Naval Technical Manual

inoxPRES® MARINEPRES® DRAIN

RIM
RACCORDERIE METALLICHE

	Country	Certification Body	Dimensions
inoxPRES			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM

	Country	Certification Body	Dimensions
marinePRES			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM
			Ø 15-108 MM

	Country	Certification Body	Dimensions
DRAIN			DN 40-150 MM
			DN 40-150 MM
			DN 40-150 MM

This edition of the technical manual supersedes and cancels all previous editions.

RACCORDERIE METALLICHE

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INOXPRES • MARINEPRES

DRAIN


INOX PRES
PRES 76

Press Fitting Systems M Profile

1.0 Introduction

1.1 Raccorderie Metalliche S.p.A

The family owned company **Raccorderie Metalliche S.p.A.** (RM), founded in 1970 in the province of Mantua (Italy), specializes in the production and distribution of stainless steel and 90/10 copper-nickel piping systems known as **inoxPRES**, **marinePRES**, and **DRAIN** for the naval sector.
Significant investments in facilities and state of the art machinery currently ensure an annual production capacity of more than **15 million press fittings**. The three-level distribution system supplies specialized marine trade warehouses throughout Europe and selected overseas markets such as the United States, Australia, Vietnam, Israel, the United Arab Emirates, Qatar, Singapore, and others.
Sales activities are further supported by affiliated branches in Germany, Spain, and France.
The company also operates a rigorous quality management system certified according to **UNI EN ISO 9001:2015.**

Figure 1 – Headquarters and manufacturing plant in Campitello

DNV

MANAGEMENT SYSTEM CERTIFICATE

Certificate no.: CERT-00317-94-AQ-MIL-SINCERT
Initial certification date: 10 November 1994
Valid: 08 October 2024 – 07 October 2027

This is to certify that the management system of
RACCORDERIE METALLICHE S.p.A.
Strada Sabbionetana, 59 - 46010 Campitello di Marcaria (MN) - Italy
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Quality Management System standard:
ISO 9001:2015

This certificate is valid for the following scope:
Manufacture and trade of welding, threaded and press metal pipe fittings and dedicated insulation system; collars and clamping systems for pipes and radiators. Trade of mixing valves and automatic float air vents, products and accessories for heating and plumbing uses in conformity with national/international standards, specifications furnished by the customer and established company specifications
(IAF 17, 29)

Place and date:
Vimercate (MB), 04 October 2024

ACCREDIA

For the issuing office:
DNV - Business Assurance
Via Energy Park, 14, - 20871 Vimercate (MB) - Italy

Claudia Baroncini
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
ACCREDITED UNIT: DNV Business Assurance Italy S.r.l., Via Energy Park, 14 - 20871 Vimercate (MB) - Italy - TEL: +39 039 68 99 905. www.dnv.it

Figure 2 – EN ISO 9001:2015 Certificate

2.0 Press Fitting System

2.1 Jointing Technology – M Profile

To create a joint, the pipe is inserted into the press fitting up to the previously marked insertion depth. The connection is achieved using approved pressing tools (see Section 2.7 Pressing Tools).

Press fitting systems from Ø12 to Ø35 mm must be pressed using jaws, while sizes Ø42 to Ø108 mm must be pressed using chains.

Figures 3 and 4 show the coupling and deformation of the pipe and fitting. During pressing, a two-level deformation occurs. The first resistance level is created through the mechanical deformation of both fitting and pipe, forming a permanent connection that provides mechanical strength.
Hydraulic sealing is ensured by the deformation of the O-ring. Thanks to its elasticity, it guarantees the long-term tightness of the joint.

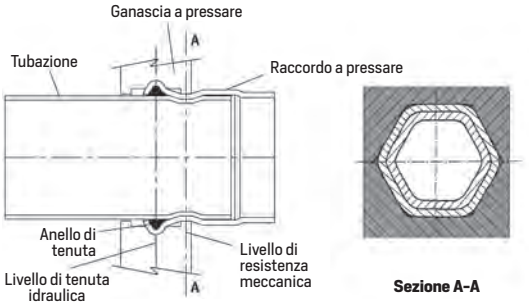


Figure 3 – Section through an **inoxPRES** / **marinePRES** connection with jaw still in position. Dimensions of ø 12 ÷ 35 mm produce a hexagonal pressing profile.

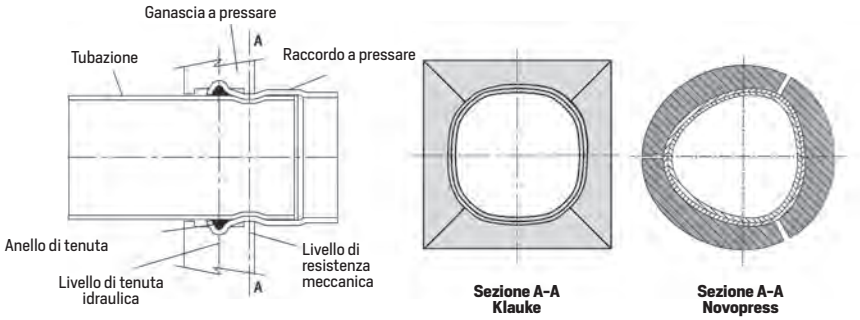


Figure 4 – Section through an **inoxPRES** / **marinePRES** connection with collar still in position. Dimensions of ø 42 ÷ 108 mm produce a defined profile.

The complete **inoxPRES** and **marinePRES** product range is available in the corresponding **Supply Program Catalogue**.

2.2 inoxPRES press fittings

inoxPRES press fittings are manufactured using high-alloyed austenitic stainless Cr-Ni-Mo steel with the material number AISI 316L (1.4404). The press fittings are indelibly marked with laser reporting the manufacturer name, diameter, DVGW test symbol and internal code. The formed ends of the press fittings are fitted with a black EPDM seal ring as standard for potable water applications.

Figura 5 – **inoxPRES** press fitting

2.3 inoxPRES piping

inoxPRES pipes are manufactured in accordance with DVGW Worksheet GW 541, EN 10217-7 (DIN 17455), and EN 10312.

The pipes are made of:
• highly alloyed austenitic Cr-Ni-Mo stainless steel, AISI 316L (material no. 1.4404), DVGW certified;

The internal and external surfaces are smooth metallic finishes, free from substances that may cause corrosion phenomena. **inoxPRES** pipes are classified as non combustible and belong to Fire Reaction Class A. Depending on the material, they are supplied in 6 meter lengths (annealed and unannealed) or 3 meter lengths (unannealed only).

TABLE 1: INOXPRES PIPES - DIMENSIONS AND CHARACTERISTICS

Pipe outside diameter x wall thickness mm	Nominal width DN	Pipe inside diameter mm	Mass kg/m	Water volume l/m
15 x 1	12	13	0,351	0,133
18 x 1	15	16	0,426	0,201
22 x 1,2	20	19,6	0,625	0,302
28 x 1,2	25	25,6	0,805	0,514
35 x 1,5	32	32	1,258	0,804
42 x 1,5	40	39	1,521	1,194
54 x 1,5	50	51	1,972	2,042
76,1 x 2	65	72,1	3,711	4,080
88,9 x 2	80	84,9	4,352	5,660
108 x 2	100	104	5,308	8,490

As with the fittings, **inoxPRES** pipes are also marked with comprehensive identification details that fully define their characteristics and ensure complete traceability:

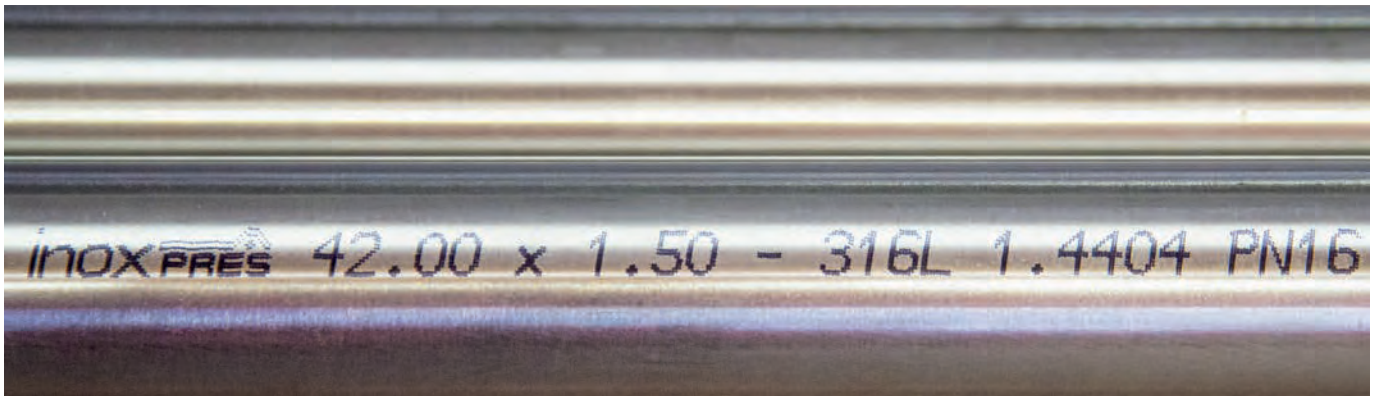


Figure 6 - **inoxPRES** Marking

2.4 marinePRES press fittings

marinePRES press fitting are made in CuNi10Fe1.6Mn (WL 2.1972) copper-nickel from ø 15 to ø 108 mm included. marinePRES fittings are indelibly marked with a laser system with the manufacturer name, the diameter and with an internal code. At the press fitting swollen ends a green FKM o-ring is fitted

Figure 7 – **marinePRES** press fitting

2.5 marinePRES piping

marinePRES piping, with thin seamless walls, are in CuNi10Fe1.6Mn copper-nickel. Tubes in copper-nickel are made in compliance with the standard DIN 86019. Inner and outer surfaces are bare metal and free of annealing colours and corrosion-promoting substances. **marinePRES** tubes are classified as non combustible, belonging to class A as fire reaction. They are supplied in 6 m long bars.

TABLE 2: MARINEPRES PIPES - DIMENSIONS AND CHARACTERISTICS

Pipe outside diameter x wall thickness mm	Nominal width DN	Pipe inside diameter mm	Mass kg/m	Water volume l/m
15 x 1	12	13	0,392	0,133
18 x 1	15	16	0,476	0,201
22 x 1	20	20	0,588	0,314
28 x 1,5	25	25	1,114	0,491
35 x 1,5	32	32	1,408	0,804
42 x 1,5	40	39	1,702	1,195
54 x 1,5	50	51	2,206	2,042
76,1 x 2	65	72,1	4,146	4,080
88,9 x 2	80	84,9	4,874	5,660
108 x 2,5	100	103	7,389	8,332

As with the fittings, **marinePRES** pipes are also marked with comprehensive identification details that fully define their characteristics and ensure complete traceability:

Figure 8 – **marinePRES** Marking

2.6 Sealing Elements

2.6.1 Sealing Ring Profile

Traditional press-fitting systems use sealing rings (O-rings) with a circular cross-section which, if handled improperly during installation, can be easily damaged.
RM, on the other hand, uses a lenticular-profile sealing ring that fits perfectly into the toroidal chamber.
This provides the following advantages:

- a sealing surface that is 20% larger;
- a significant reduction in the risk of damage to the sealing ring;
- easier pipe insertion.

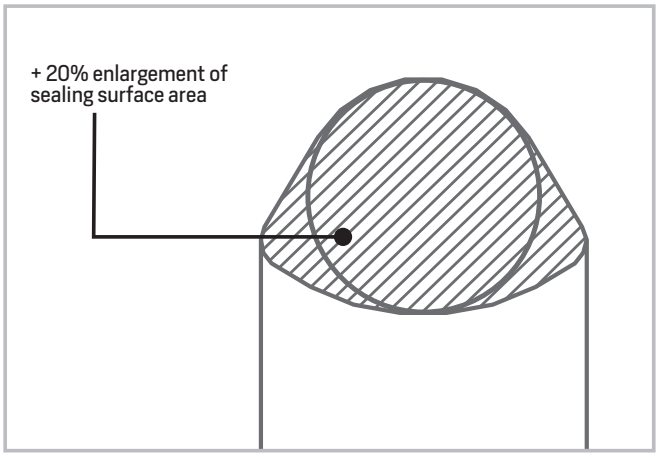


Figure 9 – Sealing Ring Profile

The black EPDM sealing ring, available for diameters from 15 to 54 mm, incorporates an additional safety feature that ensures any joint inadvertently left unpressed becomes evident during pressure testing by generating a leak.

- Leak-tightness and pressure tests must be carried out before covering the pipes (e.g., with insulation);
- **The correct execution of press connections is the responsibility of the installer / installation company.**

Figure 10 – EPDM Safety Sealing Ring (Ø 15–54 mm)

Leaks from "unpressed fittings" should be regarded as an additional support feature to help identify assembly errors, in this case the failure to press the fittings. The prerequisite for this functionality is the proper execution of the specified leak-tightness and pressure tests, and it does not exempt the installer from the obligation to perform a visual inspection of all joints to ensure correct installation.

These visual inspections and pressure tests must be recorded in the relevant test report

2.6.2 Materials, feature, applications

EPDM sealing rings in a black silicone-coated version are normally installed in **inoxPRES** press fittings and may be replaced with FKM sealing rings where required. In **marinePRES** press fittings, only green FKM sealing rings are used.

TABLE 3: SEALING RINGS - FIELDS OF APPLICATION AND TECHNICAL DATA

Technical term	Colour	Operating temperature Min / Max degress centigrade	Ranges
EPDM	black	-20* / +120 °C	inoxPRES
FKM	green	-20 / +220 °C	marinePRES

(*) Up to -30°C for occasional / non-continuous work periods

2.7 Pressing tools

2.7.1 Basics

Pressing tools essentially consist of a pressing machine equipped with jaws or chains.
Although some pressing machine manufacturers state that jaws or chains from other brands may be used, Raccorderie Metalliche only authorizes, for its systems, the use of brands tested and approved by its Quality Department in order to guarantee long-term reliability. The pressing machine and the associated tools (jaws and chains) must be produced by the same manufacturer.
If tools other than those manufactured by Novopress or Klauke are to be used, it is recommended to contact Raccorderie Metalliche for the appropriate authorization.
Pressing tools must be inspected by an authorized service center in accordance with the manufacturer's specifications (typically once a year or after 10,000 cycles for standard pressing machines, and after 1,500 cycles for King Size pressing machines).

Press-fit systems in sizes Ø12–35 mm must be pressed using jaws, while sizes Ø42–108 mm must be pressed using chains.
In all metallic press-fit systems, the profile of the toroidal chamber (the O-ring seat) of the fitting corresponds exactly to the geometric shape of the jaw/chain. Therefore, the various jaws/chains must be approved by the manufacturer of the respective press-fit system. In addition, the operating and maintenance instructions provided by the pressing tool manufacturers must be observed.

Installation temperature range for RM press-fit systems using electric pressing machines: -20°C to +40°C.
Installation temperature range for RM press-fit systems using battery-powered pressing machines: -10°C to +40°C.

Figure 11 – Klauke UAP332BT

Figure 12 – Klauke UAP100120BT

Figure 13 – Klauke UAP432BT

Figure 14 – Novopress ACO203 BT

Figure 15 – Novopress ACO403 BT

Figure 16 – Novopress ACO203 XLBT

2.7.2 Approved pressing tools

RM approves the tools produced by Klauke and Novopress listed in the tables 4 and 5 below. These are pressing tools with the appropriate pressing jaws or collars/chains.

TABLE 4: MANUFACTURER KLAUKE

Type		Piston strength	Dimension range	Weight
UAP2 – UAP3L UAP332BT		32 KN	12–54 mm	~ 3,5 Kg
UNP2		32 KN	12–54 mm	~ 3,5 Kg
UAP4 – UAP4L UAP432BT		32 KN	12–54 mm PN16 76,1–108 mm PN10	~ 4,3 Kg
UAP100 – UAP100L UAP100120BT		120 KN	76,1–108 mm	~ 12,7 Kg
AH-P700LS	PKUAP3	32 KN	12–54 mm	~ 12,3 Kg
	PKUAP4	32 KN	12–54 mm PN16 76,1–108 mm PN10	~ 12,6 Kg
	PK100AHP	120 KN	76,1–108 mm	~ 20,2 Kg
EHP2/SANB		0,75 KW	76,1–108 mm	~ 69 Kg

Klauke UAP4 / UAP4L / UAP432BT pressing machines are subject to a PN10 pressure rating limitation when used with King Size diameters ranging from 76.1 mm to 108 mm.

TABLE 5: MANUFACTURER NOVOPRESS

Type	Piston strength	Dimension range	Weight
EFP2	32 KN	12 ÷ 54 mm	~ 6,1 Kg
EFP201 – EFP202	32 KN	12 ÷ 54 mm	~ 4,4 Kg
AFP201 – AFP202	32 KN	12 ÷ 54 mm	~ 4,3 Kg
EC0202 – AC0202 EC0203 – AC0203/BT	32 KN	12 ÷ 54 mm	~ 3,3 Kg
AC0202XL AC0203XL/BT	32 KN	12 ÷ 54 mm PN16 76,1 ÷ 108(*) mm PN10	~ 4,6 Kg
AC0401 AC0403/BT	100 KN 120 KN	76,1 ÷ 168,3 mm	~ 13 kg
AC03	36 KN	15 ÷ 54 mm	~ 5,0 Kg
EC0301	45 KN	12 ÷ 54 mm PN16 76,1 ÷ 108(*) mm PN10	~ 5,0 Kg
HCP	190 KN	76,1 ÷ 168,3 mm	~ 70 Kg

(*) it must be pressed 2 times with the following adapters: AC0202 / 203XL: ZB221 –> 1° pressing ZB222 –> 2° pressing
EC0301: ZB323 –> 1° pressing ZB324 –> 2° pressing

Novopress AC0202XL / AC0203XL / EC0301 pressing machines are subject to a PN10 pressure rating limitation when used with King Size diameters ranging from 76.1 mm to 108 mm.

2.7.3 Periodic Maintenance of Equipment

Pressing machines, jaws, and chains must undergo periodic maintenance to ensure the correct installation of press-fit joints. The equipment must be serviced in accordance with the manufacturer's specifications **(typically once a year or after 10,000 cycles for standard pressing machines, and after 1,500 cycles for 120 kN King Size pressing machines).** In addition, all moving parts (thrust rollers) and the clamping surfaces of jaws and chains (internal profiles) must be kept clean and lubricated on a daily basis and before each use.
All maintenance activities must be carried out in accordance with the requirements of UNI 7129-1.

Figure 17 – Example of Corroded Equipment

Figure 18 – Example of Worn Equipment

Any possible oxidation, paint or dirt in generally affect the tool reliability leading to equipment sliding problems on joints during pressing.

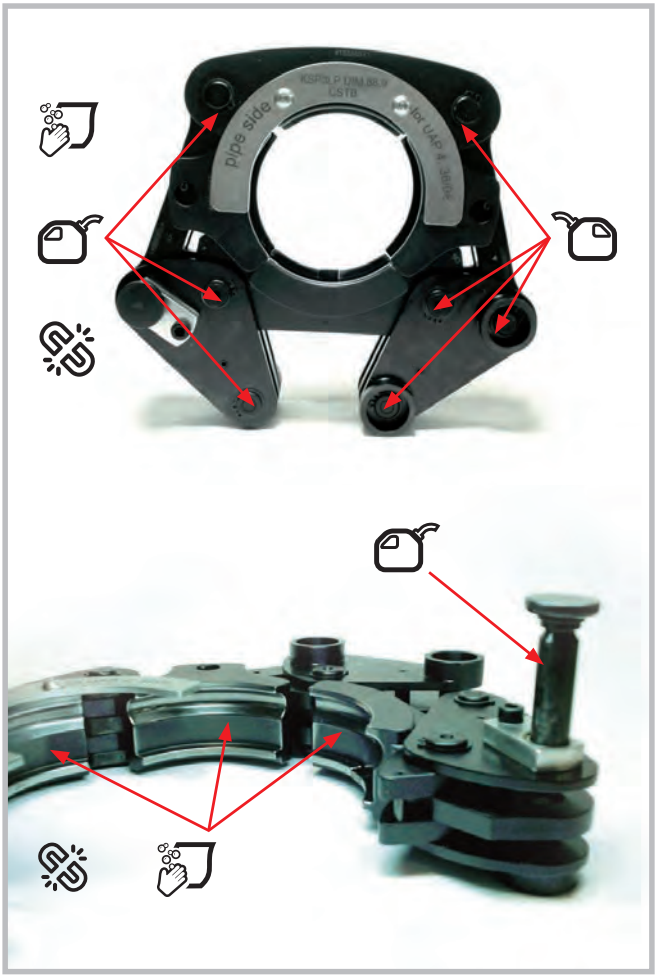


Figure 19 – Klauke equipment

Figure 20 – Novopress equipment

Keep the chain clean

Keep the pins lubricated with oil

Attention it can be broken

Raccorderie Metalliche provides maintenance and repair services through its authorized **Novopress Service Center, known as RMC.**

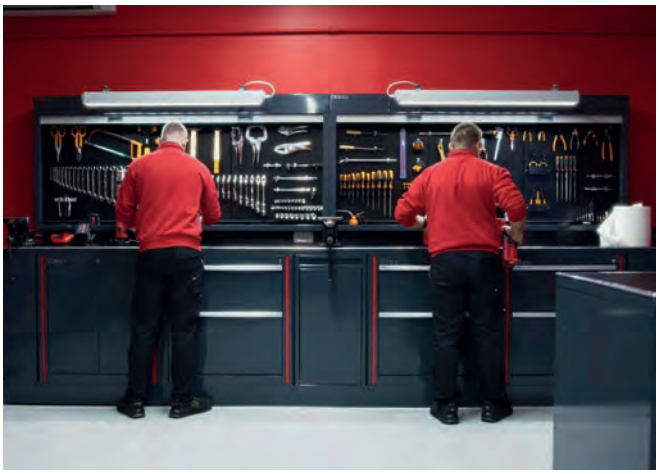


Figure 21 – RacMet Maintenance Center (RMC)

3.0 Areas of use

For application fields covered by certifications, please refer to the relevant certificates listed in the tables provided on the first page. These certificates are available for consultation on our website, **raccorderiemetalliche.com**, in the *Download* section.

An illustrative example is provided below.

TABLE 10: APPLICATION FIELDS OF INOXPRES / MARINEPRES PRESS-FIT SYSTEMS Ø 15–108 mm

SYSTEM / CONVEYED FLUID	O-RING	INOXPRES AISI 316L	MARINEPRES CuNi 90/10	T °C limite di utilizzo
Domestic Hot Water (DHW) / Potable Hot Water	EPDM	permitted	prohibited	max 120 °C
Domestic Cold Water (DCW) / Potable Cold Water	EPDM	permitted	prohibited	min 0 °C
Chilled Water (Heating) / Hot Water for HVAC	EPDM FKM	permitted	permitted	max 120 °C
Chilled Water (Cooling) / Chilled Water (CHW)	EPDM FKM	permitted	permitted	min 0 °C
Technical Water / Service Water	EPDM FKM	permitted	permitted	-20/+120 °C
Fresh Water Cooling (Closed Loop)	EPDM FKM	permitted	permitted	-20/+120 °C
Condensate Return	EPDM FKM	permitted	permitted	-20/+120 °C
Sea Water (SW)	FKM	prohibited	permitted	-20/+120 °C
Sea Water Cooling / Sea Water Cooling System	FKM	prohibited	permitted	-20/+120 °C
Ballast Water	FKM	prohibited	permitted	-20/+120 °C
Fuel Oil (FO)	FKM	permitted	permitted	max 7 bar, T max 60°C
Lube Oil (LO) / Lubricating Oil	FKM	permitted	permitted	max 7 bar, T max 60°C
Hydraulic Oil	FKM	permitted	permitted	max 7 bar, T max 60°C
Thermal Oil / Heat Transfer Oil	FKM	permitted	permitted	max 7 bar, T max 60°C
Cargo Oil (F.P. ≤ 60 °C)	FKM	permitted	permitted	max 7 bar, T max 60°C

Cargo Oil (F.P. > 60 °C)	FKM	permitted	permitted	max 7 bar, T max 60°C
Inert Gas (Nitrogen, Argon)	EPDM FKM	permitted	permitted	room temperature
Compressed Air (residual oil class 1-4)	EPDM FKM	permitted	permitted	room temperature
Compressed Air (residual oil class 5)	FKM	permitted	permitted	room temperature
Service Air (non-essential) / Utility Air	EPDM FKM	permitted	permitted	room temperature
Steam	EPDM FKM	permitted	permitted	max.120°C max. 2 bara / 1 barg
Glycols (max 40% - refer to table 6 for compatibility)	EPDM	permitted	permitted	-20/+60 °C
Brine	FKM	prohibited	permitted	0/+ 60 °C
CO_2 (outside protected spaces)	EPDM FKM	permitted	permitted	room temperature
Fresh Water Fire-Fighting System / Fresh Water Fire Main	EPDM FKM	permitted	permitted	room temperature
Sea Water Fire-Fighting System / Sea Water Fire Main	FKM	prohibited	permitted	room temperature
Bilge Lines / Bilge Piping	FKM	prohibited	permitted	room temperature
Tank Washing / Tank Cleaning	FKM	prohibited	permitted	room temperature
Urea	EPDM	permitted	prohibited	max.T 50°C
Air Escapes	EPDM FKM	permitted	permitted	room temperature

The **inoxPRES** and **marinePRES** product ranges have successfully withstood a nominal pressure of 16 bar during water pressure testing, with a safety factor of 4 (64 bar). The pressing machines used for the tests were manufactured by Novopress and Klauke.

3.1 Applications

3.1.1 Potable water, treated water

The product ranges offered by Raccorderie Metalliche for these applications are **inoxPRES** and **marinePRES**.
The **inoxPRES** press-fit system is manufactured from highly alloyed Cr-Ni-Mo stainless steel (AISI 316L, material no. 1.4404). Thanks to its excellent corrosion resistance and guaranteed hygienic properties, **inoxPRES** is suitable for all potable water applications. As this material does not release heavy metals into the water, the **inoxPRES** press-fit system does not alter the quality or purity of the water in any way and is therefore suitable for both drinking water and treated water systems.
The **marinePRES** press-fit system is manufactured from copper-nickel alloy CuNi10Fe1.6Mn (WL 2.1972).
Thanks to its high corrosion resistance, hygienic properties, and the natural antibacterial characteristics of copper, **marinePRES** is suitable for all treated water applications. However, copper-nickel is not suitable for potable water applications.

inoxPRES is not suitable for applications requiring a level of water purity higher than that of potable water.

Figure 22 – **inoxPRES** – Example of Installation

Figure 23 – **inoxPRES** – Example of Installation

3.1.2 Seawater

For systems conveying seawater, the use of the **marinePRES** system is mandatory, as it offers greater compatibility and resistance to the resulting corrosion phenomena.

3.1.3 Oils, Diesel Fuel, and Hydrocarbons

Raccorderie Metalliche recommends the exclusive use of FKM O-rings, as they provide superior resistance to hydrocarbon

3.1.4 Wastewater, Grey Water, and Black Water

Raccorderie Metalliche grants compatibility exclusively to the **marinePRES** range, as the press-fit system creates small interstitial spaces that can generate stagnant environments with low oxygen content and high bacterial activity, leading to the formation of sulfides (H_2S). These conditions are ideal for initiating corrosion in stainless steels.

3.1.5 Heating and Cooling Circuits

inoxPRES and **marinePRES** press-fit systems are suitable for use in both open-loop and closed-loop heating and cooling circuits (**inoxPRES** and **marinePRES**), with an operating temperature range of -20°C to +120°C.

The use of antifreeze agents or corrosion inhibitors requires prior approval from RM, with the exception of glycols as specified in Section 3.1.9.

3.1.6 Compressed Air and Inert Gases

inoxPRES and **marinePRES** press-fit systems are suitable for compressed air and inert gas piping installations. For compressed air systems with a residual oil content Class 1 to 4 (in accordance with ISO 8573-1:2010), the black EPDM O-ring may be used. For systems with a residual oil content Class 5 (in accordance with ISO 8573-1:2010), only the green FKM O-ring must be used. Green FKM O-rings are supplied separately and must be installed by the installer in place of the factory-fitted black EPDM O-ring.
Where silicone-free piping systems are required, **inoxPRES** fittings equipped with FKM O-rings and annealed pipes must be used.
To achieve optimum tightness of the piping system, it is recommended to moisten the O-ring with water before inserting the pipe into the fitting.
When micro-leak detection systems are used, it is recommended to perform a preliminary pressure test with water to allow the O-ring to seat correctly. After draining the system, the standard air pressure test may then be carried out.

3.1.7 Vacuum Applications

inoxPRES and **marinePRES** press-fit systems are suitable for use in the following application range:

- vacuum piping systems down to an absolute pressure of 200 mbar (-0.8 bar gauge pressure, up to a maximum of -0.95 / -0.98 bar);

To achieve optimum tightness of the piping system, it is recommended to moisten the O-ring with water before inserting the pipe into the fitting.

3.1.8 Firefighting Systems

For firefighting systems using seawater, only the **marinePRES** range shall be used.
For firefighting systems using fresh water, the use of both **inoxPRES** and **marinePRES** ranges is permitted.

3.1.9 Glycols for installation

The table below lists some of the glycol types commonly used in heating and cooling systems.
If glycols not included in the table are used, or if glycols are to be used in combination with FKM O-rings, please contact the Raccorderie Metalliche Technical Department.

TABLE 6: CHEMICAL COMPATIBILITY OF GLYCOLS WITH INOXPRES (EPDM O-RING)

GLYCOLS	MANUFACTURER
GLYKOSOL N	Pro Kühlsole GmbH
PEKASOL L	Pro Kühlsole GmbH
TYFOCOR	Tyforop Chemie GmbH
TYFOCOR L	Tyforop Chemie GmbH
CosmoSOL	Tyforop Chemie GmbH
Antifrogen N	Clariant
Antifrogen L	Clariant
DOWNCAL 100	DOW
DOWNCAL 200	DOW
STAUBCO® COOL N	STAUB & CO. – SILBERMANN GmbH
STAUBCO® COOL L	STAUB & CO. – SILBERMANN GmbH
Glysofor N	WITTIG Umweltchemie GmbH
Glysofor L	WITTIG Umweltchemie GmbH

NOTES: For the glycols listed in the table, consider the following concentration: EPDM sealing O-rings with a maximum of 40% glycol and 60% water.

4.0 Processing

4.1 Storage and transport

During transportation and storage, care must be taken to prevent components of the **inoxPRES** / **marinePRES** systems from becoming contaminated or damaged. Pipe ends are covered with protective caps to prevent the ingress of dirt.
The pipes must be stored in painted cradles or cradles protected with plastic material, ensuring that they do not come into contact with other materials. In addition, pipes and fittings must be stored in a covered area to prevent the occurrence of corrosion and/or surface oxidation.

The main recommendations for the transportation and storage of system components are listed below:

- Components must be handled with care and protected from dirt and damage while in storage, during transportation, and throughout on-site installation activities.
- During transportation, all components must be stacked in an orderly and appropriate manner.
- Loading and unloading operations must be carried out in such a way as to avoid impacts and deformation. Any pipes and/or fittings showing signs of mechanical damage must be submitted to Raccorderie Metalliche for evaluation.
- Pipes must be stored on level and uniform surfaces. For pipes supplied in film packaging, ensure that they are adequately supported on wooden pallets (or on packaging elements specifically designed and manufactured for this purpose using suitable materials such as wood, foam, or plastic).
- Do not leave fittings outside their protective packaging exposed to direct sunlight or near heat sources, as the sealing elements inside may deteriorate.
- Do not store pipes without the protective end caps fitted during storage.
- Do not store pipes in contact with other materials, in order to prevent possible corrosion initiation.

DELIVERY REQUIREMENTS:
The following are examples of conditions that should be carefully checked during the material acceptance process:

- Pipes must be supplied complete with protective end caps fitted at both ends.
- Pipes must be clearly marked.

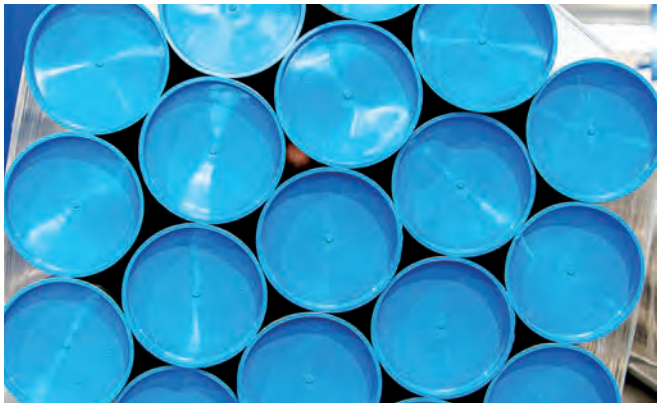


Figure 24 – Blue protective caps – **inoxPRES**

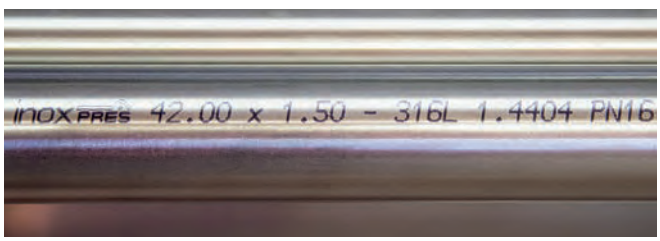


Figure 25 – **inoxPRES** marking

- Copper-nickel pipes must not exhibit deep pitting corrosion.

Figure 26 – Example of Pitting on Copper-Nickel Pipes

4.2 Pipes - cutting to length, deburring, bending

Pipes used in press-fit systems must be cut using commercially available pipe cutters suitable for the material being processed. Raccorderie Metalliche recommends the use of wheel type pipe cutters, as shown in the images below. These tools allow the pipe to be cut without causing ovalization.
Fine tooth hacksaws or suitable electromechanical saws may also be used; however, in such cases, the installer is responsible for ensuring that the pipe is not deformed during the cutting process. The cut must be perpendicular to the pipe axis in order to avoid any negative impact on the mechanical strength of the connection between the fitting and the pipe.
Only tools specifically designed for the material being processed shall be used. Particular attention must be paid, for example, to the selection of the blades or cutting wheels used. Cutting and deburring tools must be clean and free from adhered materials or metal chips. After cutting and/or deburring, the cut edges and pipe ends must be thoroughly cleaned and cleared of any chips, burrs, or other contaminants.

Figure 27 – Pipe Cutting

Figure 28 – Electric pipe cutter

The following are not permitted:

- tools that cause overheating of the material and temper colors (heat tint) during cutting;

Figura 29 – Example of Material Overheating During Cutting

- oil-cooled saws;
- hot cutting using an oxy-acetylene torch or a grinding wheel.
- stainless steel pipes must only be cut using blades intended for stainless steel. The cutting tool must not have previously been used to cut other alloys, such as carbon steel.

To prevent damage to the sealing ring during insertion of the pipe into the press fitting, the pipe must be carefully deburred both internally and externally.

Figure 30 – Example of incorrect tooling

This operation may be carried out using a manual deburring tool suitable for the material being processed. For larger diameters, dedicated electric deburring tools or hand files may also be used.

Figure 31 – Sbavatura del tubo

Figure 32 – Sbavatore manuale con lama adatta al materiale del tubo

Pipes may be cold-bent up to and including Ø22 mm using dedicated bending equipment commonly available on the market (R ≥ 3.5 × D).
Pipes may be bent with the following minimum bending radii:

DN 12 – R=45 mm DN 15 – R=55 mm
DN 18 – R=70 mm DN 22 – R=77 mm.
Hot bending of pipes is not permitted.

BENDING MACHINES		
DN	Radial bending Allowed	Axial bending Not Allowed
12 mm		
15 mm		
18 mm		
22 mm		

Observe the operating and handling instructions provided by the bending tool manufacturer.

4.3 Insertion Depth Marking

The mechanical strength of a press-fit joint is ensured only when the insertion depths specified in Table 8 are respected.
These insertion depths must be marked using suitable markers on the pipes or on fittings with insertion ends (for example, male/female elbows).
After pressing, the insertion depth marking on the pipe/fitting must remain visible immediately adjacent to the toroidal chamber of the press fitting.

The distance between the marking on the pipe/fitting and the toroidal chamber of the fitting must not exceed 10% of the specified insertion depth; otherwise, the mechanical strength of the joint cannot be guaranteed.

Figure 33 – Insertion Depth Marking Using a Measuring Tape

Figure 34 – Insertion Depth Marking Using a Marking Gauge Ø 76 mm – Ø 88 mm – Ø 108 mm

Figure 35 – Insertion Depth Marking Using a Marking Gauge Ø 15 mm – Ø 54 mm

4.3.1 Insertion Depth Marking Using a Reference Fitting

Insertion depth marking may be carried out using a reference fitting that will not be installed. The reference fitting must be clearly identifiable by means of a mark or indication as shown in the following figure.
To make the reference fitting recognizable, the O-rings must be removed from their internal seats and placed on the outside of the fitting, as illustrated in the figure.
It is recommended to mark the insertion depth using a wide-tip marker, as shown in the figure (marking consisting of a transverse line and a "V"). This is because, after inserting the pipe into the fitting, a mark that is too thin may no longer be visible.

Figure 36 – Insertion Depth Marking Using a Reference Fitting

No marking should be visible on the end of the pressed fitting once installed on the pipe, as there would be no absolute certainty that the required insertion depth had actually been respected (the operator may have traced the mark after insertion or pressing).
In such cases, the mechanical integrity of the connection cannot be guaranteed.

Figure 37 – Example of Incorrect Marking

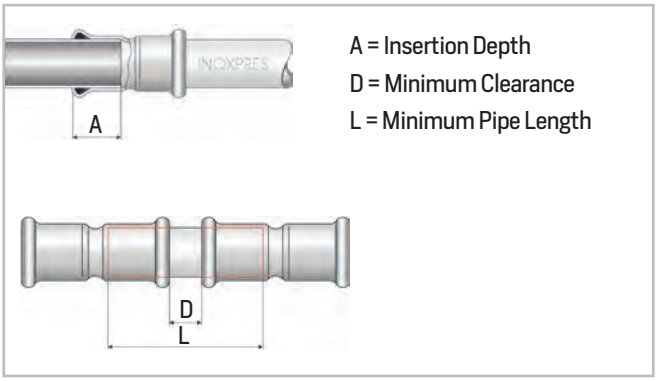
TABLE 7: INSERTION DEPTHS AND MINIMUM GENERAL CLEARANCES – M PROFILE OTHER TOOLS

Outside Pipe Diameter mm	A (*) mm	D mm	L mm
12	18	20	56
15	20	20	60
18	20	20	60
22	21	20	62
28	23	20	66
35	26	20	72
42	30	40	100
54	35	40	110
76,1	55	60	170
88,9	60	60	180
108	75	60	210

(*) Tolerance: ± 2 mm

TABLE 8: INOXPRES AND MARINEPRES INSERTION DEPTHS AND MINIMUM CLEARANCES FOR KLAUKE AND NOVOPRESS TOOLS

Outside Pipe Diameter mm	A (*) mm	D mm	L mm
12	18	10	56
15	20	10	60
18	20	10	60
22	21	10	62
28	23	10	66
35	26	10	72
42	30	20	100
54	35	30	110
76,1	55	40	170
88,9	60	40	180
108	75	40	210



A = Insertion Depth
D = Minimum Clearance
L = Minimum Pipe Length

Figure 38 – Minimum Insertion Depth and Joint Engagement Dimension

4.4 Inspection of the O-Ring in the Press Fitting

Before installing the fittings, it is advisable to verify that the sealing ring is correctly positioned in its seat and that it is free from dirt or damage. If necessary, it must be replaced.

In addition, it must be verified that the sealing ring is of the type required for the specific application and, where applicable, that it does not need to be replaced with a different type.

Figure 39 – O-Ring Inspection

4.5 Installation of the Joint Ø 12-108 mm

The pipe must be inserted into the fitting with a slight axial push combined with a simultaneous rotating motion, up to the previously marked insertion depth.
If insertion is difficult due to tight tolerances, it is recommended to moisten the sealing ring with water or a soap solution.

The use of oils or greases as lubricants is not permitted.

Before inserting the pipe into the fitting, it is recommended to verify that the pipe is unobstructed internally and that the protective end cap fitted at the factory has been removed from the pipe end.

Figure 40 – Example of an Unobstructed Pipe

Figure 41 – Example of an Obstructed Pipe

Figure 42 – Pressing the Fitting

Proceed with the pressing operation using the appropriate electromechanical/electrohydraulic tools equipped, depending on the size, with either jaws or chains. The fitting must be pressed onto a clean pipe surface (for example, the pipe must not be painted; if paint is present, it must be removed before pressing). Suitable pressing tools that have been tested and approved are listed in Tables 4 and 5.

Figure 43 – Novopress Jaw Mounted on ZB203 Adapter

Depending on the size of the press fitting, the appropriate jaw is mounted on the pressing machine, or the chain is positioned around the fitting and tightened using an adapter jaw, which must be mounted onto the pressing machine.

Figure 44 – Novopress Swivel Jaw Mounted on SZB201 Adapter

The Novopress tool range includes a series of snap-on chains that swivel on a horizontal axis and are tightened using the dedicated SZB201 adapter jaw. This type of equipment facilitates handling of the cylinder/chain assembly during installation, even in confined spaces.
Available for diameters from Ø15 mm to Ø35 mm.

For diameters from Ø12 mm to Ø35 mm, both jaws and snap-on chains are permitted. For diameters from Ø42 mm to Ø108 mm, only chains with the appropriate adapters are permitted.
For diameters Ø76 mm, Ø88 mm, and Ø108 mm, the ACO403 machine has a PN rating of 16 bar and is certified for these diameters in marine applications. **The ACO203XL machine, for diameters Ø76 mm, Ø88 mm, and Ø108 mm, has a PN rating of 10 bar.**

Please note that for diameter Ø108 mm, the ACO203XL machine requires two pressing operations: the first using the ZB221 adapter and, without removing the chain from the fitting, the second using the ZB222 adapter.
The ZB222 adapter may only be mounted after the first pressing operation has been completed using the ZB221 adapter.
Proceed with the second pressing operation until the pressing tool stops automatically.

Figure 45 – ACO 203 XL with ZB 221 Adapter

Figure 46 – ACO 203 XL with ZB 222 Adapter

After pressing, it is necessary to verify that the joint has been correctly deformed and that the required insertion depth has been respected. If the deformation appears abnormal, installation must be stopped immediately and the cause investigated. Installations that have been fully pressed with defective joints cannot be accepted as a warranty claim.

Once pressing has been completed, the joints must no longer be subjected to mechanical stress. Pipe alignment and tightening of threaded connections must therefore be completed before pressing. However, slight movement or lifting of the piping is permitted, for example for painting operations.
A correctly completed press connection can be identified by the mark embossed on the fitting, which differs according to the manufacturer of the pressing jaw/tool used.

Figure 47 – Mark Embossed on the Fitting After Pressing

If the fitting is found to be non-compliant, do not perform a second pressing operation. A second pressing would compromise the integrity of the joint and could result in leakage due to improper deformation of the pipe–fitting assembly.
The joint must therefore be removed and replaced.

The correct execution of press-fit connections is the responsibility of the installer / installation company.

For **inoxPRES** fittings Ø 15–54 mm equipped with EPDM O-rings, leaks from “unpressed fittings” should be regarded as an additional support feature to assist in identifying assembly errors, in this case the failure to press the fittings.
The prerequisite for this functionality is the proper execution of the specified leak-tightness and pressure tests. This feature does not relieve the installer of the obligation to perform a visual inspection of all joints in order to ensure correct installation. These visual inspections and pressure tests must be recorded in the corresponding test report.

4.6 Protection of Pipes and Fittings Against External Corrosion General Requirements

All piping systems must be externally protected with suitable coverings to prevent undesirable phenomena such as:

- condensation formation;
- condensation formation leading to external corrosion;
- corrosion caused by external agents;
- heat loss.

Figure 48 – Insulated Installation

Protection by means of wrapping tapes and/or painting must always be applied only after the system pressure test has been successfully completed.
NOTE: Responsibility for the selection of the protection system and its installation rests with the designer / installer.

4.7 Minimum distances and space requirement for pressing

To ensure correct pressing operations, the minimum clearances between the pipe and the supporting structure (building construction), as well as between adjacent pipes, must be maintained as specified in the following tables:

TABLE 9: MINIMUM CLEARANCES AND OVERALL DIMENSIONS IN mm FOR Ø12–35 mm

Pipe	Figure 49		Figure 50			Figure 51				Figure 52	
Ø	A	D	A	D	D1	A	C	D	D1	D	E
12	56	30	75	30	35	85	155	30	35	40	60
15	56	30	75	30	35	85	155	30	35	40	60
18	60	30	75	30	40	85	165	30	40	40	60
22	75	40	80	40	40	85	165	40	40	40	61
28	82	40	90	40	45	90	180	40	45	40	63
35	85	40	90	40	45	90	180	40	45	40	66

TABLE 10: MINIMUM INSTALLATION DIMENSIONS IN mm FOR Ø42–108 mm

Pipe	Figure 52		Figure 53		
Ø	D	E	A	B	C
42	50	80	150	150	110
54	50	85	150	150	110
76,1	60	115	170	210	170
88,9	60	120	190	260	190
108	60	135	200	320	280

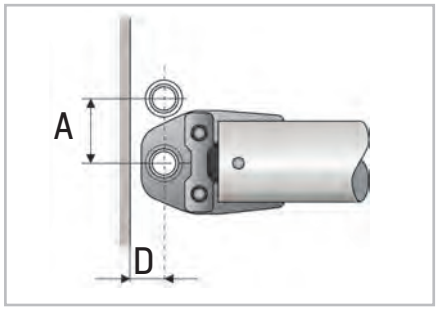


Figure 49 – Minimum Clearances and Overall Dimensions

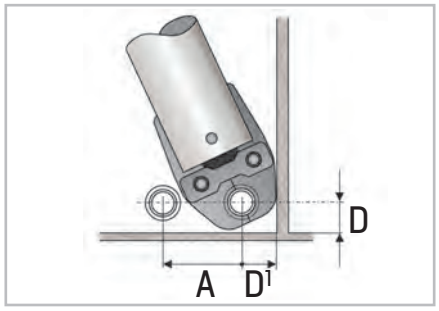


Figure 50 – Minimum Clearances and Overall Dimensions

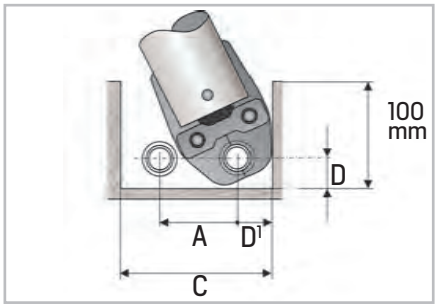


Figure 51 – Minimum Clearances and Overall Dimensions

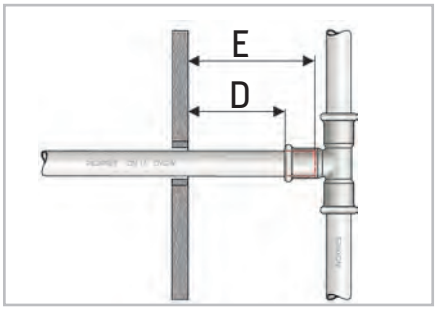


Figure 52 – Minimum Clearances and Overall Dimensions

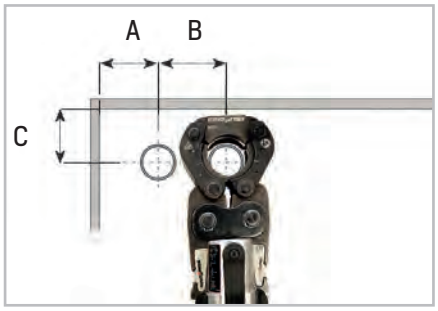


Figure 53 – Minimum distances for chains / collars

4.8 Threaded and Flanged Connections

Press fittings may be connected to threaded end pieces conforming to ISO 7-1 (formerly DIN 2999) or ISO 228 (formerly DIN 259), commonly available on the market, as well as to stainless steel or non-ferrous metal valves.

The sealing materials used must not contain chlorides (e.g. PTFE tapes containing chlorides). We recommend the use of hemp with sealing compounds and chloride-free plastic sealing tapes.

Flanges from the **inoxPRES** / **marinePRES** range may be connected to standard commercially available flanges designed for PN 6 / 10 / 16 pressure ratings.

During installation, the threaded or flanged connection must be completed first, followed by the pressing operation.

4.8.1 Connection Between Pipe and inoxPRES / marinePRES Flanged Fittings

Connections to metal fittings and/or pipes can be achieved as follows:

- **inoxPRES / marinePRES – PN6 and PN16 FLANGED CONNECTION**:
  By means of a stub end for loose flange, PN6 and PN16, available in sizes Ø15–108 mm, used in combination with a loose flange:

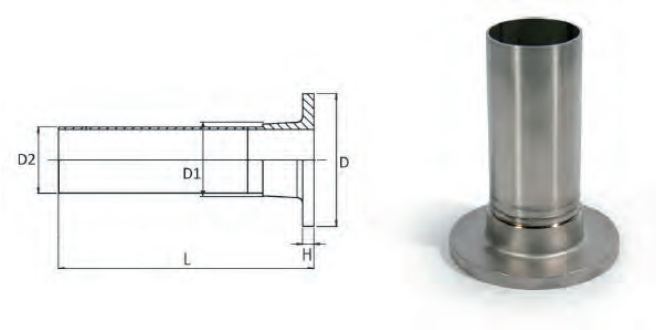


Figure 54 – Stub End for Loose Flange

- **inoxPRES / marinePRES – PN6 and PN16 FLANGED CONNECTION**:
  By means of a PN16 flanged coupling, available in sizes Ø15–108 mm:

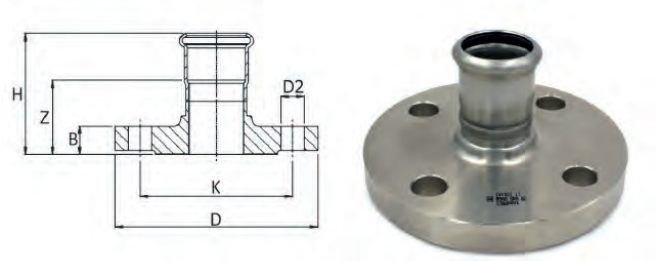


Figure 55 – PN6 / PN16 Flanged Coupling

- **inoxPRES – ANSI 150 FLANGED CONNECTION**:
  By means of an ANSI 150 flanged coupling, available in sizes Ø15–108 mm:

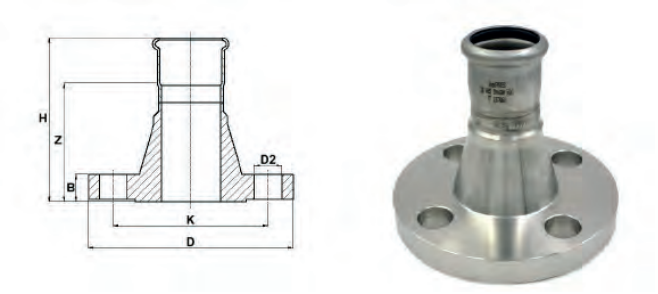


Figure 56 – ANSI 150 Flanged Coupling

The flanges of the **inoxPRES** and **marinePRES** ranges may be connected to standard commercially available flanges.
For installation, the flange connection should be assembled and secured first, followed by the pressing operation.

4.8.2 Connection Between Pipe and inoxPRES / marinePRES Threaded Fittings

The connection between the **inoxPRES** / **marinePRES** system and threaded fittings is achieved by using male-threaded or female-threaded fittings:

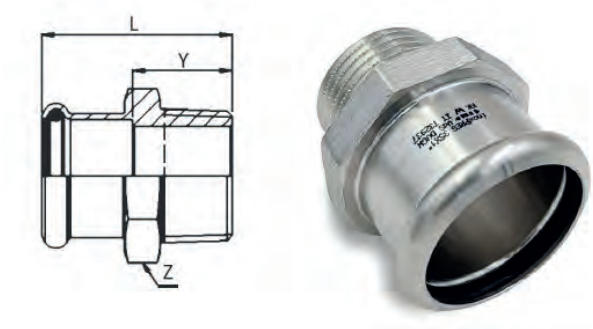


Figure 57 – Male-Threaded Fitting

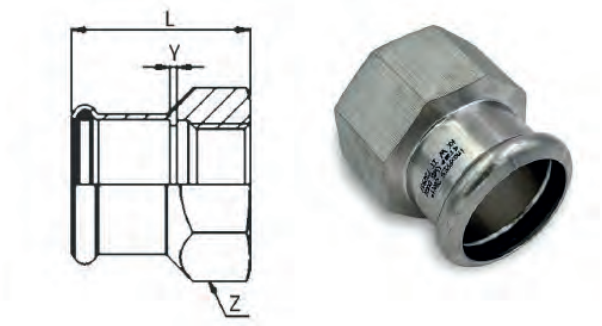


Figure 58 – Female-Threaded Fitting

Sealing materials used with **inoxPRES** fittings must not contain chlorides (e.g. PTFE tape). The use of hemp fibers with sealing compounds and chloride-free sealing tapes is recommended.

4.8.3 Watertight Deck/Bulkhead Penetrations for inoxPRES / marinePRES

The **inoxPRES** and **marinePRES** product ranges include an A0–A60 certified weld-in watertight deck/bulkhead penetration, available in diameters from Ø15 mm to Ø108 mm.
One of the distinctive features of this penetration is its special design, consisting of a carbon steel sleeve factory-welded around the **inoxPRES** / **marinePRES** pipe.
This sleeve enables the interface with decks or bulkheads, which are normally also made of carbon steel, thereby ensuring excellent weldability.
The sleeve is protected by a water-based coating that does not need to be removed prior to welding. It is also equipped with a small hole designed to allow heat generated during welding to dissipate externally without compromising the integrity of the passing pipe (this hole must always remain visible and unobstructed).
For information regarding the insulation class of watertight penetrations, please contact Raccorderie Metalliche.

Figure 59 – Watertight Penetration with Heat-Dissipation Hole in the Sleeve for Welding Operations

IMPORTANT
For safety reasons, the transition from RM press-fit systems to multilayer piping systems must be made using a threaded connection.
This requirement is intended to prevent isolated cases of leakage after pressing, which may occur when fittings from different manufacturers and made of different materials (e.g. brass / steel) are combined.

5.0 Planning

5.1 Pipe fixing, distances between clamps

Pipe supports are used to secure pipes to ceilings, walls, or floors and to compensate for length variations caused by temperature fluctuations.
By properly positioning fixed points and sliding supports, the thermal expansion and contraction of the piping system can be guided in the desired direction.

Supports must not be positioned directly at fittings. Sliding pipe clamps must be installed in such a way that they do not restrict the thermal expansion or contraction of the pipes.

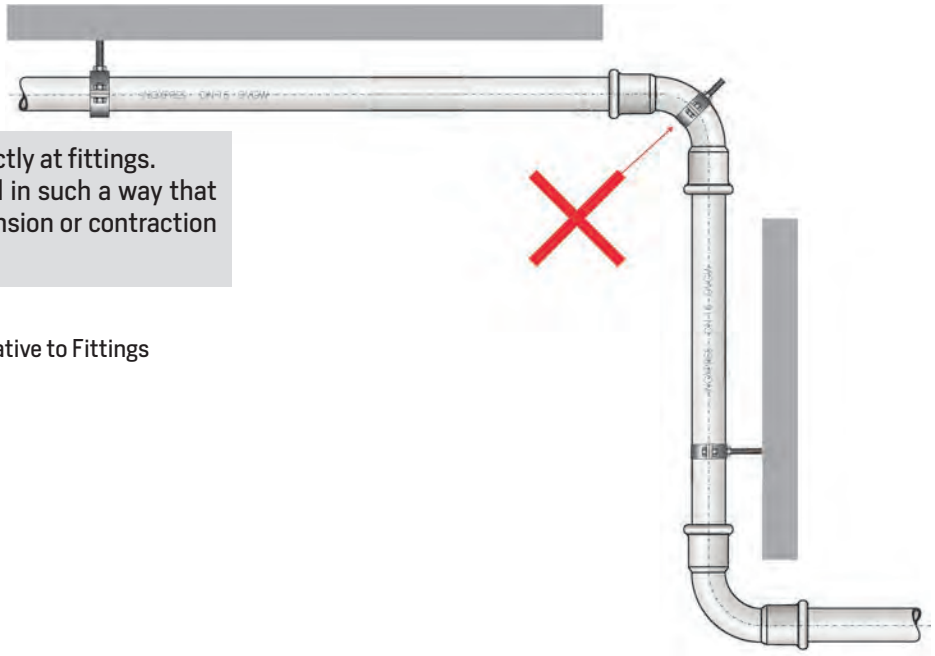


Figure 60 – Positioning of Pipe Clamps Relative to Fittings

The maximum support spacing for **inoxPRES** / **marinePRES** pipes is specified in Table 11.

TABLE 11: MAXIMUM PERMITTED DISTANCES BETWEEN SUPPORTS - EN 806-4

DN	Outside Pipe Diameter (mm)	Horizontal Support Spacing meters (Recommended)	Vertical Support Spacing meters (Recommended)
10	12	1,2	1,8
12	15	1,2	1,8
15	18	1,2	1,8
20	22	1,8	2,4
25	28	1,8	2,4
32	35	2,4	3,0
40	42	2,4	3,0
50	54	2,7	3,6
65	76,1	3,0	3,6
80	88,9	3,0	3,6
100	108	3,0	3,6

5.2 Thermal Expansion Compensation

Metal piping systems expand to varying degrees depending on the temperatures to which they are exposed and the materials from which they are manufactured.
Table 12 shows the length variation of **inoxPRES** and **marinePRES** pipes as a function of temperature differentials.
Length variation can be compensated through the proper arrangement of fixed points and sliding supports, by incorporating expansion compensators, expansion loops, U-bends, or line compensators, and by providing sufficient space for thermal expansion.

TABLE 12: LENGTH VARIATION - INOXPRES / MARINEPRES

	L [m]	Δt [°K]									
		10	20	30	40	50	60	70	80	90	100
inoxPRES	3	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0
	4	0,7	1,3	2,0	2,6	3,3	4,0	4,6	5,3	5,9	6,6
	5	0,8	1,7	2,5	3,3	4,1	5,0	5,8	6,6	7,4	8,3
	6	1,0	2,0	3,0	4,0	5,0	5,9	6,9	7,9	8,9	9,9
	7	1,2	2,3	3,5	4,6	5,8	6,9	8,1	9,2	10,4	11,6
	8	1,3	2,6	4,0	5,3	6,6	7,9	9,2	10,6	11,9	13,2
	9	1,5	3,0	4,5	5,9	7,4	8,9	10,4	11,9	13,4	14,9
	10	1,7	3,3	5,0	6,6	8,3	9,9	11,6	13,2	14,9	16,5
	12	2,0	4,0	5,9	7,9	9,9	11,9	13,9	15,8	17,8	19,8
	14	2,3	4,6	6,9	9,2	11,6	13,9	16,2	18,5	20,8	23,1
	16	2,6	5,3	7,9	10,6	13,2	15,8	18,5	21,1	23,8	26,4
	18	3,0	5,9	8,9	11,9	14,9	17,8	20,8	23,8	26,7	29,7
	20	3,3	6,6	9,9	13,2	16,5	19,8	23,1	26,4	29,7	33,0
marinePRES	3	0,5	1,0	1,5	2,0	2,6	3,1	3,6	4,1	4,6	5,1
	4	0,7	1,4	2,0	2,7	3,4	4,1	4,8	5,4	6,1	6,8
	5	0,9	1,7	2,6	3,4	4,3	5,1	6,0	6,8	7,7	8,5
	6	1,0	2,0	3,1	4,1	5,1	6,1	7,1	8,2	9,2	10,2
	7	1,2	2,4	3,6	4,8	6,0	7,1	8,3	9,5	10,7	11,9
	8	1,4	2,7	4,1	5,4	6,8	8,2	9,5	10,9	12,2	13,6
	9	1,5	3,1	4,6	6,1	7,7	9,2	10,7	12,2	13,8	15,3
	10	1,7	3,4	5,1	6,8	8,5	10,2	11,9	13,6	15,3	17,0
	12	2,0	4,1	6,1	8,2	10,2	12,2	14,3	16,3	18,4	20,4
	14	2,4	4,8	7,1	9,5	11,9	14,3	16,7	19,0	21,4	23,8
	16	2,7	5,4	8,2	10,9	13,6	16,3	19,0	21,8	24,5	27,2
	18	3,1	6,1	9,2	12,2	15,3	18,4	21,4	24,5	27,5	30,6
	20	3,4	6,8	10,2	13,6	17,0	20,4	23,8	27,2	30,6	34,0

Total linear expansion

ΔL = L x α x Δt
ΔL = linear expansion in mm
L = pipe length in m
α = linear expansion coefficient
inoxPRES α = 0,0165 mm / (m x °K)
marinePRES α = 0,017 mm / (m x °K)
Δt = temperature difference in °K

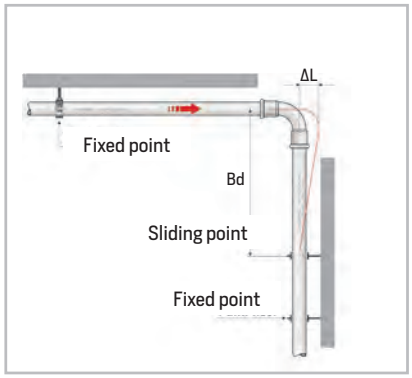


Figure 61 – Compensation of Thermal Expansion (Bd) by Means of an Orthogonal Offset

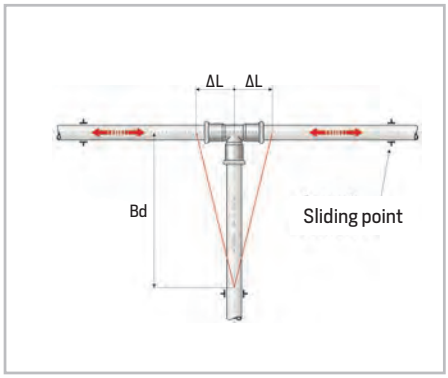


Figure 62 – Compensation of Thermal Expansion (Bd) by Means of a Tee Offset

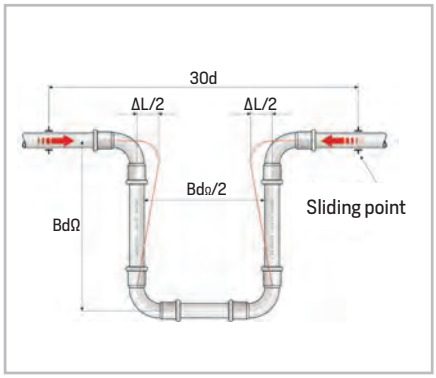


Figure 63 – U-Loop Thermal Expansion Compensation (BdΩ = Bd / 1.8)

Calculation formula Orthogonal - bend and T - junction (figure 61 and 62)

$$Bd = k \times \sqrt{(da \times \Delta L)}\ [mm]$$

k = constant material
inoxPRES = 60 for σ (sigma) 190 N/mm²
marinePRES = 63 for σ (sigma) 105 N/mm²
da = outer diameter pipe in mm
ΔL = linear expansion in mm

Calculation formula U bend (figure 63)

$$Bd\Omega = k \times \sqrt{(da \times \Delta L)}\ [mm] \text{ or } Bd\Omega = Bd/\sqrt{1,8}$$

k = constant material
inoxPRES = 34 for σ (sigma) 190 N/mm²
marinePRES = 35 for σ (sigma) 105 N/mm²
da = outer diameter pipe in mm
ΔL = linear expansion in mm

TABLE 13a: EXPANSION ARMS Ø 15–108 mm (Bd) INOXPRES

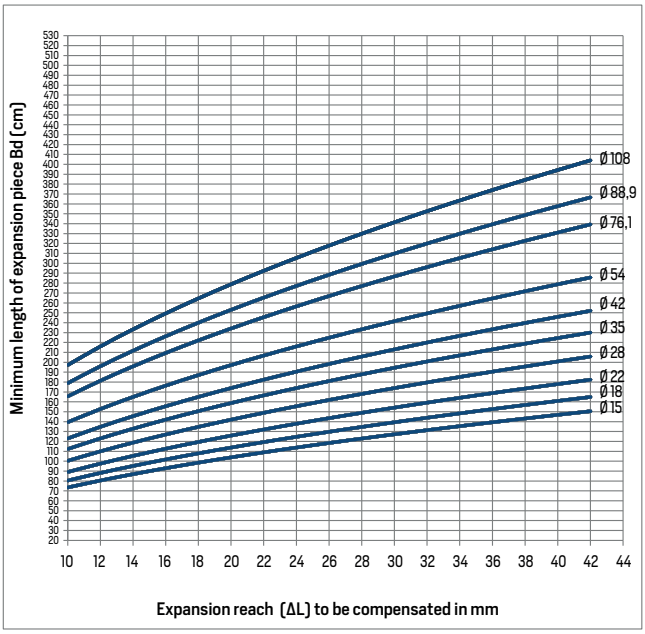


TABLE 13b: COMPENSATION ARMS FOR U-LOOP EXPANSION COMPENSATORS Ø 15–108 mm (BdΩ) INOXPRES

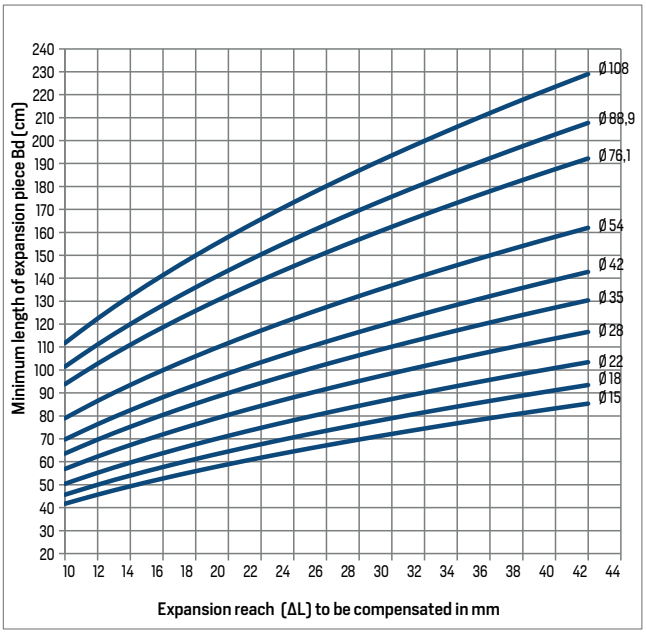


TABLE 14a: EXPANSION ARMS Ø 15–108 mm (Bd) MARINEPRES

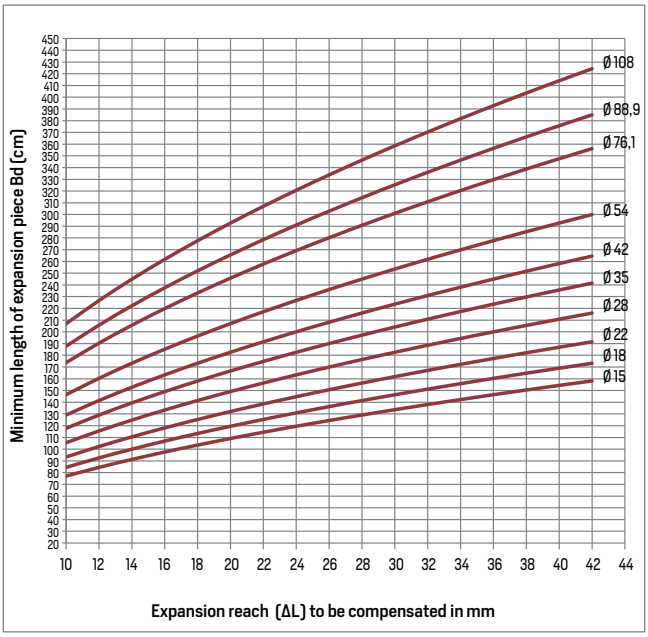
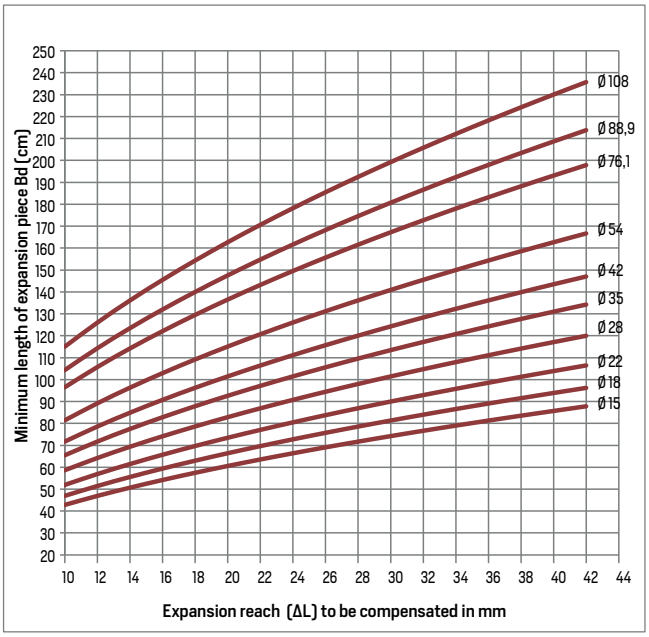


TABLE 14b: COMPENSATION ARMS FOR U-LOOP EXPANSION COMPENSATORS Ø 15–108 mm (BdΩ) MARINEPRES



5.3 Thermal emission

Depending on temperature difference, warm piping releases heat into the environment.
The thermal emissions of the **inoxPRES** piping system are shown in the following table.

TABLE 15: THERMAL EMISSIONS OF UNINSULATED INOXPRES PIPE (W/m) EXPOSED INSTALLATION

d x s (mm)	TEMPERATURE DIFFERENCE Δt (°K)									
I	10	20	30	40	50	60	70	80	90	100
-	3,8	7,5	11,3	15,1	18,8	22,6	26,3	30,1	33,9	37,6
15 x 1	4,7	9,3	14,0	18,6	23,3	28,0	32,6	37,3	41,9	46,6
18 x 1	5,6	11,2	16,8	22,4	28,0	33,6	39,2	44,8	50,4	55,9
22 x 1,2	6,8	13,7	20,5	27,4	34,2	41,0	47,9	54,7	61,5	68,4
28 x 1,2	8,7	17,4	26,1	34,8	43,5	52,2	60,9	69,6	78,3	87,1
35 x 1,5	10,9	21,8	32,7	43,5	54,4	65,3	76,2	87,1	98,0	108,8
42 x 1,5	13,1	26,1	39,2	52,3	65,3	78,4	91,4	104,5	117,6	130,6
54 x 1,5	16,8	33,6	50,4	67,2	84,0	100,8	117,6	134,4	151,2	168,0
76,1 x 2	23,7	47,3	71,0	94,7	118,4	142,0	165,7	189,4	213,1	236,7
88,9 x 2	27,7	55,3	83,0	110,6	138,3	165,9	193,6	221,2	248,9	276,6
108 x 2	33,6	67,2	100,8	134,4	168,0	201,6	235,2	268,8	302,4	336,0

External Heat Transfer Coefficient αe = 10 W/(m²·K)

The thermal emissions of the **marinePRES** piping system are shown in the following table.

TABLE 16: THERMAL EMISSIONS OF MARINEPRES PIPE (W/m) EXPOSED INSTALLATION

A - M d x s (mm)	TEMPERATURE DIFFERENCE Δt (°K)									
	10	20	30	40	50	60	70	80	90	100
15 x 1	5,1	10,2	15,4	20,5	25,6	30,7	35,9	41,0	46,1	51,2
18 x 1	6,1	12,3	18,4	24,6	30,7	36,9	43,0	49,2	55,3	61,5
22 x 1	7,5	15,0	22,6	30,1	37,6	45,1	52,6	60,1	67,7	75,2
28 x 1,5	9,6	19,1	28,7	38,3	47,8	57,4	67,0	76,5	86,1	95,7
35 x 1,5	12,0	23,9	35,9	47,8	59,8	71,8	83,7	95,7	107,6	119,6
42 x 1,5	14,4	28,7	43,1	57,4	71,8	86,1	100,5	114,8	129,2	143,5
54 x 1,5 • 54x2	18,5	36,9	55,4	73,8	92,3	110,8	129,2	147,7	166,1	184,6
76,1 x 2	26,0	52,0	78,0	104,0	130,1	156,1	182,1	208,1	234,1	260,1
88,9 x 2	30,4	60,8	91,2	121,6	151,9	182,3	212,7	243,1	273,5	303,9
108 x 2,5	36,9	73,8	110,7	147,6	184,6	221,5	258,4	295,3	332,2	369,1

External Heat Transfer Coefficient αe = 10 W/(m²·K)

5.4 Thermal Insulation

In addition to preventing heat loss, thermal insulation of piping systems can prevent condensation formation, external corrosion, unwanted heating of the conveyed fluid, as well as the generation and transmission of noise.
Cold-water pipes must be insulated in such a way as to prevent water heating, thereby preserving its suitability for potable use.
The installer is responsible for the correct and professional execution of the insulation work.
It is particularly important to ensure that all transitions, joints, and fittings within the system are properly sealed and/or bonded so that moisture cannot penetrate under any operating conditions.

For the insulation of **inoxPRES** pipes, only insulation materials containing a maximum of 0.05% water-soluble chloride ions shall be used. Insulation materials must comply with the applicable marine regulations.

Figure 64 – Rubber-Lined Pipe Clamp

5.5 Sound Insulation (DIN 4109)

Noise in potable water and heating systems mainly originates from valves, taps, and sanitary fixtures. Pipes can transmit these noises to the building structure, which then generates the airborne sound perceived as disturbing noise. By using **PRATIKO** sound-insulated pipe clamps (compliant with DIN 4109) and properly insulating the piping system, sound transmission can be significantly reduced.

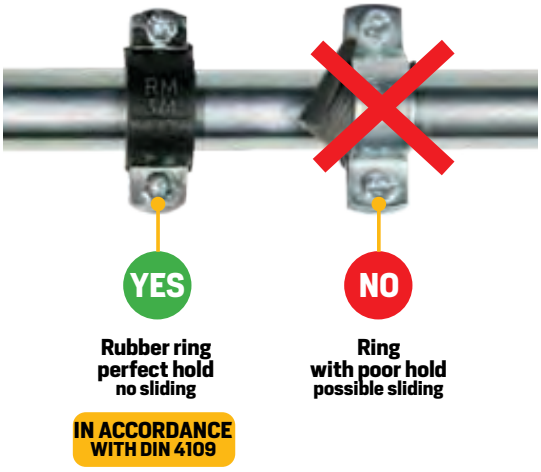


Figure 65 – PRATIKO Rubber-Lined Pipe Clamp Compliant with DIN 4109 (RM Series Articles 355/G – 351/G – 555/G – 156/G)

5.6 Equipotential Bonding

inoxPRES and **marinePRES** are electrically conductive systems and must therefore be included in the equipotential bonding system.

Responsibility for the equipotential bonding connection rests with the electrical system installer.

5.7 Sizing

TABLE 17a : PIPE FRICTION PRESSURE DROP
INOXPRES / INOXPRES 304L

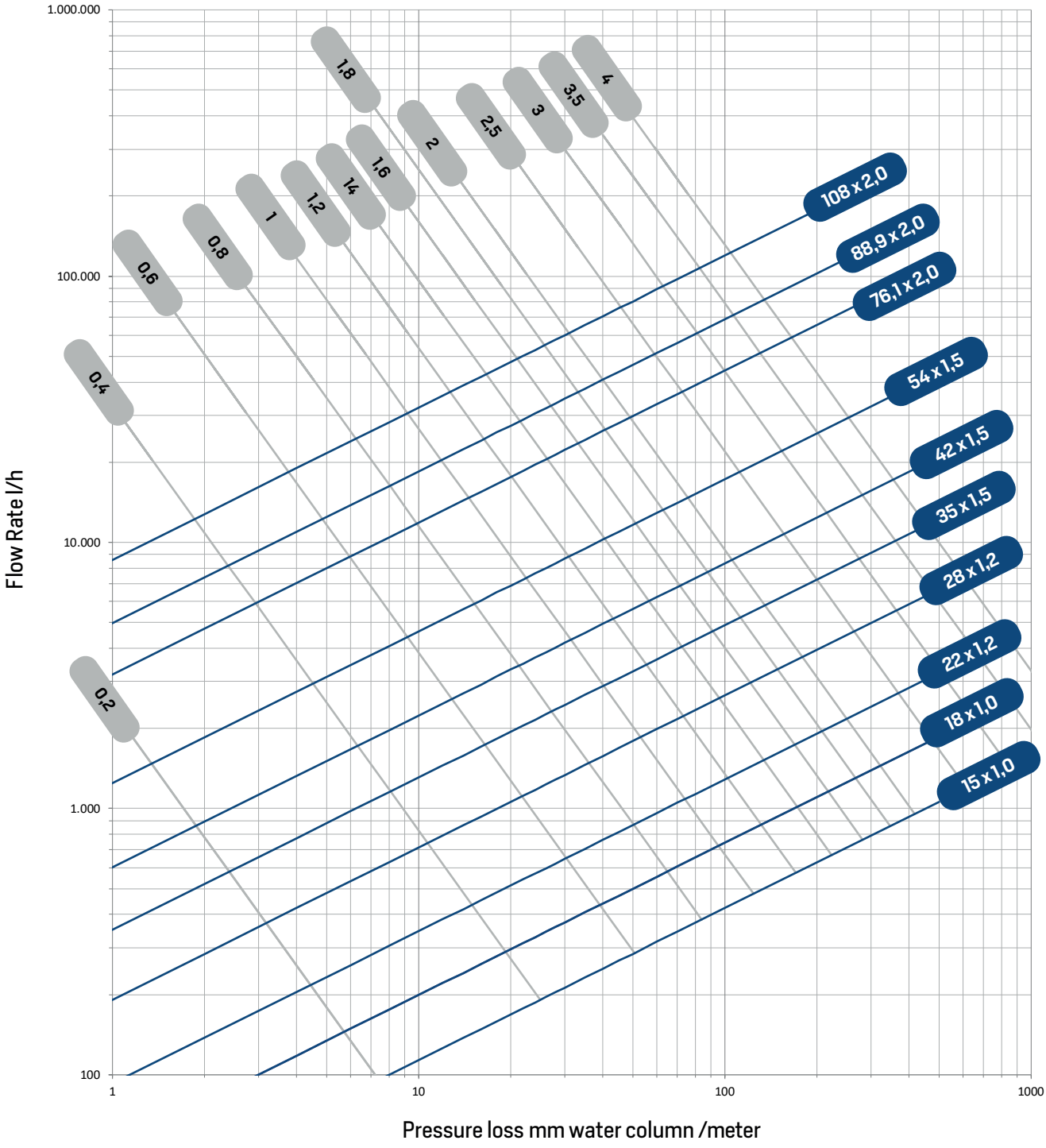
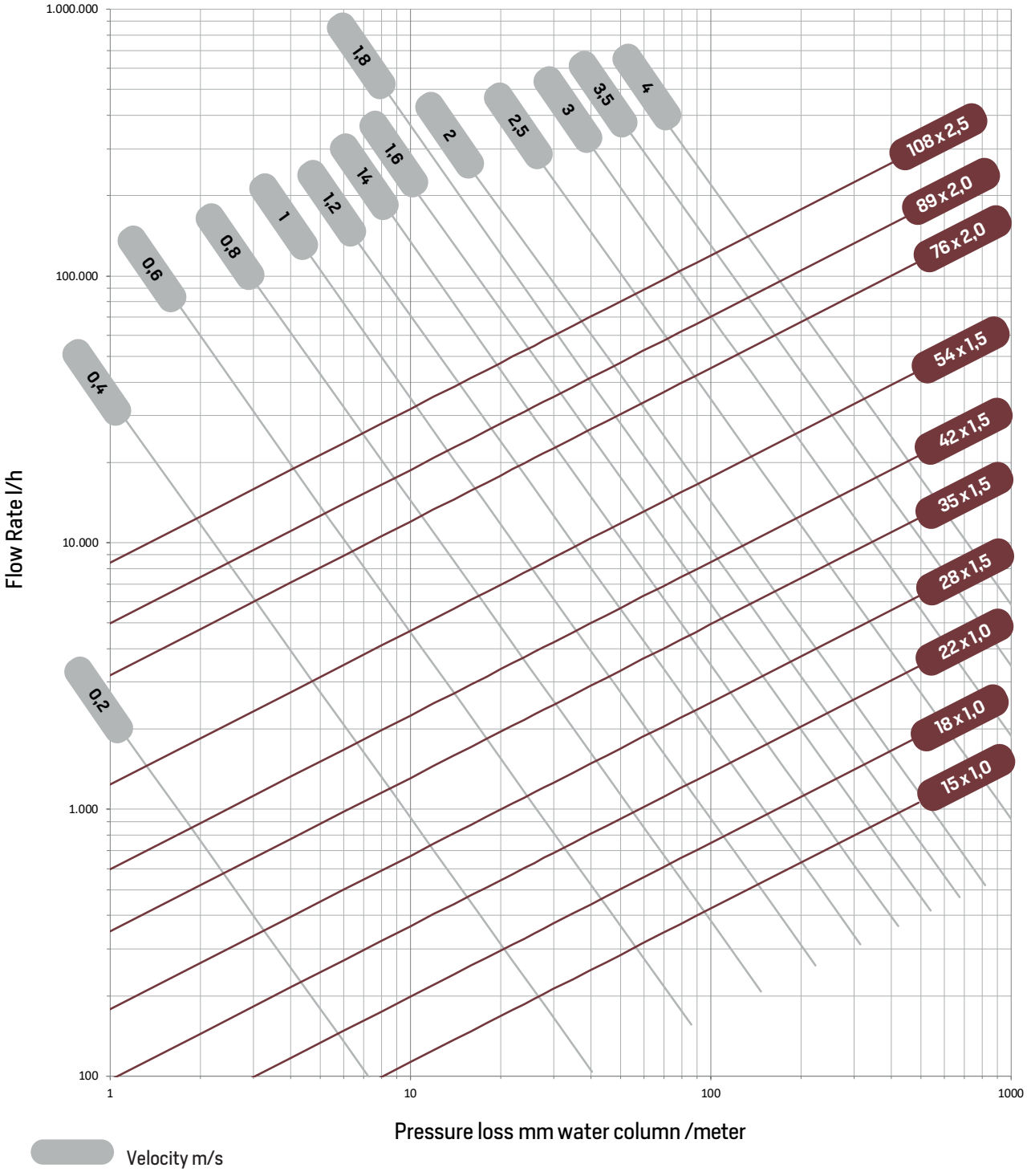


TABLE 17b : PIPE FRICTION PRESSURE DROP
MARINEPRES



5.8 Trace heating

When trace heating is used, the temperature of the pipe inside wall may not exceed 60 °C. For thermal disinfection purposes a temporary temperature increase to 70 °C (1 hour per day) is permitted. Pipes which are fitted with drainage valves or back-flow prevention valves must be protected against excessive pressure increase resulting from warming. The fitting instructions issued by trace heating manufacturers are to be followed exactly.

6.0 Commissioning

6.1 Pressure Testing

Corrosion phenomena may occur in systems manufactured from metallic materials such as stainless steel and copper alloys when specific conditions arise involving water and air in contact with the metal.
This effect can be prevented by keeping the system completely filled with water until it is placed into service. Otherwise, the risk of corrosion in metallic piping systems increases significantly due to residual water remaining in the system (i.e., when the metal is simultaneously exposed to both water and air). If a potable water system cannot be commissioned shortly after the pressure test, the test should be performed using compressed air or an inert gas.

- Leak-tightness and pressure tests must be carried out before covering the pipes (e.g., with insulation);
- The fluid used for pressure testing must have characteristics that do not impair the performance of the system.
- The correct execution of press-fit connections is the responsibility of the installer / installation company.

These visual inspections and pressure tests must be recorded in the relevant test report.
For pressure testing, reference should be made to IACS (International Association of Classification Societies) document UR P2.

As good engineering practice, the leak-tightness test should be carried out at a pressure equal to 1.5 times the operating pressure.
It is also recommended to allow an adequate stabilization period once the test pressure has been reached.
The test pressure must be increased gradually through progressive pressure increments.
Each pressure increment should be followed by an adaptation period, typically corresponding to pressure increases of 2 bar every 5 minutes.

6.2 System Flushing

Following the installation of an **inoxPRES** / **marinePRES** system, flushing is recommended in order to remove any manufacturing residues, installation debris, or general contamination that could adversely affect proper system operation.
The fluid used for flushing must have characteristics that do not compromise the functionality of the system.
As with pressure testing, stagnant sections, closed branches, and inadequate deaeration must be avoided.
At the end of the flushing operation, the system must be completely drained of the flushing fluid used.

7.0 Corrosion

7.1 inoxPRES

The corrosion behavior of the **inoxPRES** system is determined by the Cr-Ni-Mo stainless steel used (AISI 316L, material no. 1.4404).

7.1.1 Bimetallic Corrosion (Mixed Installations)

inoxPRES may be combined in mixed installations with all non-ferrous metals (copper, brass, bronze) without the need to consider flow direction according to the electrochemical nobility of the metals.

Bimetallic corrosion may occur only on galvanized components if they come into direct contact with **inoxPRES** components. By providing a non-ferrous metal spacer greater than 80 mm in length (e.g. an isolation valve), bimetallic corrosion can be prevented.

7.1.2 Crevice Corrosion and Pitting Corrosion

Based on the W**HO document *Guide to Ship Sanitation* and the VSP Environmental Health Standard (Vessel Sanitation Program)**, it is recommended not to exceed a chlorine concentration of 50 mg/l.
In cases of hyperchlorination, reference should be made to the VSP standard. Since the passive layer that protects stainless steels tends to deteriorate at temperatures above 65°C, it is essential that any combination of elevated temperature and the presence of chloride-containing agents be carefully managed by the system designer. This is necessary to prevent corrosion phenomena and ensure the long-term durability of the system.
Potential stagnant conditions of the circulating fluid and dead legs within the system must therefore be appropriately assessed during both the design and operation phases, taking into consideration the specific water quality and all installation environment conditions that may generate or promote corrosion.
For potable water systems, it is important to ensure continuous flow while avoiding dead legs and stagnant conditions. These application and operating conditions help preserve the materials of the **inoxPRES** range over time and contribute to their durability.

The risk of crevice corrosion and pitting corrosion on **inoxPRES** components exists if:

- the system is drained after a pressure test and residual water remains in piping that is open to the atmosphere. Slow evaporation of the residual water may increase the chloride concentration beyond acceptable limits, causing pitting corrosion at the water-material-air interface. If it is not possible to place the system into service shortly after a water pressure test, the test should be carried out with air. See also Section 6.1 Pressure Testing;
- an increase in water temperature is caused externally through the pipe wall (e.g. by an electric heating cable). Deposits formed on the internal pipe wall under these conditions may result in an increased concentration of chloride ions. See also Section 5.8 Heating Cable;
- sealing materials containing chlorides or plastic tapes are used. The release of chloride ions into potable water from sealing materials may cause localized chloride enrichment and, consequently, crevice corrosion. See also Section 4.8 Threaded and Flanged Connections;
- the material has become sensitized as a result of exposure to temperatures above the permitted limits. Any heating of the material that produces heat-tint colors alters its metallurgical structure and may lead to intergranular corrosion. Hot bending and hot cutting of pipes using grinders or oxy-acetylene torches are not permitted.

7.1.3 External Corrosion

The risk of external corrosion on **inoxPRES** components exists if:

- non-approved insulation materials or insulating sleeves are used. Only insulation materials or insulating sleeves containing a maximum of 0.05% water-soluble chloride ions are permitted;
- **inoxPRES** comes into contact with chlorine-containing gases or vapors;
- inoxPRES comes into contact with chloride-containing materials in the presence of moisture;
- evaporation of water from hot pipes causes an increase in chloride concentration (water vapor-saturated atmosphere);
- high concentrations of salts are present in the atmosphere, such as in marine or coastal environments.

inoxPRES components can be protected against external corrosion by adopting the following measures:

- use closed-cell expanded elastomer insulation materials;
- apply protective coverings;
- apply protective coatings/paint systems;
- avoid installation in corrosive environments.

Responsibility for the selection and implementation of corrosion protection measures rests with the designer and/or installer.

7.2 marinePRES

The corrosion behavior of **marinePRES** systems is determined by the quality of the base material—copper—which is the principal constituent of the alloy used in the press-fit system.

The **marinePRES** system is particularly recommended for applications involving high salt concentrations, such as the conveyance of brackish water.

7.2.1 Bimetallic Corrosion (Mixed Installations)

marinePRES systems may be combined with other materials, both ferrous and non-ferrous. However, particular attention must be paid to the ratio between cathodic and anodic surface areas in order to avoid unfavorable corrosion conditions. Copper normally acts as the cathodic material and may therefore induce corrosion in adjoining components.
In open-loop systems, in order to prevent corrosion in mixed-material installations, the following general rules should be observed:

- considering the direction of water flow, copper and copper alloys should always be installed downstream of systems made from ferrous materials;
- non-ferrous spacers longer than 80 mm (e.g. isolation valves, bronze fittings, or brass fittings) should be installed between sections made of different materials.

7.2.2 External Corrosion

Copper and copper alloys are generally resistant to external corrosion and therefore do not normally require specific protective measures. However, where sulfides, nitrites, or ammonia are present, the piping system must be protected.
marinePRES components can be protected against external corrosion by adopting the following measures:

- closed-cell insulation materials;
- protective coverings;
- protective coatings/paint systems;
- avoiding installation in corrosive environments.

Responsibility for the selection and implementation of corrosion protection measures rests with the designer and/or installer.

7.3 Material Compatibility – Bimetallic Connections

The table below provides a summary of the compatibility of different material combinations in both open-loop and closed-loop systems.

TABLE 18: MATERIAL COMPATIBILITY – BIMETALLIC CONNECTIONS

PRESSFITTING		PIPE		
System	Circuit Type	Stainless Steel	Carbon Steel	Copper-Nickel
inoxPRES	Open-loop system			
	Closed-loop system		2)	
marinePRES	Open-loop system			
	Open-loop system		2)	

Permitted Combination attenzione alle note sottostanti Combination Not Permitted

NOTES:

1) Any stainless steel/copper sections of the network must be separated from carbon steel by means of non-ferrous transition spacers (e.g. a valve, bronze fitting, or brass fitting).
Individual stainless steel/copper fittings installed within a carbon steel system are permitted.

2) Any carbon steel section of the network must be separated by a non-ferrous transition spacer (e.g. a valve, bronze fitting, or brass fitting).
Individual carbon steel fittings installed within a stainless steel/copper system are not permitted.

The compatibility ratings shown in the table refer to water conveyance under standard operating conditions (PN16, 20°C). This table is intended as a general guideline only. From a corrosion standpoint, the surface areas of the various components and the actual operating conditions must always be evaluated.

8.0 Disinfection

For the disinfection of potable water systems, reference should be made to the **Vessel Sanitation Program** document, without exceeding the chlorine limits recommended by the **WHO document Guide to Ship Sanitation**.

9.0 Hygiene

The design, installation, and operation of potable water distribution systems must be carried out in strict compliance with hygiene requirements.
Particular attention must be paid to the regulations in force in the country where the installation is performed, especially with regard to system design, sanitation procedures, and periodic maintenance.
The following measures are suitable for ensuring the required drinking water quality and for minimizing the risk of microbial contamination:

- use of materials suitable for the intended application;
- selection of the smallest practical nominal diameters during network design calculations;
- selection of piping layouts with due consideration for hygiene requirements (looped piping systems); dead legs and unidirectional branch lines, which are critical from a hygienic standpoint, should be avoided;
- avoidance of sections where water stagnation may occur (e.g. drain lines and main shut-off valve sections);
- preference for check valves on individual branch lines;
- separation of firefighting water piping from the potable water distribution network;
- maintenance of the specified temperature throughout the entire potable water heating system;
- proper sizing and balancing of recirculation piping systems;
- evaluation of the possibility of installing bypass sections on the main line in complex systems, allowing thorough flushing operations without shutting down the system and thereby improving the effectiveness of disinfection treatments;
- protection of cold-water piping against unwanted heating;
- use of materials and auxiliary substances in full compliance with hygiene requirements;
- documentation of piping routes and layouts;
- continuous maintenance.

10.0 Common Errors

FIGURE	DESCRIPTION	CORRECTIVE ACTION
	Non-watertight joint due to failure of the internal O-ring in the pressed fitting.	The joint must be replaced, taking care not to damage the O-ring during insertion of the pipe into the fitting. The pipe must be inserted into the fitting with a slight axial push while simultaneously rotating it.
	Joint separation due to insufficient insertion depth. Absence of the insertion depth marking. Pipe cut using a cut-off grinding disc.	The joint must be replaced using a pipe cut with a wheel pipe cutter and marked with the correct insertion depth.
	Material build-up on the toroidal section of the fitting after pressing. The material lip completely overlaps the O-ring seat.	The joint must be replaced using a pressing jaw that is in good condition, clean, and properly lubricated. Regular and periodic maintenance of the equipment by an Authorized Service Centre does not eliminate the need for frequent cleaning and lubrication by the user.
	The shoulder of the pressed fitting shows the same coloration as the mark made on the pipe to indicate the correct insertion depth; therefore, the insertion depth marking was made after the fitting had already been pressed. The pipe may have been inserted only a few millimetres into the fitting.	The joint must be replaced by marking the correct insertion depth on the pipe before proceeding with the pressing operation.
	The deformation of the pressed joint is not perpendicular to the pipeline axis, and the toroidal section of the fitting appears distorted and flattened.	The joint must be replaced. Particular care shall be taken to position the pressing tool perpendicular to the joint axis and to maintain this position throughout the entire pressing operation.

Multiple pressing impressions are visible around the circumference of the fitting's toroidal section. This condition presents a high risk of leakage due to improper deformation of the pipe-fitting assembly. Additionally, the insertion depth marking is absent.

The joint must be replaced by performing
only a single pressing operation on the fitting. In addition, the insertion depth marking must be clearly visible.

11.0 Forms, Protocols and Warranty

For the following documents, please refer to the M Profile Technical Manual available on the RM portal:

- Compatibility request form;
- Pressure testing protocols
- Warranty documentation (and any warranty extension).

Note


RM DRAIN ITEM 802065025
316L - 1.4404 Dn 65
RM DRAIN ITEM 819065000
316L - 1.4404 Dn 65

Waste Systems

12.0 Fields of Application

The **RM DRAIN** system is certified for use in the installation of the following Class III systems:

TABLE 19: FIELDS OF APPLICATION

SYSTEM / CONVEYED FLUID	Gasket	Gasket Temperature Range	Design Pressure
Black and grey wastewater	EPDM	-20/+120 °C	up to 0,5 bar
Vacuum systems	EPDM	-20/+120 °C	up to - 0,97 bar
For vent piping in sanitary drainage systems and for centralized vacuum cleaning systems	EPDM	-20/+120 °C	up to 0,5 bar
Lines in tanks not forming part of the ship's structure	EPDM	-20/+120 °C	up to 0,5 bar
Food waste collection systems	EPDM	-20/+120 °C	up to 0,5 bar
Internal and external scuppers	EPDM	-20/+120 °C	up to 0,5 bar
Air vents	EPDM	-20/+120 °C	up to 0,5 bar

The push-fit joints of the components, which allow for quick and secure installation, comply with the requirements of EN 1124-3 and withstand the following operating pressures:

TABLE 20: OPERATING PRESSURE PEAKS

Internal pressure	DN 40 to DN 150	+0,5 bar
pressione interna, se bloccate con apposito collare anti sfilamento	DN 40 to DN 65	+2,0 bar[1]
	DN 80 to DN 150	+1,5 bar [1]
Negative pressure (vacuum)	DN 40 to DN 150	- 0,97 bar [1]

[1] The indicated pressures are to be considered peak pressures and therefore apply only for a very short period of time.

For further details regarding the applicable certifications, please refer to the documentation available on our portal, **raccorderiemetalliche.com**, in the ***Download*** section.
Please note that the use of the **RM DRAIN** system, due to its jointing technology, is permitted in shipboard spaces in accordance with the requirements of the **SOLAS Convention**.

12.1 Application Notes

The types of systems for which the **RM DRAIN** system is certified allow its use, provided that certain rules are observed, arising from the material from which it is manufactured, namely AISI 316L (1.4404) stainless steel.
In light of this, particular care must be taken to prevent chemical substances that may cause corrosion of the pipes or fittings from being introduced into the piping system, especially in the presence of stagnant water or dead legs within the installation.

13.0 Push-Fit Jointing System

13.1 Jointing Technique

The **RM DRAIN** system uses a jointing method between its components that falls within the category of push-fit systems. Specifically, the connection between two components is achieved by inserting an element with a tubular end into an element with a socket end fitted with a gasket whose function is to ensure the leak-tightness of the joint.
A cross-section of a joint is shown below:

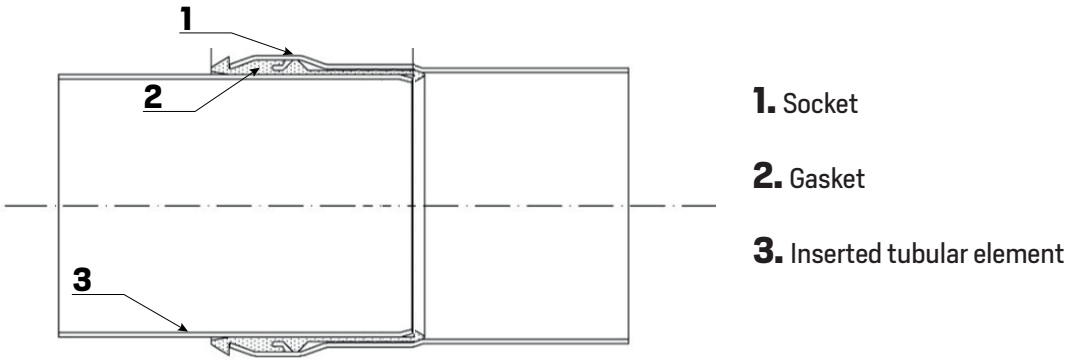


Figure 66 – Cross-section of a fitting connected to a pipe with an interposed "high" gasket, type 826/GV

13.2 Gaskets

RM DRAIN fittings are factory-equipped with EPDM gaskets to ensure the hydraulic tightness of the joint (under both positive and negative pressure conditions).
The materials and characteristics of the installed gaskets are listed below:

TABLE 21: SEALING RINGS – APPLICATIONS AND TECHNICAL CHARACTERISTICS

Technical Specifications	Colours	Operating Temperature Min / Max Degrees Celsius	Operating Pressure (bar)
EPDM	black	-20 / +120 °C	0,5

Elements with nominal diameters DN 40 – 50 – 65 are factory-equipped with 826/GV gaskets (the “high” type), as shown in the table below:

TABLE 22: 826/GV GASKETS

NOMINAL DIAMETER (DN)	OUTSIDE DIAMETER (DE)	826/GV "HIGH" TYPE
40	42	
50	53	
65	73	

Elements with nominal diameters DN 80 – 100 – 125 – 150 are factory-equipped with 826/G gaskets (the “low” type), as shown in the table below:

TABLE 23: 826/G GASKETS

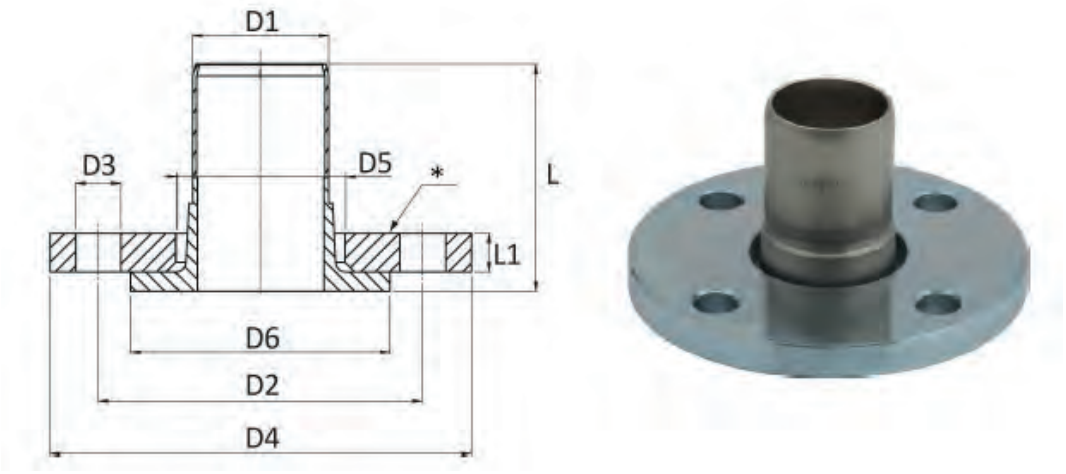
NOMINAL DIAMETER (DN)	OUTSIDE DIAMETER (DE)	826/G "LOW" TYPE
80	88,9	
100	102	
125	133	
150	159	

If an element with a nominal diameter smaller than DN 80 is fitted with a low-profile gasket, the vacuum sealing performance is not compromised.

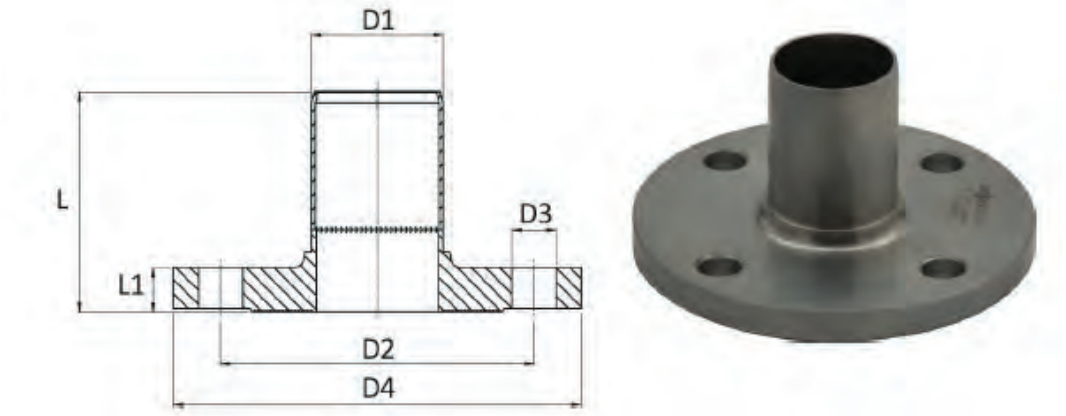
13.3 Connection Between RM DRAIN Pipes and Flanged Fittings

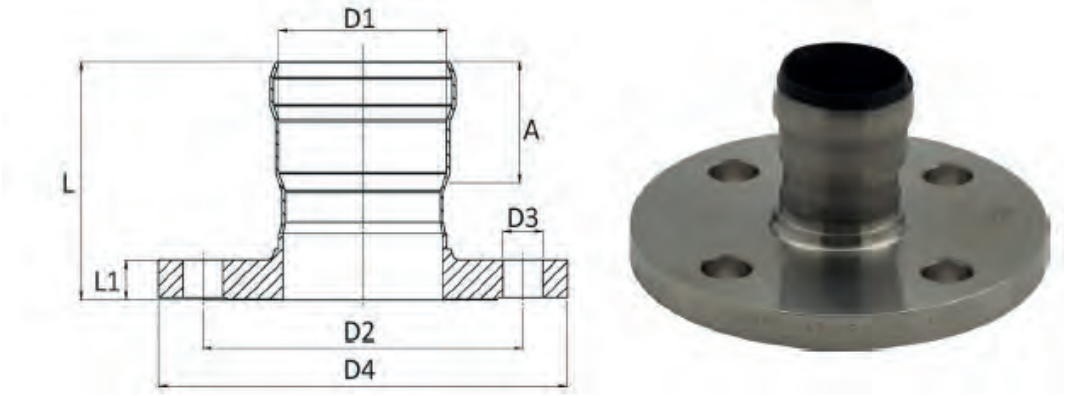
Connection to fittings and/or metal pipes can be achieved using the following methods:

1. RM DRAIN / CONNECTION WITH STUB END AND LOOSE FLANGE PN6/PN16



2. RM DRAIN / CONNECTION WITH FLANGE AND MALE/FEMALE THREADED FITTING PN6/PN16



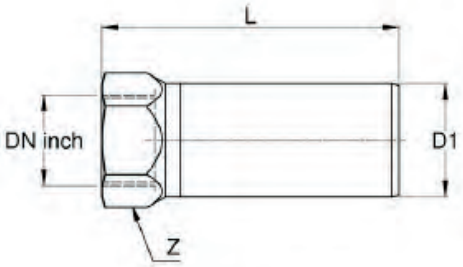


For installation, first proceed with fastening the flange.

13.4 Connection Between RM DRAIN Pipes and Threaded Fittings

The connection between the **RM DRAIN** system and threaded fittings is achieved through the use of female threaded fittings:

1. FEMALE THREADED FITTINGS

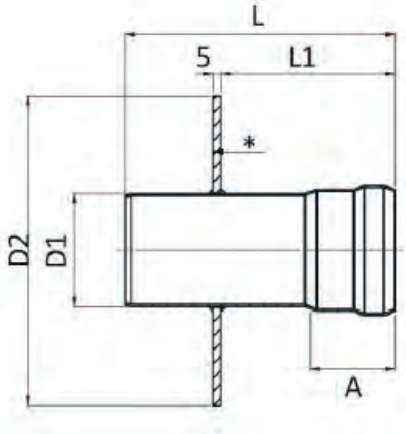


Sealing materials used with the threaded parts of **RM DRAIN** fittings (e.g., PTFE tape) must not contain chlorides. The use of hemp fibres with sealing compounds and chloride-free sealing tapes is recommended.

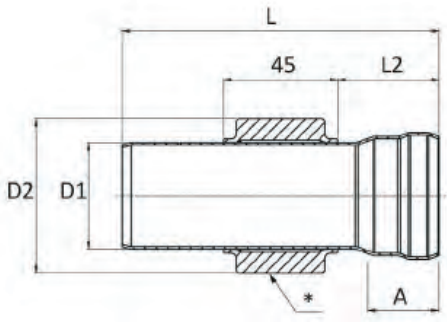
13.5 RM DRAIN Watertight Deck/Bulkhead Penetrations

The **RM DRAIN** fitting range includes a series of watertight penetrations with weld-on sleeves for decks and bulkheads, available in different configurations. The available products are listed below:

1. F1 WATERTIGHT PENETRATION



2. M1 WATERTIGHT PENETRATION



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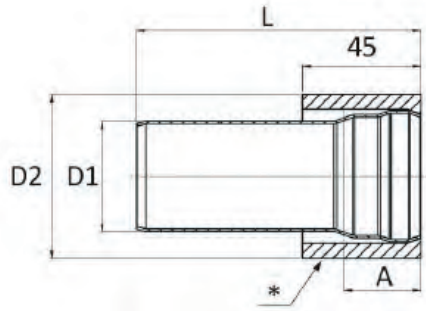
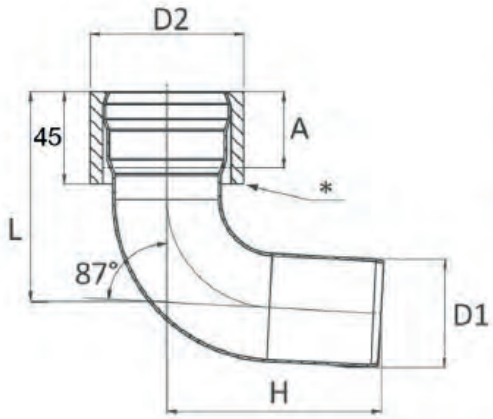


4. M3 WATERTIGHT PENETRATION



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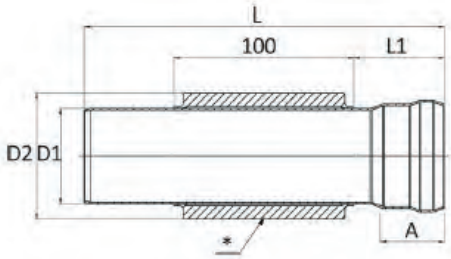
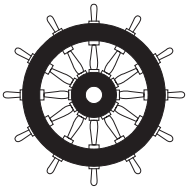


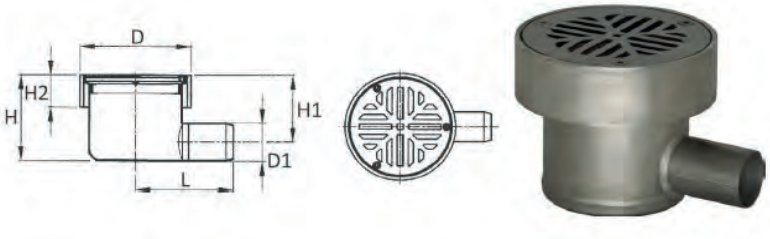


A0 - A60

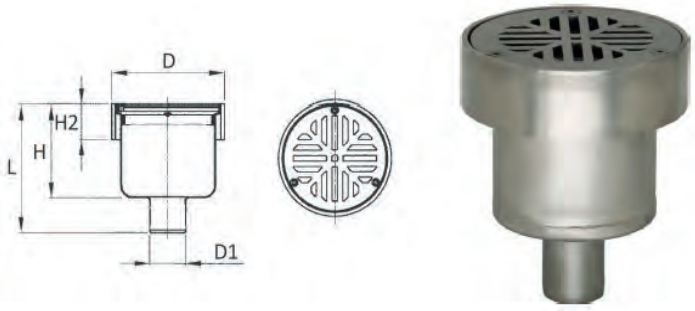
13.6 RM DRAIN Floor Drains

The **RM DRAIN** fitting range includes a series of drains with or without trap (water seal), with vertical or horizontal outlet, with telescopic drain body and, where required, with a bimetallic weld-on interface for installation on light-alloy decks (available on request). They may be of the weld-on type (items 825/02, 825/04, 825/05, 825/06Q, 825/06C, 825/07Q, 825/07C) or fastened by countersunk-head screws (items 825/01, 825/03).
The following products are available:

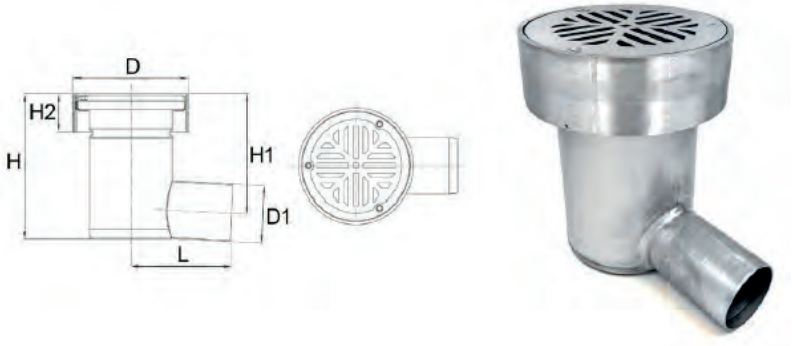
1. WELD-ON FLOOR DRAIN / HORIZONTAL OUTLET



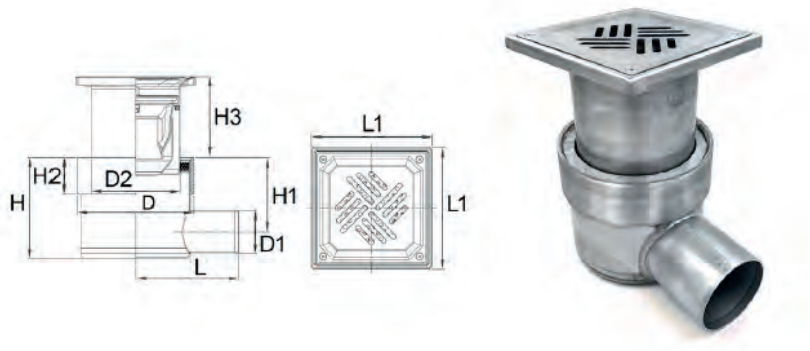
2. WELD-ON FLOOR DRAIN / VERTICAL OUTLET



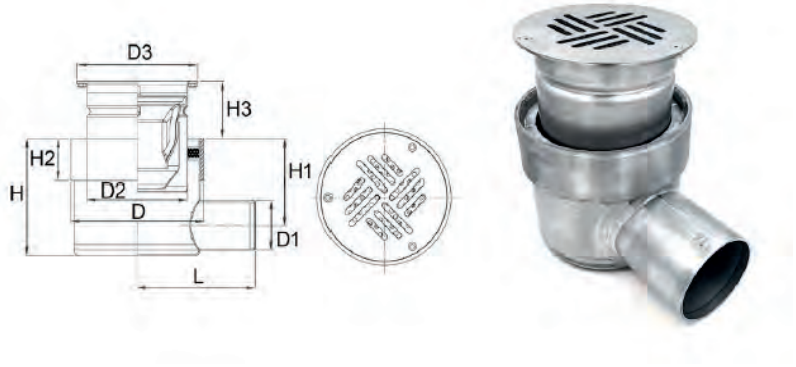
3. WELD-ON FLOOR DRAIN / HORIZONTAL OUTLET / LONG



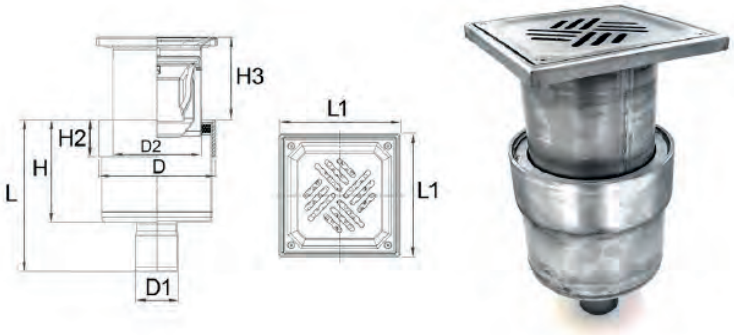
4. WELD-ON FLOOR DRAIN / HORIZONTAL OUTLET / TELESCOPIC / SQUARE



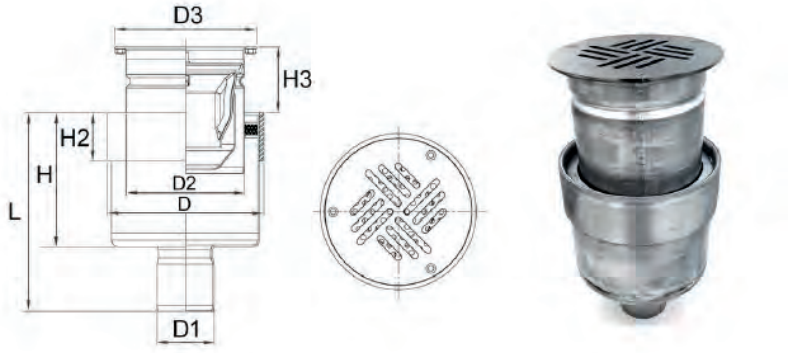
5. WELD-ON FLOOR DRAIN / HORIZONTAL OUTLET / TELESCOPIC / ROUND



6. WELD-ON FLOOR DRAIN / VERTICAL OUTLET / TELESCOPIC / SQUARE



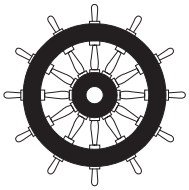
7. WELD-ON FLOOR DRAIN / VERTICAL OUTLET / TELESCOPIC / ROUND



8. FLOOR DRAIN WITH FLANGE / VERTICAL OUTLET

9.FLOOR DRAIN WITH FLANGE / HORIZONTAL OUTLET

10. TRAP FOR FLOOR DRAIN



A0 - A60

14.0 Push-Fit System Components RM DRAIN System Components

14.1 RM DRAIN Fittings

RM DRAIN fittings are manufactured from highly alloyed Cr-Ni-Mo austenitic stainless steel AISI 316L (material No. 1.4404).
The fittings are labelled with the manufacturer's name, diameter, trademark, and an internal traceability code.
A black EPDM rubber gasket (either the "high" or "low" version, depending on the fitting diameter) is factory-fitted into the female ends of the fittings.

Figure 67 – Branch Fitting from the RM DRAIN Range

14.2 RM DRAIN Pipes

RM DRAIN pipe elements are thin-wall longitudinally welded pipes manufactured in accordance with DVGW Worksheet GW 541, EN 10217-7 (DIN 17455) and EN 10312.
They are produced from highly alloyed Cr-Ni-Mo austenitic stainless steel AISI 316L (material No. 1.4404).
The internal and external surfaces are smooth and free from substances that could cause corrosion.
RM DRAIN pipe elements are classified as non-combustible and belong to Fire Reaction Class A. They are supplied in lengths of 250, 500, 750, 1000, 1500, 2000, 2500 and 3000 mm.
The ends of the pipe elements, which may be Male/Female or Female/Female, are factory-fitted with a black EPDM rubber gasket (either the "high" or "low" version, depending on the diameter of the element).
As with the fittings, **RM DRAIN** pipe elements are also provided with markings that fully identify their characteristics and ensure complete traceability.

Figure 68 – Label Example

Figure 69 – Male/Female Pipe (M/F)

Figure 70 – Female/Female Pipe (F/F)

15.0 Push-Fit System RM DRAIN Processing and Installation

15.1 Transport and Storage

The main recommendations for the transport and storage of RM DRAIN system components are as follows:

- Components must be handled with care and protected from dirt and damage during warehouse storage, transportation, and installation on site.
- During transport, all components must be stacked in an orderly and practical manner.
- Loading and unloading operations must be carried out in such a way as to prevent severe impacts and deformation. Pipes and/or fittings showing mechanical damage must be submitted to Raccorderie Metalliche for evaluation.
- Store pipes on level and uniform surfaces. In the case of pipes packaged in protective film, ensure that they are properly supported on wooden pallets (or on the packaging supports if specifically designed for this purpose and manufactured from suitable materials such as wood, foam, or plastic).
- **Do not leave pipes or fittings outside their protective packaging exposed to direct sunlight or near heat sources, as the gaskets inside may deteriorate.**
- Do not store pipes in contact with other materials in order to avoid potential corrosion initiation.

15.2 Cutting, Deburring and Bending

RM DRAIN pipes must be cut using commercially available pipe cutters suitable for stainless steel applications. The ideal tool is a wheel pipe cutter, either manual or powered. When a wheel pipe cutter is used, the pipe end is slightly tapered, facilitating insertion into the fitting and eliminating the need for external deburring of the pipe end.

Particular attention must be paid to the cutting wheel and other cutting tools used. Cutting tools must be compatible with the material being processed, clean, and free from adhering materials or metal chips. After cutting, all cutting edges and pipe ends must be cleaned and cleared of chips and impurities.

Figure 71 – Powered Pipe Cutter

Figure 72 – Manual Pipe Cutter

NOTE:
Whenever possible, it is preferable to use pipes in their standard commercial lengths, avoiding cutting operations.
The currently available pipe lengths for all diameters are:
250 mm, 500 mm, 750 mm, 1000 mm, 1500 mm,
2000 mm, 2500 mm, 3000 mm.

15.3 Marking the Insertion Depth

The hydraulic tightness of the joint, especially in gravity drainage systems, is achieved only by observing the insertion depths specified in the table below.

It is recommended to mark the insertion depth using a broad-tip marker and a measuring tape, as the marking may not be visible after insertion of the pipe into the fitting if the line is too thin.

TABLE 24: RM DRAIN SYSTEM INSERTION DEPTHS

Pipe Size DN	Pipe Outside Diameter OD [mm]	Pipe Insertion Depth into the Fitting Socket [mm]
DN 40	42	34
DN 50	53	41
DN 65	73	58
DN 80	88,9	70
DN 100	102	85
DN 125	133	88
DN 150	159	95

Figure 73 – Example of Insertion Depth Marking

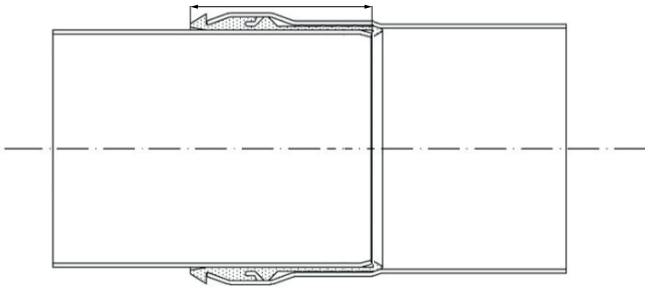


Figure 74 – Insertion Depth

15.4 Gasket Inspection

Before assembling the fittings, verify that the sealing gasket is correctly positioned in the socket end and that it is neither dirty nor damaged.
If necessary, the gasket must be replaced.

Figure 75 – Gasket Inspection

15.5 Joint Assembly

To make a joint using the **RM DRAIN** system, the following three operations must be carried out:

1. The gasket located inside the socket end must be lubricated using RM Chloride Free lubricant before inserting the pipe or fitting.

NOTE:
The use of oils and greases as lubricants is not permitted.

Figure 76 – Lubricating the Gaske

2. The pipe or fitting must be inserted into the socket end with a slight axial push while simultaneously rotating it, until the previously marked insertion depth is reached.

Figure 77 – Inserting the Pipe/Fitting

3. Any excess lubricant must be removed using a clean cloth.

Figure 78 – Removal of Excess Lubricant

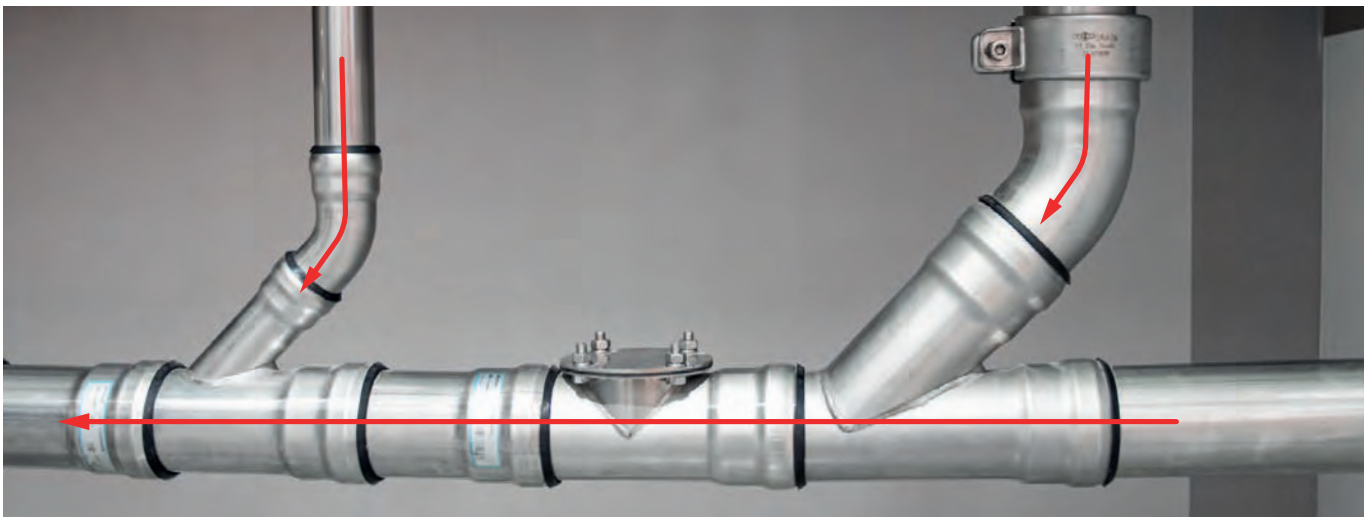
15.6 Final Joint Inspection

Once the operations described in section 15.5 have been completed, the joint must be inspected to verify correct assembly.
To validate proper installation, the joint should be similar to that shown in Figure 79, where the insertion depth corresponding to a specific diameter is clearly visible.

NOTE:
The socket joint system is designed to facilitate drainage, whether by gravity or under vacuum conditions. Therefore, the direction in which the male end is inserted into the socket (female end) corresponds to the direction of flow. For air vent lines, installation is carried out in the same manner as for gravity drainage systems in order to facilitate the discharge of condensate.

Figure 79 – Verification of Complete Pipe Insertion into the Socket

Figure 80 – Correct Fluid Flow Direction in the DRAIN System



15.7 Installation of RM DRAIN Watertight Deck/Bulkhead Penetrations and Drains

The **RM DRAIN** system includes a range of A0–A60 certified weld-on deck and bulkhead watertight penetrations available in diameters from DN 40 to DN 150.
One of the distinctive features of these penetrations is their special design, namely the presence of a carbon steel sleeve/collar factory-welded around the pipe. This sleeve/collar provides the interface with the deck or bulkhead, which are normally also made of carbon steel, thereby ensuring perfect weldability. The sleeve/collar is protected by a water-based coating that does not need to be removed before welding. It is equipped with a small vent hole designed to allow heat generated during welding to dissipate externally without compromising the integrity of the pipe passing through it (the hole must always remain visible and unobstructed). **RM DRAIN** watertight penetrations, items 823/F1, 823/M1, 823/M2, 823/M3 and 823/M4, must be installed by welding. The flanges or sleeves must be fully welded to the deck or bulkhead on both sides, removing the primer in the weld area if required.
RM DRAIN drains, items 825/02, 825/04, 825/05, 825/06Q, 825/06C, 825/07Q and 825/07C, must be installed by welding. The carbon steel tubular rings must be fully welded to the deck on both sides, removing the primer in the weld area if required. **RM DRAIN** drains, items 825/01 and 825/03, must be installed using countersunk-head screws.

Figure 81 – Examples of Watertight Penetrations from the **RM DRAIN** Range

15.8 Disassembly of the RM DRAIN System

RM DRAIN joints that have been assembled for a long period of time may be difficult to disassemble due to the drying of the lubricant used during installation.
Should this occur, the joints can be easily disassembled by heating their external surface with a high-temperature hot air stream.
The internal gasket, once heated, cannot be reused and must be replaced.

Figure 82 – Weld-On Floor Drain

15.9 Compatibility with Other Drainage Systems

The **RM DRAIN** system can be supplied with special stainless steel transition fittings that enable simple and reliable connections to piping systems made from other materials, including ABS, cast iron, vitrified clay, PE, PP, PVC, etc., for DN 40, DN 50 and DN 65.

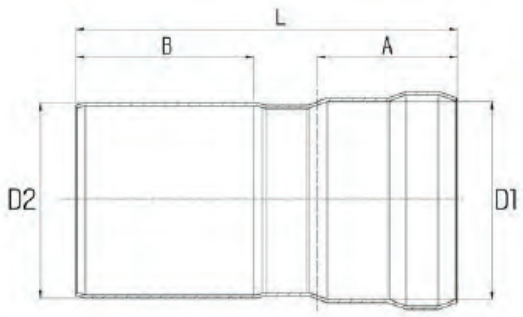


Figure 83 – Female/Male Adapter (F/M)

16.0 Design

16.1 Pipe Support and Clamp Spacing

Pipes must be secured using clamps capable of supporting the loads indicated in the table below [LB5.1].
For the **RM DRAIN** system, the use of RM stainless steel clamps is recommended. These are also available with vulcanized rubber lining, which provides excellent sound insulation and vibration damping properties.
In straight pipe runs, whether vertical or horizontal, pipes must be supported by clamps positioned at intervals not exceeding 2000 mm.
At changes in pipe direction, clamps must be positioned at a distance not exceeding 750 mm.
For long horizontal runs, pipe anchoring must include fixed points, with clamps positioned at a maximum distance of 10 m from one another.

TABLE 25:
WEIGHT OF WATER-FILLED PIPES

Pipe Diameter DN	Pipe Weight (Kg/m)
DN 40	2,3
DN 50	3,3
DN 65	6,1
DN 80	8,6
DN 100	10,9
DN 125	18,1
DN 150	25

Figure 84 - Anti-Withdrawal Collar

Under demanding operating conditions, or wherever local pressure peaks may occur, the joints can be secured against withdrawal by means of dedicated safety collars, available as accessories within the **RM DRAIN** product range. An illustration is provided below.
If the designer/installer considers that withdrawal conditions may arise, it is recommended that each joint be secured by positioning a clamp at a maximum distance of 1 OD (Pipe Outside Diameter) from the joint. Mixed installations using both safety collars and clamps positioned close to the socket are permitted.
To withstand pressure peaks as indicated in the table below, every joint along the pipeline must be secured using an anti-withdrawal collar.

TABLE 26: OPERATING PRESSURE PEAKS

Internal Pressure	from DN 40 to DN 150	+0,5 bar
Internal Pressure, when secured with a dedicated anti-withdrawal collar	from DN 40 to DN 65	+2,0 bar[1]
	from DN 80 to DN 150	+1,5 bar[1]
Negative Pressure (Vacuum)	from DN 40 to DN 150	- 0,97 bar[1]

[1] The indicated pressures are to be considered peak pressures and therefore apply only for a very short period of time.

17 Start-up

17.1 Pressure Testing

VACUUM TEST:

Vacuum Piping Only

- The leak-tightness test shall be carried out on the entire vacuum piping network, with no components connected (WC units, grey water interfaces, vacuum unit, etc.).
- All pipe ends must be closed.
- The maximum acceptable leakage is: vacuum drop from -0.55 bar to -0.45 bar within one hour.

Complete Vacuum System

- The leak-tightness test shall be carried out on the complete vacuum system, with all components connected (WC units, grey water interfaces, vacuum unit, etc.).
- The maximum acceptable leakage is: vacuum drop from -0.55 bar to -0.40 bar within 20 minutes.
- Piping installations shall be tested in accordance with the recommendations of the vacuum system supplier.
- A maximum vacuum of -0.85 bar is recommended for pipes with an outside diameter of 40–75 mm, and a maximum vacuum of -0.60 bar for pipes with an outside diameter greater than 75 mm.

GRAVITY TEST:

- Piping installations shall be tested at a maximum pressure of 0.5 bar, for example by isolating the installation at each deck level and filling it with water.

18 Corrosion

Use products suitable for contact with AISI 316L (1.4404) stainless steel and EPDM gaskets.
In case of doubt, contact the manufacturer of the fluid concerned.
For further information regarding stainless steel corrosion, refer to Section 7.0.

19 Warranty

Systems manufactured and sold by Raccorderie Metalliche are covered by a Warranty.
For complete details, please contact Raccorderie Metalliche.

Note

Note

I riferimenti completi dei nostri funzionari e partner commerciali sono disponibili sul nostro sito internet **raccorderiemetalliche.com**

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