4.500	19085	4	9543	4	23856		31809	4	600	9543
5	5.563	29167	5	14583							
6	6.625	41366	6	20683					6	450	15512
8	8.625	70112	8	35056					8	450	26292
10	10.750	108915	10	54458					10	450	40843
12	12.750	153212	12	76606					12	450	57454
14	14.000	184726	14	92363					14	450	69272
16	16.000	241274	16	120637					16	600	120637

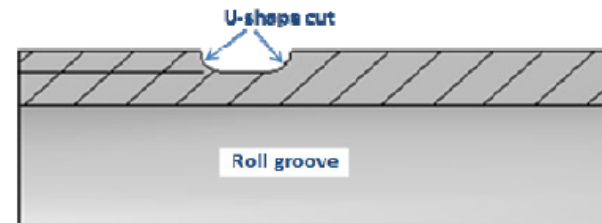
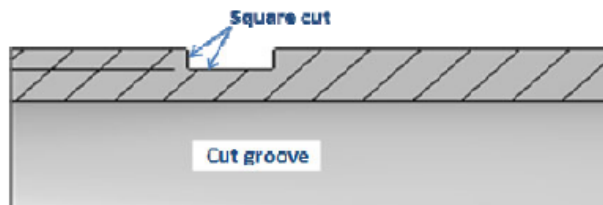
APPENDIX G: ROLL GROOVE WORKING PRESSURES



ROLL GROOVE PIPE COUPLINGS PRESSURE RATING

rev.4: 2025-02-07

Nominal Pipe Size	Pipe O.D.	ASME Pipe Schedule + Groove type	Pipe Wall thickness (ASME Sch. No.)	AWWA-C606 Table 5: roll groove 'Tmin' wall thickness	Style B couplings joint	Style K couplings joint	Style M couplings joint	Style P couplings joint	Style D couplings joint
					Allowable max. Working pressure	Allowable max. Working pressure	Allowable max. Working pressure	Allowable max. Working pressure	Allowable max. Working pressure
Inches / DN mm	Inches / mm		Inches / mm	Inches / mm	psi / bar	psi / bar	psi / bar	psi / bar	psi / bar
3/4" / DN20	1.050 (26.70)	Sch. 40S Cut groove (or heavier)	0.113 / 2.87	--	600 psi (rated pressure)	450 psi (rated pressure)	--	250 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.113 / 2.87	0.065 / 1.65	600 psi	450 psi	--	150 psi	750 psi
		Sch. 10S Roll groove	0.083 / 2.11	0.065 / 1.65	500 psi	300 psi	--	150 psi	500 psi
1" / DN25	1.315 (33.40)	Sch. 40S Cut groove (or heavier)	0.133 / 3.38	--	600 psi (rated pressure)	450 psi (rated pressure)	--	250 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.133 / 3.38	0.065 / 1.65	600 psi	450 psi	--	150 psi	750 psi
		Sch. 10S Roll groove	0.109 / 2.77	0.065 / 1.65	500 psi	300 psi	--	150 psi	500 psi
1 1/2" / DN40	1.900 (48.26)	Sch. 40S Cut groove (or heavier)	0.145 / 3.68	--	600 psi (rated pressure)	450 psi (rated pressure)	--	250 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.145 / 3.68	0.065 / 1.65	600 psi	450 psi	--	150 psi	750 psi
		Sch. 10S Roll groove	0.109 / 2.77	0.065 / 1.65	500 psi	300 psi	--	150 psi	500 psi
2" / DN50	2.375 (60.33)	Sch. 40S Cut groove (or heavier)	0.154 / 3.91	--	600 psi (rated pressure)	450 psi (rated pressure)	--	250 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.154 / 3.91	0.065 / 1.65	600 psi	450 psi	--	150 psi	750 psi
		Sch. 10S Roll groove	0.109 / 2.77	0.065 / 1.65	500 psi	300 psi	--	150 psi	500 psi
2 1/2" / DN65	2.875 (73.03)	Sch. 40S Cut groove (or heavier)	0.203 / 5.16	--	600 psi (rated pressure)	300 psi (rated pressure)	450 psi (rated pressure)	250 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.203 / 5.16	0.083 / 2.11	600 psi	300 psi	450 psi	150 psi	750 psi
		Sch. 10S Roll groove	0.120 / 3.05	0.083 / 2.11	500 psi	200 psi	300 psi	150 psi	500 psi
3" / DN80	3.500 (88.90)	Sch. 40S Cut groove (or heavier)	0.216 / 5.49	--	600 psi (rated pressure)	300 psi (rated pressure)	450 psi (rated pressure)	225 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.216 / 5.49	0.083 / 2.11	600 psi	300 psi	450 psi	150 psi	750 psi
		Sch. 10S Roll groove	0.120 / 3.05	0.083 / 2.11	500 psi	200 psi	300 psi	150 psi	500 psi
4" / DN100	4.500 (114.30)	Sch. 40S Cut groove (or heavier)	0.237 / 6.02	--	600 psi (rated pressure)	300 psi (rated pressure)	450 psi (rated pressure)	225 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.237 / 6.02	0.083 / 2.11	600 psi	300 psi	450 psi	150 psi	750 psi
		Sch. 10S Roll groove	0.120 / 3.05	0.083 / 2.11	450 psi	180 psi	300 psi	150 psi	450 psi
6" / DN150	6.625 (168.28)	Sch. 40S Cut groove (or heavier)	0.280 / 7.11	--	600 psi (rated pressure)	300 psi (rated pressure)	--	100 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.280 / 7.11	0.109 / 2.77	500 psi	250 psi	--	--	500 psi
		Sch. 10S Roll groove	0.134 / 3.40	0.109 / 2.77	200 psi	100 psi	--	--	200 psi
8" / DN200	8.625 (219.08)	Sch. 40S Cut groove (or heavier)	0.322 / 8.18	--	600 psi (rated pressure)	300 psi (rated pressure)	--	100 psi (rated pressure)	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.322 / 8.18	0.109 / 2.77	400 psi	200 psi	--	--	
		Sch. 10S Roll groove	0.148 / 3.76	0.109 / 2.77	125 psi	65 psi	--	--	
10" / DN250	10.750 (273.05)	Sch. 40S Cut groove (or heavier)	0.365 / 9.27	--	600 psi (rated pressure)	300 psi (rated pressure)	--	--	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.365 / 9.27	0.134 / 3.40	400 psi	200 psi	--	--	
		Sch. 10S Roll groove	0.165 / 4.19	0.134 / 3.40	125 psi	65 psi	--	--	
12" / DN300	12.750 (323.85)	Sch. 40S Cut groove (or heavier)	0.375 / 9.53	--	600 psi (rated pressure)	300 psi (rated pressure)	--	--	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.375 / 9.53	0.156 / 3.96	400 psi	200 psi	--	--	
		Sch. 10S Roll groove	0.180 / 4.57	0.156 / 3.96	125 psi	65 psi	--	--	
14" / DN350	14.000 (355.60)	Sch. 40S Cut groove (or heavier)	0.438 / 11.13	--	--	300 psi (rated pressure)	--	--	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.438 / 11.13	0.156 / 3.96	--	200 psi	--	--	
		Sch. 10S Roll groove	0.250 / 6.35	0.156 / 3.96	--	65 psi	--	--	
16" / DN400	16.000 (406.40)	Sch. 40S Cut groove (or heavier)	0.500 / 12.70	--	--	300 psi (rated pressure)	--	--	1200 psi (rated pressure)
		Sch. 40S Roll groove	0.500 / 12.70	0.165 / 4.19	--	200 psi	--	--	
		Sch. 10S Roll groove	0.250 / 6.35	0.165 / 4.19	--	65 psi	--	--	



NOTES

- The above data is for ASME Types 304/304L and 316/316L stainless steel pipe with the correspondent wall thicknesses Sch. shown.
- The pressure performance values shown for PIEDMONT couplings on light wall Sch.10 stainless steel pipe are dependent on the use of required special roll grooving light-wall stainless steel pipe. Failure to make use of the required special rolls for roll grooving light-wall stainless steel pipe may result in equipment failure.
- This doc complements the published Piedmont Couplings Installation Manual data.

REFERENCE

- [1.] ANSI/AWWA C606 -2011, Standard for Grooved and Shouldered Joints
- [2.] DIN-934 (Metric Series): Hexagon nuts with metric coarse and fine pitch thread (ISO 4032: coarse pitch thread nuts).
- [3.] DIN-125-1 (Metric Series): Product grade A washers with a hardness up to 250 HV, designed for use with hexagon head bolts and nuts (ISO 7089 Plain washers - normal series)
- [4.] Piedmont Pacific oval neck track bolt (Metric Series) based on DIN-5903 design
- [5.] DIN-931 (Metric Series): M 1,6 to M 39 hexagon head bolts (metric thread) (ISO 4014)



Piedmont Pacific Inc. (H2O Innovation)

330 St-Vallier St. East, Suite 340, Quebec City, Quebec Canada G1K 9C5

Phone: +1 760.305.7616, Fax: +1-760-598-2208

www.piedmontpacific.com

sales@piedmontpacific.com

© 2025 Piedmont Pacific Corporation. All Rights Reserved.

Rev. Date: February 2025