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Introduction

Thank you for selecting our product Molco Joint for your project.

Prior to installation, please read through this manual for proper use of our products.

- Benkan Corporation is not liable for any damage or loss caused by a failure to follow the instructions given on this manual.
- Please read Notice on Construction Safety carefully.
- For future reference, please store this manual in a secure and convenient place.

Notes for Construction Safety

For safe construction, please follow the guidance for the proper uses of fittings / tools.

Especially important notes are indicated as follows.

CAUTION

Benkan Corporation is not held responsible for damages, injuries or deaths arising from modification to our products or use of our products not specified on this manual.

Specification

- Molco Joint is compatible with stainless steel pipes conformed to BS EN 10312 Series1 / BS4127 / BS 3605.
- Molco Joint can be used under the following conditions.

Usage	Piping systems for cold water, hot water, hot & cold water, coolant water and *other fluids.
Operating Pressure	14 Bar (1.4MPa) and below.
Operating Temperature	Below 80℃

*Not suitable for steam piping.

*Please consult us on use for fluids other than listed above.

- Stainless steel piping systems may develop issues such as leakage and corrosion depending on usage and water quality. Please measure the water quality prior to construction.
- The properties of water quality include chloride, sulfate, hardness, electric conductivity, ferrite and its compounds, pH and so on.
- If you use chlorine disinfection, keep the density of free residual chloride appropriate.
- Some water treatment agents may contain chlorides. Please carefully select the type and monitor the water quality.

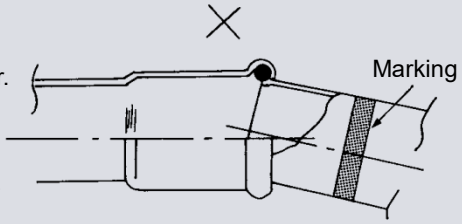
3 Important Notes on Molco Joint Installation

1) Do not damage the rubber ring

(Damaged rubber ring may cause leakage)

- Any pipe end deformities must be removed.
- Remove burrs around the pipe end with a reamer.
- Do not force the pipe into the fitting.

⚠ **Please be sure to insert the pipe straight into the fitting**

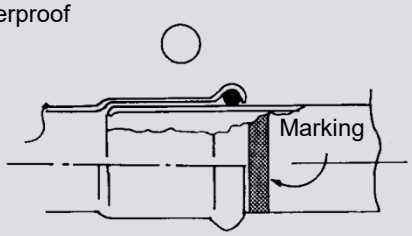


2) Insert the pipe as far as the marking

(Insufficient insertion may lead to pipe disconnection)

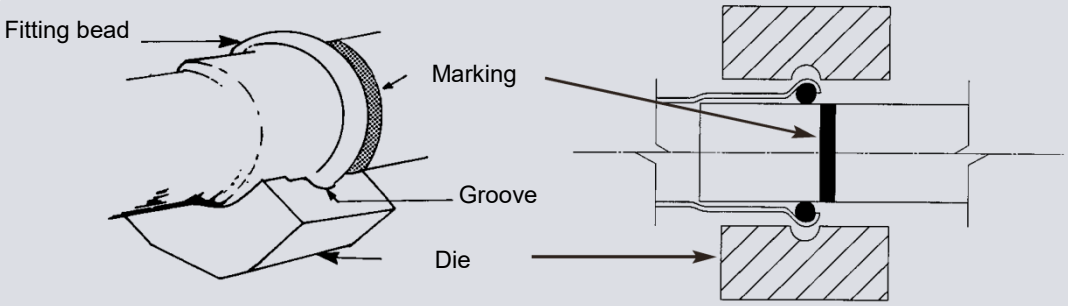
- Mark on the pipe, using the line gauge and waterproof ink pen.

⚠ **The connection and rubber ring must be kept free from scratches, oil, sand, dust and other impurities.**



3) Do not forget to press the fitting

(Failure to press the fitting causes pipe disconnection)



⚠ **Please use the proper size of crimp jaw and die for the fitting / pipe you are installing, or it causes damages to fitting / pipe.**

Installation Workshop

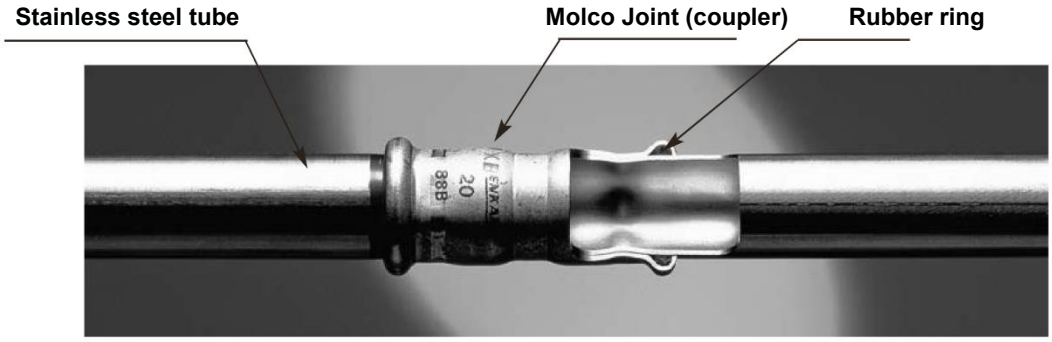
Please read this manual carefully when you install Molco Joint, and complete the installation workshop we provide for users prior to construction.
(We issue a certificate card for those who completed the workshop.)

1 PRODUCT SUMMARY & FEATURES

1-1 Features of Molco Joint

Molco Joint is a human-friendly, eco-friendly, highly durable product which meets the needs of contemporary construction.

- **Dramatically reduces the construction time.**
- **The press tool ensures uniform quality of installation, unaffected by the skills of workers.**
- **No flame is required for installation.**
- **Stainless piping systems are extremely light and durable, have a high recyclability and do not produce chemicals harmful to the environment.**



Before Insertion

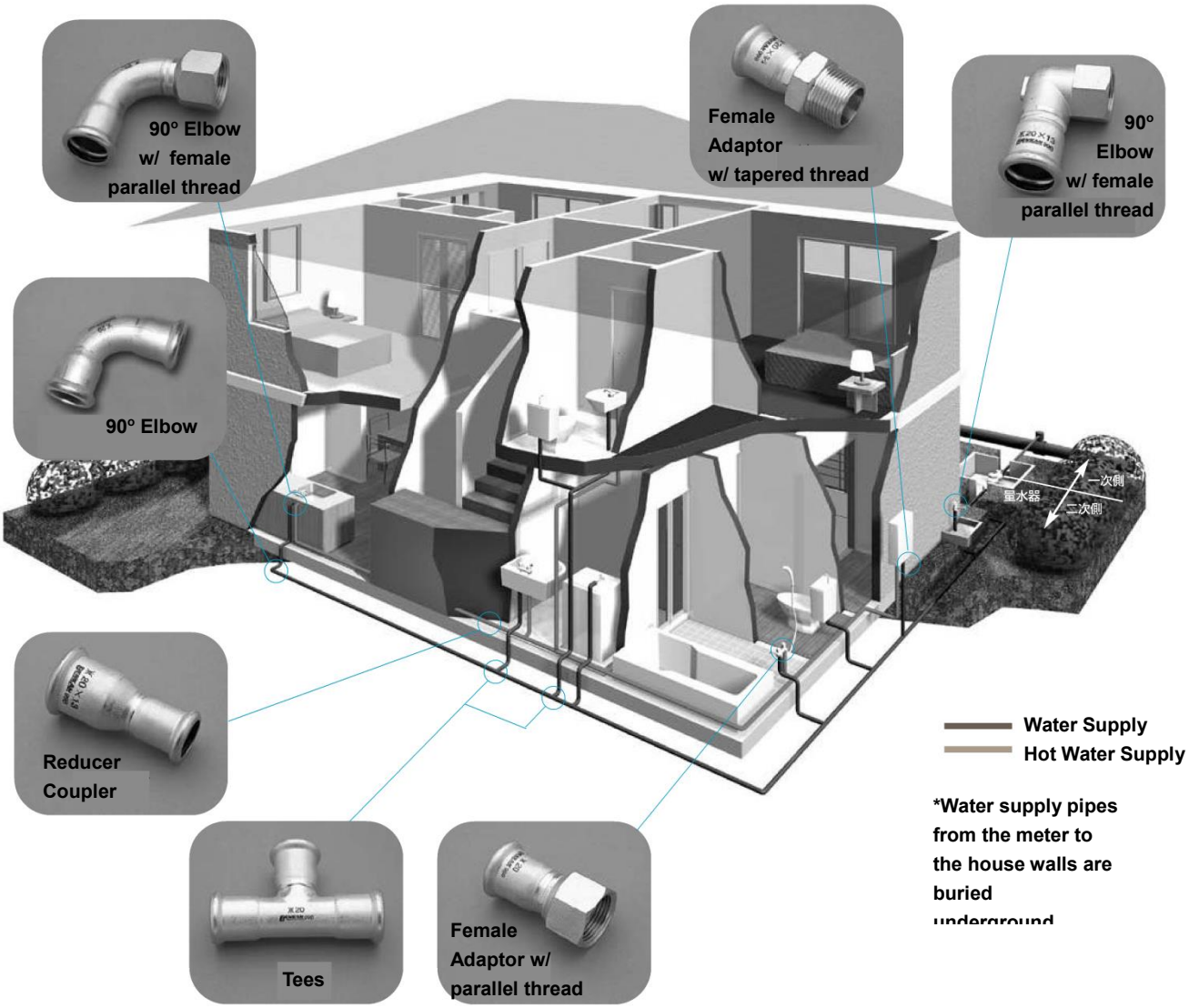
After Insertion

Pressed

1-2 Branch Piping System

In branch piping systems, where Molco Joints are used, the main pipe running from the meter bifurcates into multiple branch pipes to distribute water to each tap in the house. The pipe diameter is largest on the meter side, and smallest at the ends.

This is the most prevalent piping method for water supply. Piping systems designed this way are very simple and easy to maintain, as it usually a single system is enough to distribute water in the entire house. Plus, Molco Joint and stainless pipes have excellent durability, which saves you the trouble of repair work.



The picture above shows a typical water / hot water supply system for a residential house in Japan.

2 FOR DESIGNERS & ENGINEERS

2-1 The Properties of Stainless Steel

■ What is stainless steel?

Stainless steels are metal alloys known for excellent corrosion resistance. The special quality is obtained by adding 12-20% chromium to iron, which creates a protective oxide film on the surface. This layer serves as a shield against corrosion, and is self-hearing if scratched. As the amount of chromium increases, stainless steel becomes more resistant to corrosion.

Stainless steel products in water / hot water supply systems are usually free from rust. However, exposure to highly acidic fluids and other adverse conditions may cause corrosion. Therefore, it is important to learn the characteristics of the metals and their proper use.

■ Stainless steel tubes for ordinary piping

There are more than 100 types of stainless steel with different ingredients. For water supply piping, two main alloy families called 304 and 316 grades are commonly used.

Stainless steel forms a thin (3nm), passivation layer on its surface. This protective layer is resistant to corrosion, and when damaged, recovers itself if oxygen is present.

2-1-1 Physical Properties of Stainless Steel Pipes

The table below shows the typical physical properties of pipe materials.

Table 2-1-1 Physical properties of pipe materials

	Specific gravity	Average Coefficient of thermal expansion $\times 10^{-6}$/°C	Thermal conductivity W/(m·K)	Specific heat (J/kg·K)	Electrical resistivity ($\mu\Omega$·cm)	Young's Modulus (kN/mm^2)	Magnetism
Stainless Steel pipes	7.93	17.3	16.3	502	72	193	No
Copper pipe	8.96	17.6	391	385	1.71	108	No
Carbon Steel pipe	7.86	11.6	59.5	481	14.2	206	yes

2-1-2 Mechanical Properties of Stainless Steel Pipes

The table below shows the mechanical properties of pipe materials.

Table 2-1-2 Mechanical properties of pipe materials

	Tensile strength (N/mm^2)	Elongation (%)
Stainless Steel pipe	720 (520 and above)	47.5 (35 and above)
Copper pipe	240 (205 and above)	53.0 (40 and above)
Carbon Steel pipe	350 (290 and above)	46.4 (30 and above)

*Elongation parallel to the axis. *The figures in brackets ( ) are the minimum standards set by JIS.

2-2 Standards

2-2-1 Dimensions

Table 2-2-1 Dimensions of light gauge stainless steel tubes – Series 1 (EN 10312:2002)

Speficied Outside Diameter *D*	Outside diameter		Specified wall thickness *T*
	maximum	minumum	
15	15,04	14,94	0,6
22	22,05	21,95	0,7
28	28,05	27,95	0,8

2-2-2 Stainless Steel Pipe Standards

Molco Joint is a press type fitting compatible with stainless steel pipes conformed to BS EN 10312 Series1 / BS4127 / BS 3605.

2-2-3 Stainless Steel Fitting Standards

Molco Joint is conformed to JWWA G 116 (the Japanese Water Works Association standard for stainless steel fittings for water supply) and SAS 322 (the Stainless Steel Association performance criteria for stainless steel fittings for ordinary piping). It meets the requirements for water supply equipments issued from the JWWA quality assurance center, and received a third party approval for its excellent performance.

Molco Joint is a product approved by Water Supply Department in Hong Kong.

The seal ring is certified by WRAS for use in contact with potable water (BS 6920-1:2014).

2-3 Scope of Molco Joint

2-3-1 Application

- Compatible pipe materials — stainless steel pipes conformed to BSEN 10312 Series1 / BS4127 / BS 3605
- Application — Water supply / hot water supply, hot & cold water supply, coolant water and others. ***Not suitable for steam piping.**

2-3-2 Working Temperature & Pressure

- Maximum working temperature — Below 80°C
- Maximum working pressure — 14 bar (1.4 MPa 14.2kgf/cm^2)

*If you are considering its application to supply systems of hot water hotter than 80°, please be sure contact us.

2-4 Pipework Support

As for pipework support, please refer to the design specification and drawings.

Below are suggested pipe support intervals based on the standard specification provided by the Japanese Ministry of Land, Infrastructure, Transport and Tourism.

2-4-1 Hanger and Stabilizer for Horizontal Pipes

Pipe hanger intervals	2.0 m or less.
Pipe stabilizer intervals	Not necessary

1) Incline the pipe for easy drainage of air or water.
2) If you are using steel pipe supports, wrap the stainless steel pipes in rubber or insulation tape, or select the pipe supports with resin or other insulation coating.
3) In supporting the heavy equipments other than fittings and pipes, support them at the nearest points. Apply supports to pipe bends and branch points, if necessary.

2-4-2 Fixation and Stabilizer for Vertical Pipes

Pipe fixation	The floor of the top floor or of the ground level
Pipe stabilizer intervals	One per each floor (If the pipework goes through the floor, one per three floors is sufficient)

2-5 Thermal Expansion & Contraction

2-5-1 Thermal Expansion Rate

Stainless steel has a relatively high thermal expansion rate. Expansion and contraction of pipes may lead to damages to the pipe supports and other components, or cause the pipes to bend.

The thermal expansion rate of stainless steel pipes is greater than that of carbon steel pipes by 50%. The piping systems need to be designed in such a manner as to absorb deflection caused by this phenomenon (ex. decrease straight pipe lengths).

Figure 2-5-1 Thermal expansion rate of stainless steel pipes (per pipe length of 10m)

Temperature change: Δt(°C)	10	20	30	40	50	60	70	80	90	100
The amount of change in pipe length: ΔL(mm)	1.7	3.5	5.2	6.9	8.7	10.4	12.1	13.8	15.6	17.3

$\Delta L = \alpha \cdot L \cdot \Delta t$

ΔL: Amount of change in pipe length (mm)
α : Coefficient of thermal expansion (17.3×10^{-6}/°C)
L : Total Pipe Length (mm)
Δt :Temperature change (°C)

2-5-2 Design Solutions for Thermal Movement

When the effect of thermal expansion/contraction is remarkable, use flexible fittings to absorb it. Slide type expansion joints, Bellows expansion fittings are generally used.

Also, use of ball joints or flexible bends also serves this purpose.

2-6 Water Hammer

Water hammer is a pressure wave caused by a sudden closing of water taps / valves or pump failure, which propagates in the pipe and causes vibration.

Designers should take into consideration the effect of water hammer because it causes noise issues and damages to the pipe and water supply equipments.

2-6-1 How to Prevent Water Hammer

- Avoid high pressure. When the pressure is too high, use the pressure reducing valve.
- Design the piping system in a way as to prevent the flow velocity from being excessively high.
- Where water hammer is likely to occur, apply taps or flexible pipes with anti-water hammer functions.
  (Some hygiene equipment manufacturers offer flexible pipes specially designed for stop valves Please use appropriate types for different places.)

Flexible pipes with anti-water hammer functions

2-7 Thermal Insulation & Anti-Condensation

2-7-1 Material Selection

The table 2-7-1 shows the types of thermal insulations with density, operating temperature, heat conductivity, inflammability.

Figure 2-7-1 Themal Insulation Materials

Standard No.	Name	Type	Density kg/m^3	Maximum Operating Temperature ºC	Heat Conductivity W/(m·K)	Resistance to bending N/(cm^2)	Flammability
JIS A 9504	Rock-Wool	-	40-200	400	0.044 or less	-	Not flammable
	Glass-Wool	-	45-90	300	0.043 or less	-	Not flammable
JIS A 9511	Expanded Poly-Styrene Foam	1 2 3	35 or above 30 or above 25 or above	70 70 70	0.036 or less 0.036 or less 0.037 or less	30 or more 25 or more 20 or more	Flammable
	Rigid Urethane Foam	1 2 3	45 or above 35 or above 25 or above	100 100 100	0.024 or less 0.024 or less 0.025 or less (Average temp 30±5ºC)	35 or more 25 or more 15 or more	Flammable

The types that do not contain soluble halides are preferred.

Figure 2-7-1 shows acceptable contents of chlorides and sodium silicates in insulation materials.

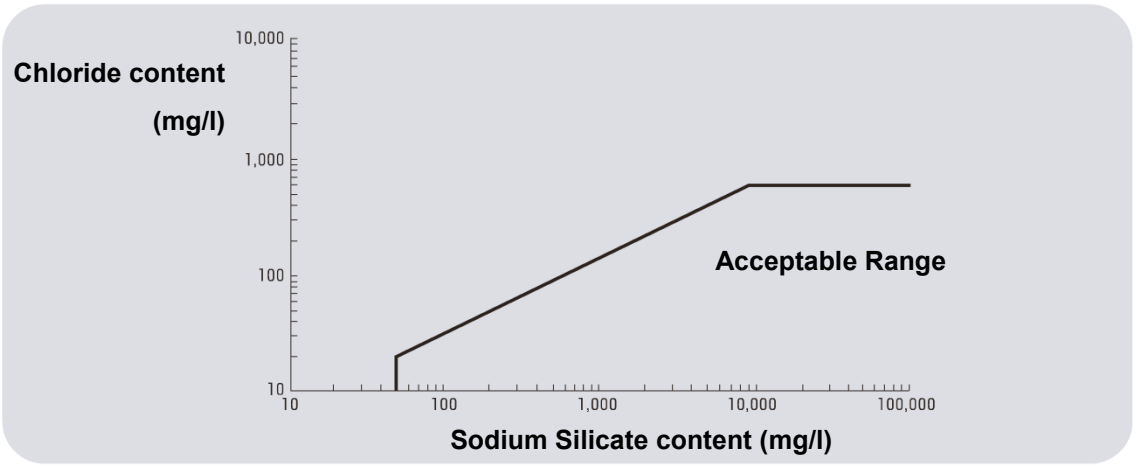


Figure 2-7-1 acceptable contents of chlorides and sodium silicates in insulation materials

2-7-2 Critical Thickness of Insulation

Table 2-7-2 shows the preferred thickness of insulation materials for each size of stainless steel pipe as recommended by The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan.

Figure 2-7-2 Thickness of Insulation Pipe Sleeves

For Water Supply

General Cases
(In-pipe water temperature 15°C, Room temperature 30°C, Relative Humidity 85%)

Standard No.	15	22	28
Thickness (mm)	25		
Insulation Pipe Sleeve Materials	Rock-Wool, Glass-Wool, Poly-styrene Foam 3		

Under High Humidity
(In-pipe water temperature 15°C, Room temperature 30°C, Relative Humidity 90%)

Standard No.	15	22	28
Thickness (mm)	25		30
Insulation Pipe Sleeve Materials	Rock-Wool, Glass-Wool, Poly-styrene Foam 3		

For Hot Water / Warm Water Supply Piping

General Cases
(In-pipe water temperature 100°C, Room temperature 20°C, Relative Humidity 40% and less)

Standard No.	15	22	28
Thickness (mm)	25		
Insulation Pipe Sleeve Materials	Rock-Wool, Glass-Wool		

3 INSTALLATION GUIDANCE

3-1 Installation Steps

3-1-1 Cutting Pipes

Outer burrs must be completely removed.

Mark the desired length on the pipe, place the cutting edge on the line and cut the pipe.

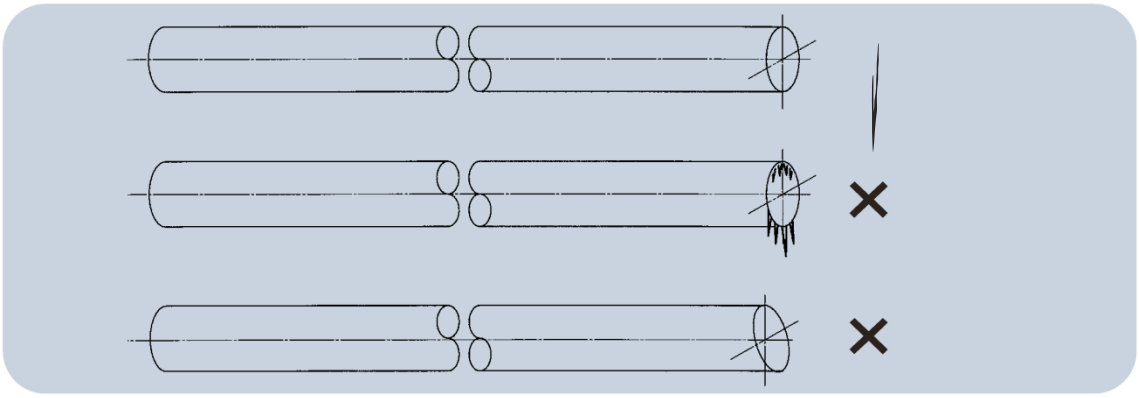
Avoid applying too much force as it may deform the pipe.

[Recommended Method]

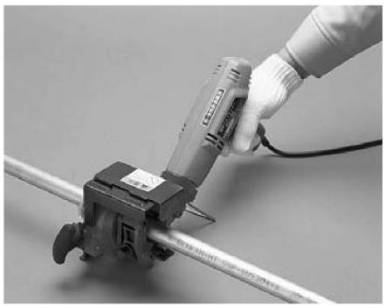
1) Rotary Cutter

[Important Notes]

- **Do not apply too much force.**
- **Remove if any burrs around the pipe edge with a reamer or a file.**



2) Electric Pipe Cutter



[Important Notes]

- **Please follow the instruction manual of the pipe cutter you are using.**

3-1-2 Chamfering & Deburring

Although cutting with a rotary cutter or electric pipe cutter usually leave the pipe edge free of burrs, if you find any, be sure to remove them completely. In case of using a chop saw, outer / inner burrs are almost inevitable. After removing the burrs, chamfer the pipe edge.

Electric reamer

Manual pipe reamer

If the burrs are left around the pipe edge, it may damage the rubber ring inside the Molco Joint and cause leakage.

Do not use cutting tools which were used to cut other metal pipes, as the metal particles left on the cutting edge can cause corrosion of the stainless steel pipe.

3-1-3 Marking the Insertion Length on the Pipe

Marking must be done for all joints.

- Marking of the insertion length on the pipe is one of the most important processes in Molco Joint installation. Please make sure to mark on all the pipe ends where Molco Joints are to be installed.
- **Please use the BENKAN line marker (water-proof ink pen and gauge) for marking.**

- **The insertion length for each pipe diameter**

OD	15	22	28
Insertion Length (mm)	21	24	24

Any leakage or other problems arising from installation done without marking will not be covered by the warranty.

3-1-4 Inserting of the Pipe into the Fitting

Please be careful not to damage the rubber ring inside.

- Do not confuse with fittings from other manufacturers. Please check that the Benkan logo BENKAN is printed on the fitting body.
- Verify the presence and correct positioning of the rubber ring by touching it with your finger.
- Insert the pipe straight into the fitting so as not to scratch the rubber ring with the pipe edge, as it may cause leakage.
- Please ensure the pipe is inserted until the fitting comes in contact with the marking.

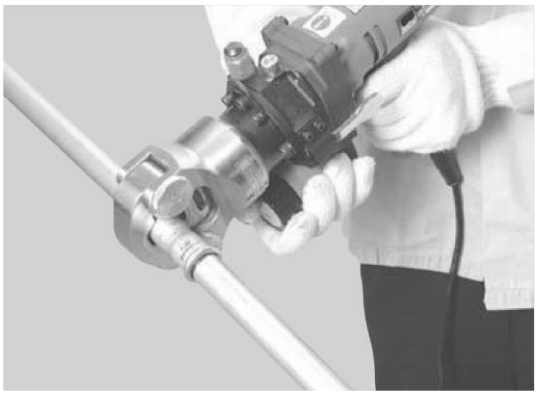
Do not apply mineral lubricating oil to the rubber ring / thread of the fitting.

Prior to insertion, please remove any deformity, oil, sand, dust and other impurities from the pipe edge and the rubber ring / thread of the fitting.

3-1-5 Pressing

Please read the manuals of the press tool prior to use.

- Set the fitting bead onto the groove of the press tool die.
- Pull the trigger to activate the press tool, and keep pressing until both dies / crimp jaws meet.



- After the pressing is complete, use the hexagonal gauge to check the pressed area.

- If you notice at this step that the pipe was not fully inserted (the distance from the fitting edge and the marked line must be within 3mm), cut off the fitting and the pipe at the joint section, and reinstall a new fitting.
- If the hexagonal gauge does not fit, examine the press tool for errors, and repress the fitting (after repressing, please recheck with the hexagonal gauge).

After installation, please check the marked lines visually.

Please store Molco Joints separately from similar fitting joints.

Do not use a press tool not authorised by Benkan Corporation, or fatal installation errors may occur.

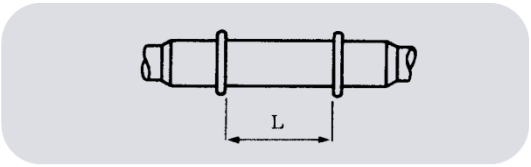
3-2 Notes On Installation

3-2-1 Minimum distances between joints

Installation of press fittings more or less affects the shape of the pipe. Please ensure that the fittings are installed at the minimum distances as in Table 3-2-1 (1) or the greater.

Table 3-2-1 (1) Minimum distances between joints

OD	Minimum distance L (mm)
15-28	20



- The minimum distances from two 90° elbows [left in Figure3-2-1 (2)], and a 90° elbow and a tee [right in Figure 3-2-1 (2)] are as listed below. Under tight space constraints, please use **90° elbow with a plain end** to make the assembly compact and economical, as illustrated in **Figure 3-2-1 (3) and (5)**.

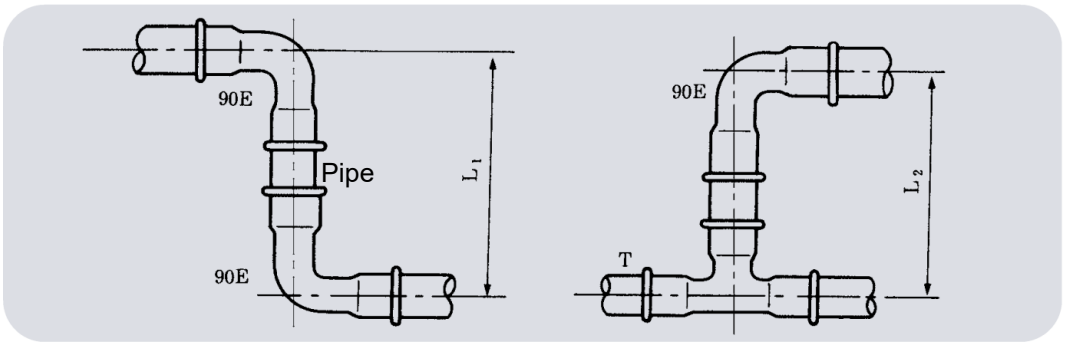


Figure 3-2-1 (2) Minimum distances between fittings (with normal 90° elbow)

OD	15	22	28
L1 (mm)	102	120	128
L2 (mm)	99	116	125

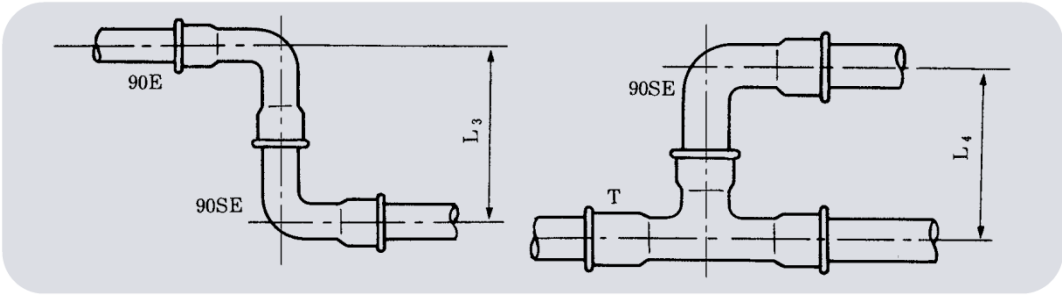


Figure 3-2-1 (2) Minimum distances between fittings (with 90° elbow with a plain end)

OD	15	22	28
L3 (mm)	81	97	109
L4 (mm)	78	93	106

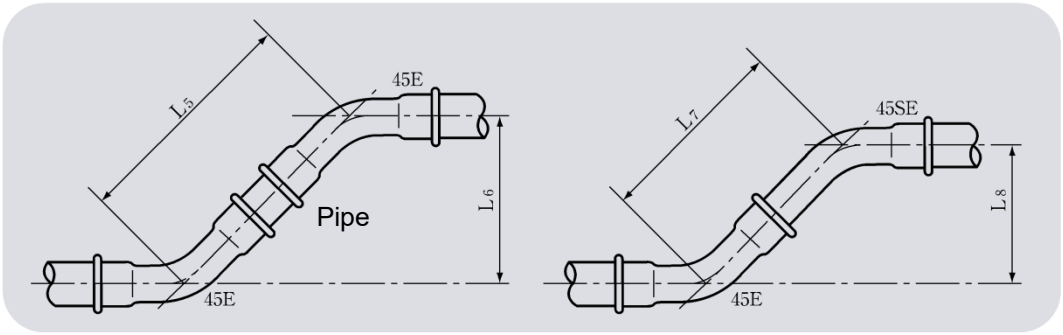


Figure 3-2-1 (4) Minimum distances between two normal 45° elbows

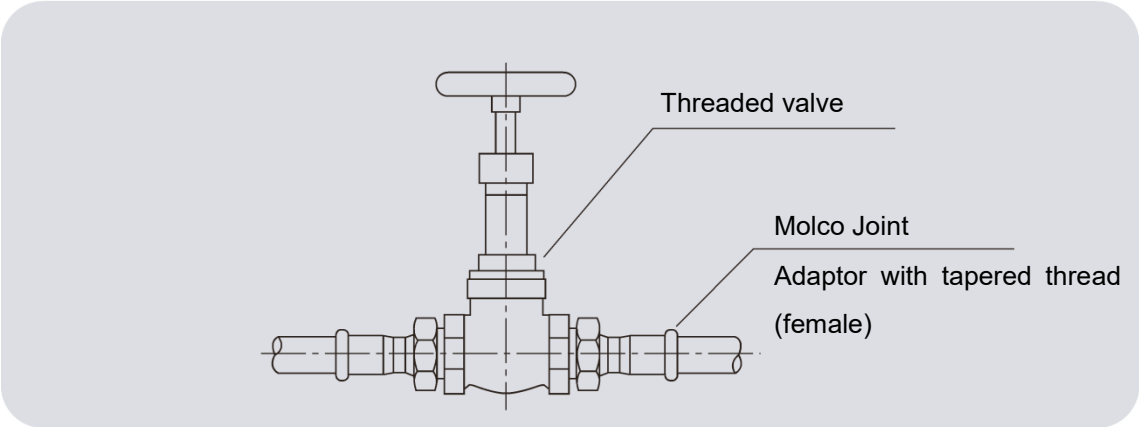
OD	15	22	28
L5 (mm)	92	104	112
L6 (mm)	65	74	79

Figure 3-2-1 (5) Minimum distances between a normal 45° elbow and the type with a plain end

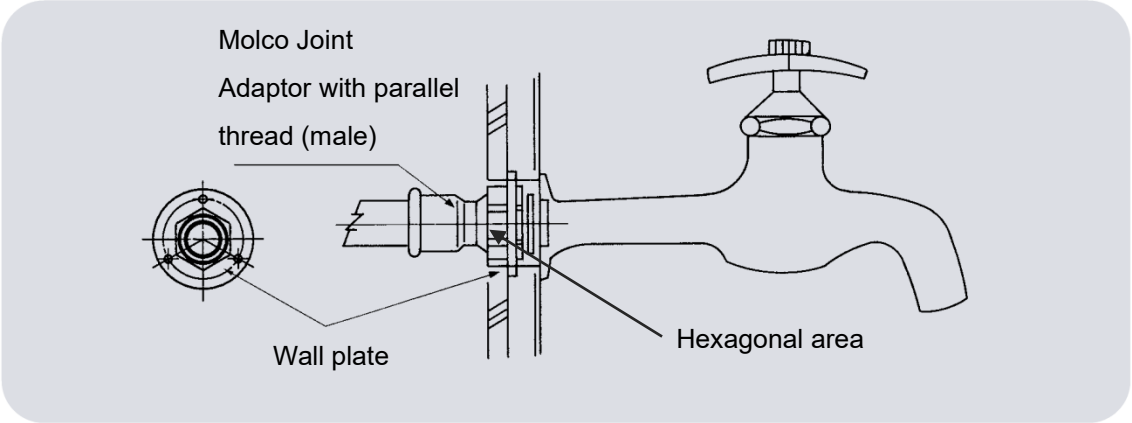
OD	15	22	28
L7 (mm)	69	78	86
L8 (mm)	49	55	61

3-2-2 Thread connections

Connection of the threads must be done before pressing because twisting the pipe may cause the press connection to loosen.



In the figure below, a tap is being connected to a preexisting Molco Joint adaptor with a female thread. When screwing the tap into the adaptor, attach a wall plate to the hexagonal area of the adaptor, or hold the adaptor with a spanner to avoid torsion of the press connection.



Notes on thread connection of stainless steel piping materials

Please use a thread sealant designed for stainless steel.

Please note that thread connection between stainless steel products are more likely to produce adhesive wear than between other metals.

Please pay attention to the thread types of Molco Joints and the equipment you are installing. Do not connect different types of threads as it may cause leakage.

The parallel female thread is designed for the equivalent male thread. Do not connect it to tapered or other thread types.

3-2-3 Connection to other pipe materials

When stainless steel pipes / fittings are used in contact with other metals, the corrosion potential difference between the two metals can cause bimetallic corrosion (also known as “galvanic corrosion”) to the less noble metal. To prevent this, they need to be electrically insulated. Table 3-2-3 shows which metal pipes (materials) can be directly connected to stainless steel pipes / fittings without insulation.

Table 3-2-3 The availabilities of direct connection between stainless steel and other metal pipes

Metals materials in direct connection to stainless steel	Direct connection is	Notes
Copper or bronze pipe	✔	The galvanic potential is similar to that of stainless steel.
Brass pipe	×	May cause dezincification corrosion
PVC pipe	✔	PVC serves as an insulator
PVC lined steel pipe thread	×	The steel threads require insulation
SGP pipe	×	Requires insulation
Aluminum pipe	×	Requires insulation

1) How to connect stainless steel pipes to a zinc-plated steel pipes or PVC lined pipes

- For flange connection, use an insulation flange or insulation nuts and bolts, as shown in Figure 3-2-3 (1).
- PTFE-coated gaskets are preferably used.

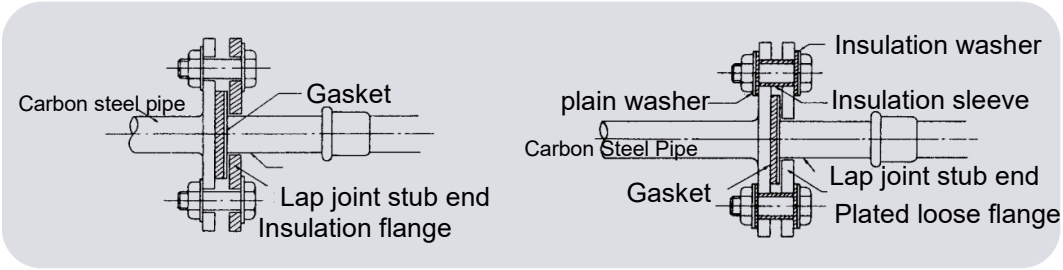


Figure 3-2-3 (1) Connection using an insulation flange

- For sizes 15-28, use an Insulation Union for PVC lined steel pipes, as shown in Figure 3-2-3 (2).

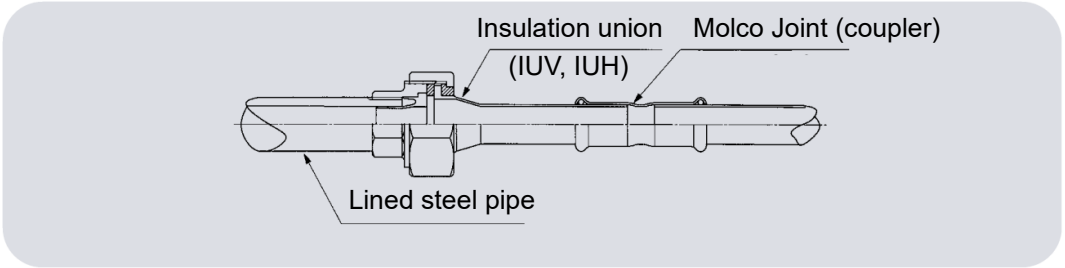


Figure 3-2-3 (2) Connection using an insulation union

2) How to connect stainless steel pipes to copper pipes

- Stainless steel pipes and copper pipes are connected by threads or flanges, as shown in Figure 3-2-3 (3)(4).

*The thread of copper pipe / pipe materials must always be male when connected to stainless steel pipe / pipe materials.

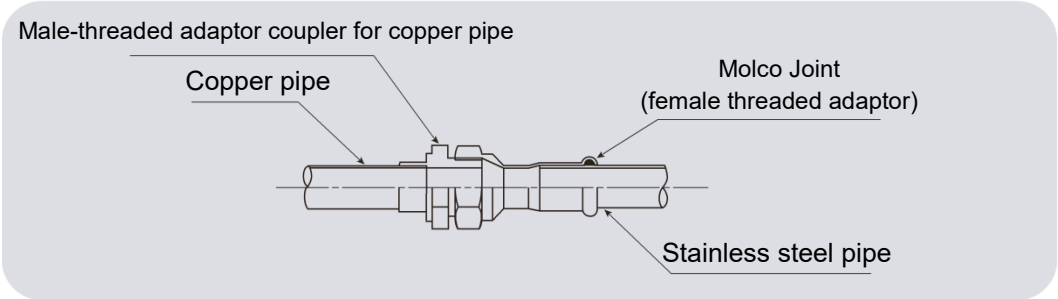


Figure 3-2-3 (3) Thread connection between stainless steel pipes and copper pipes

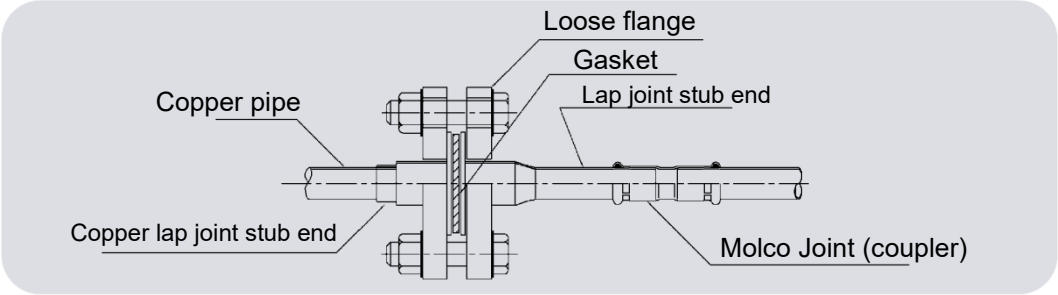


Figure 3-2-3 (4) Flange connection between stainless steel pipes and copper pipes

3) How to connect stainless steel pipes to PVC pipes

- Stainless steel pipes and PVC pipes can be connected using a valve socket for PVC piping and a female-threaded adaptor coupler, as shown in Figure 3-2-3 (5).

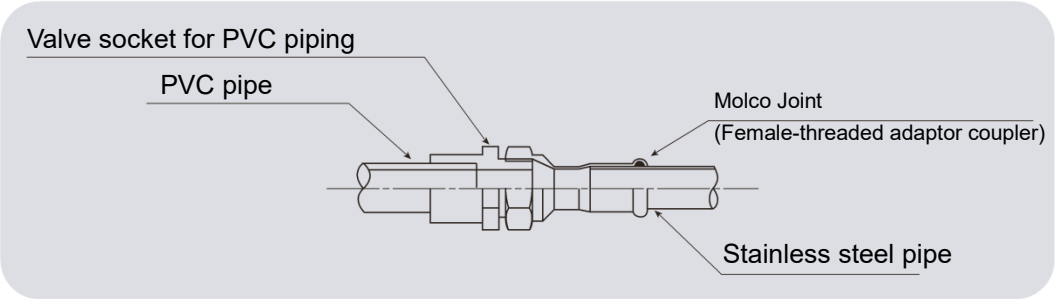


Figure 3-2-3 (5) Flange connection between stainless steel pipes and copper pipes

3-2-4 Connection to electrical appliances

Pipes connected to electrical appliances (such as water heaters) need to be insulated even when the connected appliance is made in stainless steel, as electric current might leak through the pipe and leads to accidents.

Do not connect the earth wires of electrical appliances or the return wires of arc welding tools to the stainless steel piping system, as it generate heat (Figure 3-2-4).

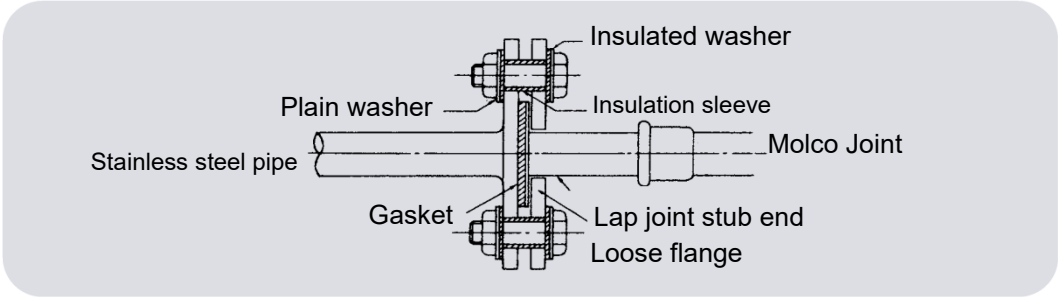


Figure 3-2-4

3-2-5 Connection to valves and other equipments

There are two methods for connecting stainless steel pipes to valves: flange connection and thread connection. Please keep in mind the galvanic potential difference between the pipes and components. The figure below shows an example of how to connect stainless pipes to valves (Figure 3-2-5).

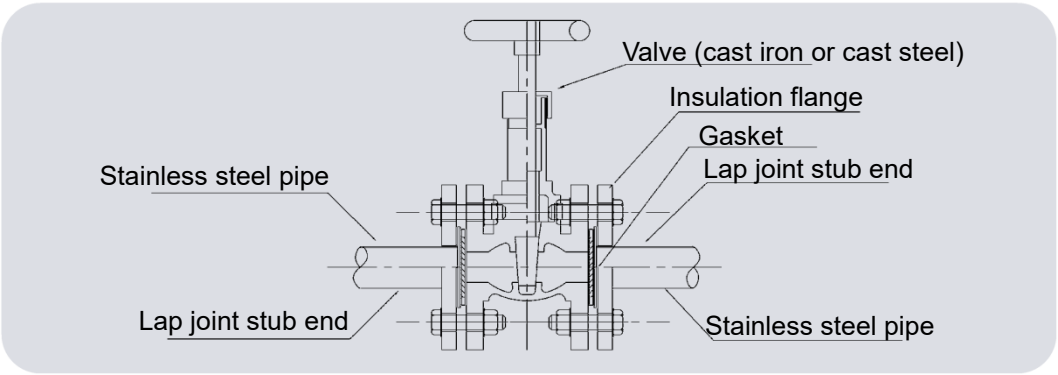


Figure 3-2-5 Flange connection to valve

- Valves, pumps and equipments used in a stainless piping system should preferably be made in stainless to maximize the durability of stainless steel piping.
- For connection between different metal types and insulation methods, please refer to the previous page.

3-3 Construction In Common Houses

3-3-1 Pipes Passing Through the Foundation Wall

The pipes which pass through the foundation wall should be encased in pipe sleeves, instead of passing them directly through the wall, for easy access at maintenance checks.

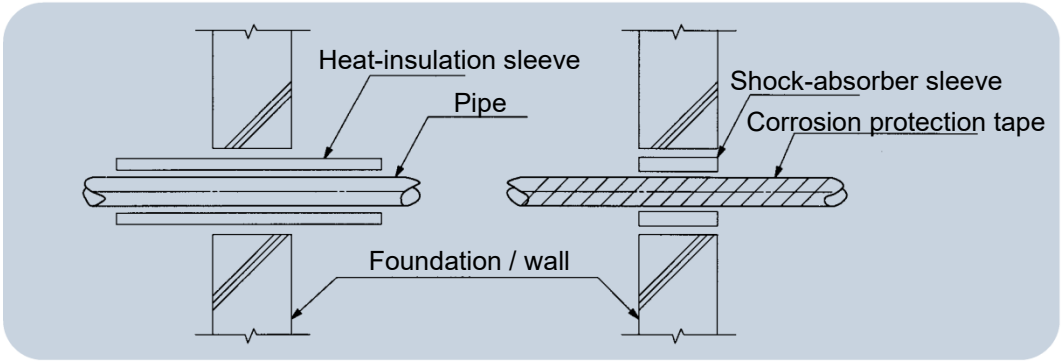


Figure 3-3-1

3-3-2 Installation Inside Open Trenches

In building mat foundations, some parts of piping systems are installed inside an open trench to allow easier access for maintenance. When you install the piping system in a tighter space, please follow the minimum dimensions as shown in the figure 3-3-2 below.

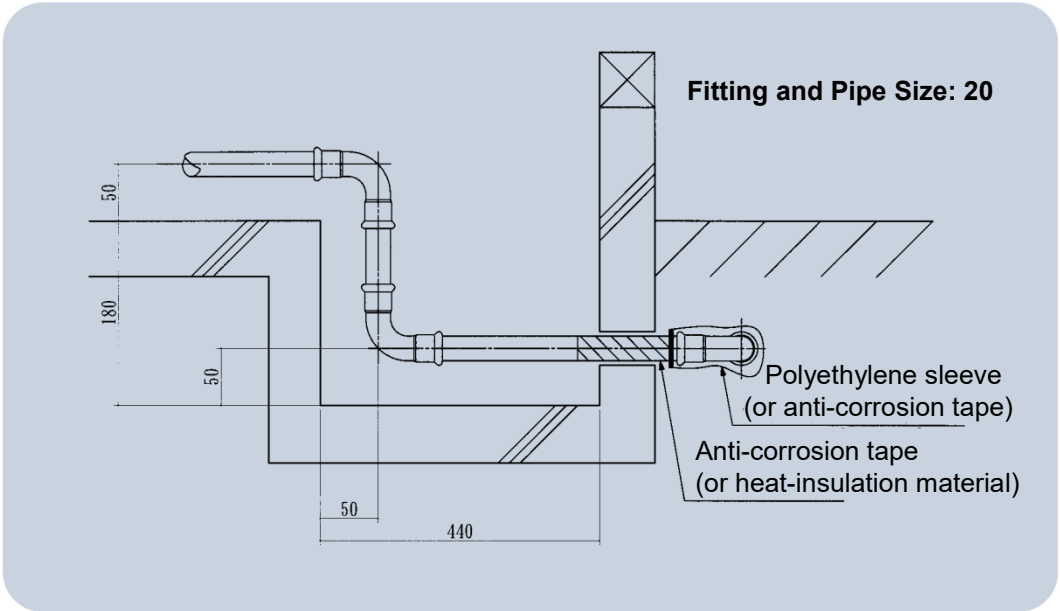
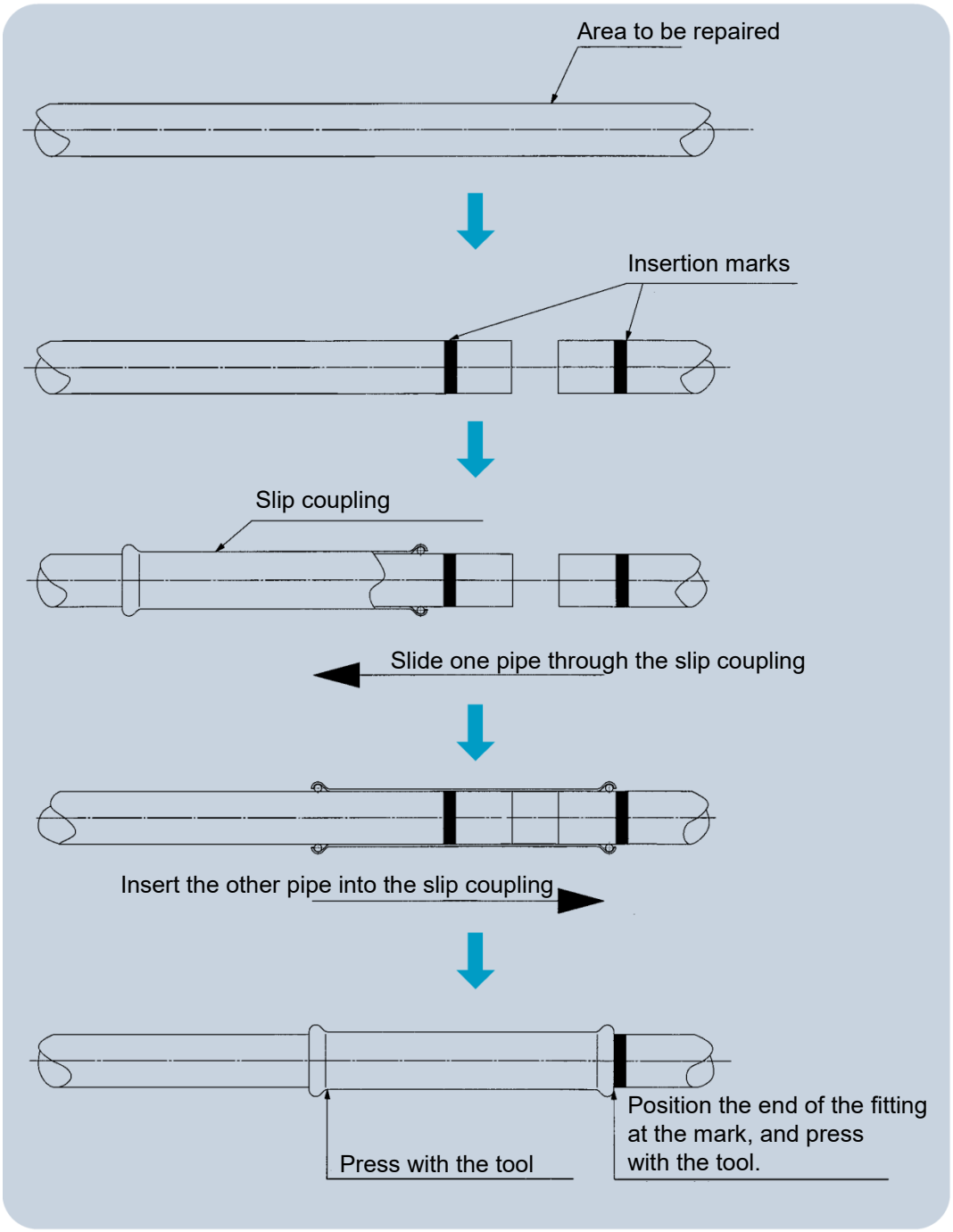


Figure 3-3-2

3-3-3 How To Use Slip Coupling

Slip coupling is used in repair works as illustrated below.



3-4 Underground Piping

3-4-1 Underground Construction

When installing stainless steel piping systems underground, please protect them with anti-corrosion materials.

The stainless steel pipes and fittings must either be 1) encased in polyethylene sleeves or heat-shrinkable tubes, or 2) wrapped with PVC tapes by “half lap” method as shown in Figure 3-4-1 (1).

Please be careful not to damage the stainless steel pipes in backfilling. Consider double-layering / waterproof coating the pipes or using sands for pipe bedding.

Pipes subjected to temperature changes are preferably double-layered and placed in open trenches.

If you cannot avoid underground installation, shorten the lengths of straight pipes as much as possible.

Where land subsidence and earthquakes are concerned, the flexible fittings or expansion fittings are recommended for the tie-in point (where the pipe enters the building). The pipes and fittings used at the tie-in point must be insulated.

If the piping system is constructed in such environments as seaside, a volcanic area or a hot spring, please investigate the nature of the soil prior to construction, and take necessary measures to protect the piping system.

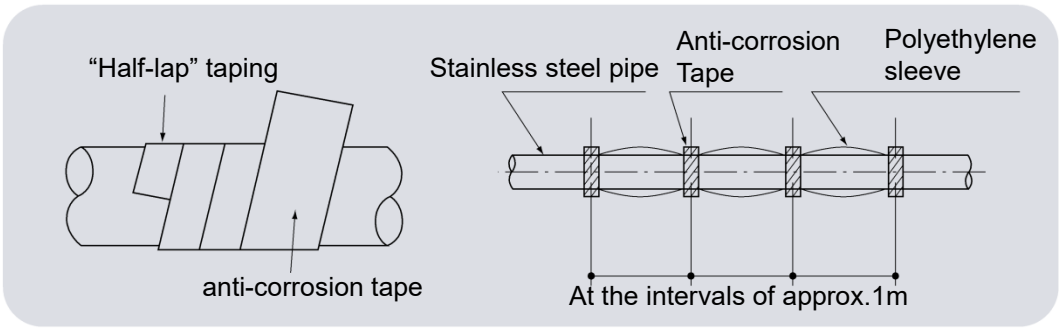


Figure 3-4-1 (1) Protection from corrosion (for reference)

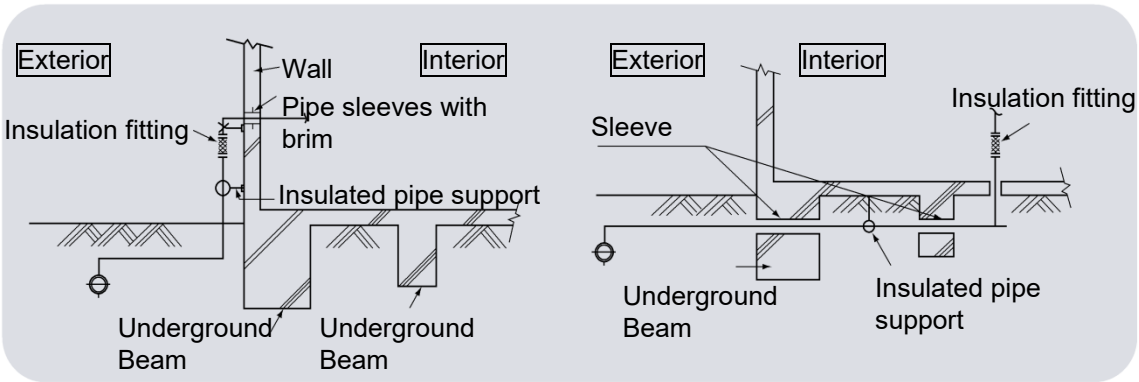


Figure 3-4-1 (2) Installation example of insulation fitting

3-4-2 Embedding Pipes in Concrete

When encasing stainless steel pipes / fittings in concrete, they must be protected with polyethylene sleeves, anti-corrosion tapes, etc. If you use anti-corrosion tapes, please make sure to leave no gaps by “half lap” method.

Pipes that are exposed to temperature changes (ex. in a hot water supply system) must not be directly embedded in concrete. Please leave enough space for the pipes to expand by wrapping them in heat insulating materials.

If a greater portion of the piping system needs to be embedded in concrete, please shorten the lengths of straight pipes as much as possible and use more bend parts to absorb the change arising from heat expansion.

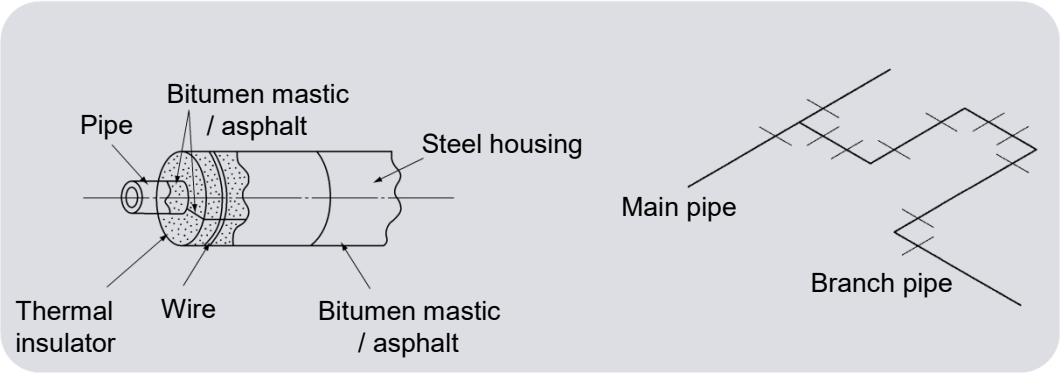


Figure 3-4-2 (1) Anti-corrosion treatment

3-4-3 Elevated Water Tank / Water Receiver Tank

The outer surface of the pipe inside an elevated water tank or water receiver tank must be coated with resin coating 500 mm into the water.

This is to prevent the air inside the tank, dense with chlorine gas, from causing corrosion to the pipe. Also, the chloride ion tends to condense where the water level fluctuates. Apply coating such as epoxy resin to the area subject to the corrosive effects of chlorides (Figure 3-4-3).

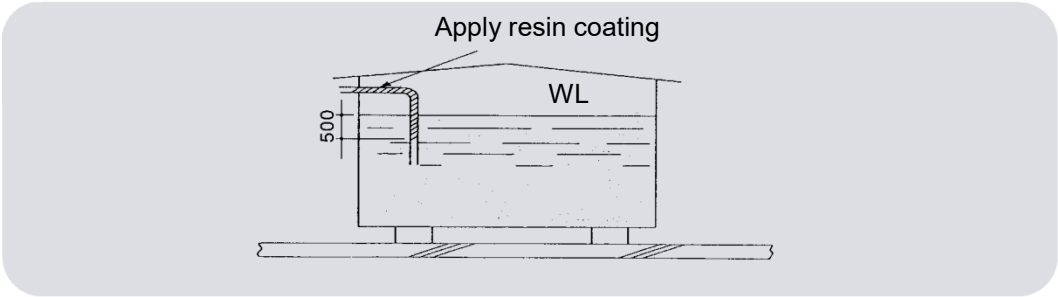


Figure 3-4-3 Area require resin coating

3-5 Piping Installation In Cold Districts

Frozen pipes may damage the joint area. Please make sure to drain the water system after use, and select thermal insulation materials of the appropriate thickness for the local climate.

1) Make sure there is no space between the insulation materials.
2) When you install a piping system in a place exposed to the wind, or in a shade, wrap insulation material thick.
3) In selecting pipe sizes, please note that pipes of smaller diameters are quicker to freeze. If possible, select pipe sizes less likely to freeze.
4) In cold districts, use drain plugs, valves and other anti-freeze products.
5) If you use an anti-freeze heater, do not directly wrap it around the fittings and pipes. Use thermometers or other devices to avoid extremely high temperatures.
6) Do not use electric defrosters on frozen pipes.
7) Frozen pipe cause damage to the fittings. Please carefully inspect fittings for damages when the pipes are frozen.

3-6 Water Pressure Test For Piping Systems

Prior to insulation treatment or backfilling, all pipeworks must be tested to ensure they were properly installed. For the testing methods, please follow the specification below.

Figure 3-6 Water Test Pressures (SHASE-S 010-207, 206-2009)

Piping System		Water Pressure Test	
		Test Pressure	Minimum Test Time
Coolant Water / Cold & Warm Water		At least, 1.5 times the maximum working pressure (the minimum test pressure: 0.75 MPa).	30 minutes
Cold water/ Hot water	Directly from the meter	The minimum test pressure of 1.75 MPa. Please follow the guideline by the administrator as well.	60 minutes
	From elevated tank	At least, twice the pressure applied in use (the minimum test pressure: 0.75 MPa).	60 minutes
	From water lifting device	At least, twice the hydraulic head of the pump (the minimum test pressure: 0.75 MPa).	60 minutes

- Water pressure test is intended to detect water leaks resulting from installation failure or damaged rubber ring, and must be conducted prior to insulation treatment or backfilling.
- Please drain the air inside the pipelines before applying a test pressure.
- Before applying test pressures, please check for leakage at the inner pressure of 0.0MPa, 0.1 MPa and 0.2MPa for 3 minutes each.
- Visually inspect pipe joints for water leaks.
- Keep away from the pressurized segment of the system during the test.

Water pressure test may not serve to detect foreign objects trapped between the rubber ring and the outer surface of the pipe.

3-7 Thermal Insulation and Anti-Condensation

General notes

1) Prior to thermal insulation, ensure that installation of fittings and supporting materials are complete.
2) Ensure that the pipelines are attached to equipments and other equipments, and that all the pipelines are already checked for leakage.

Installation of insulation material

1) Attach thermal insulation sleeves. For horizontal pipes, the seam of the sleeve must not face in the gravitational direction.
2) Prevent the pipe supports from biting in to the sleeves too much. If they are too loose, on the other hand, the insulation seams may open, so adjust the clamps as necessary.
3) If the insulation sleeve is made from glasswool, it must be bound to the pipe by two rounds of wire at two points or more. For sleeves shorter than 200 mm, wiring can be done at one point.
4) If the insulation sleeve is made from polyethylene, it must be bound to the pipe by two rounds of tape at two points or more. For sleeves shorter than 200 mm, taping can be done at one point.

Sleeve ends

Cover the sleeve ends with caps. The clasps of the caps will be less noticeable when attached behind the pipework. Exposed pipes that run through the wall hole must be supported to protect the insulation material. Slip a stainless steel plate (0.2mm or thicker) as a shim under the pipe so the pipe is rested at least above 150 mm from the bottom.

If you use cotton cloth for insulation, insulation caps and pipe must be attached after the pipe surface coating is done.

Do not use wet insulation materials.

3-8 Soundproofing and Quakeproofing

As for soundproofing and reduction of piping vibrations, please refer to the following instructions by The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan.

1) Prevent the noises and vibrations generated by the pumps and electric motors from being transmitted through the piping system.
2) In interior piping, take appropriate measures to absorb the acoustic radiation from the walls and structure-borne noise.
3) Locate the pipe shafts away from the rooms that should be kept quiet.
4) Quick closing water taps and valves may require appropriate measures to prevent water hammer.

3-9 Piping Supports

3-9-1 Types of Supporting Materials

Stainless steel pipes in direct contact with dissimilar metals and alloys may cause galvanic corrosion. The supporting materials for stainless steel piping must therefore be made in rubber, plastic, or insulation-coated. If you need to use supports for carbon steel pipes, slip an insulation material inbetween (as shown in Figure 3-9-1).

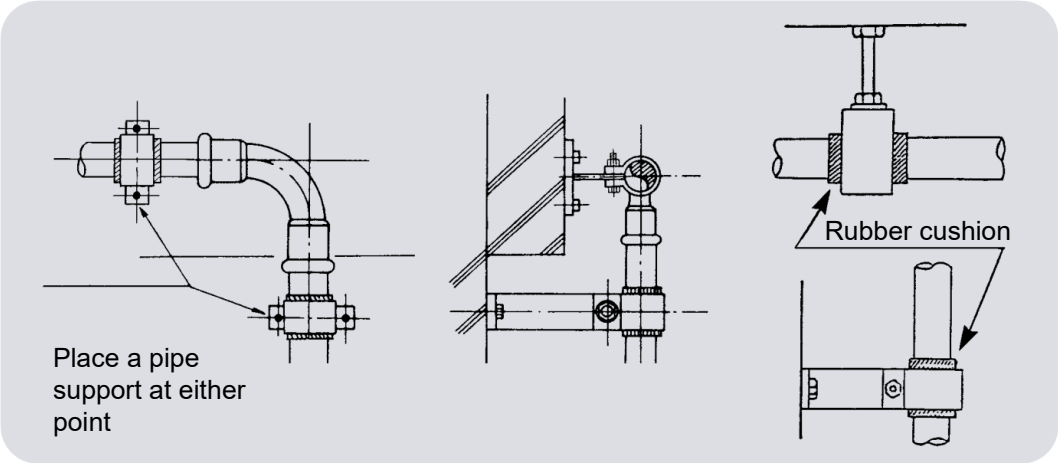


Figure 3-9-1 Supporting pipes using insulation materials

3-9-2 Installation of Pipe Supports

1) Place pipe supports near fittings

   A long, straight pipeline is more likely to bend by virtue of gravity. Pipe supports must be installed near fittings to reduce stress on the pipes and fittings (as shown in Figure 3-9-2).

2) Thermal expansion

   In case with a long straight pipeline, allowance for thermal expansion must be taken into account. Avoid attaching pipe supports directly onto the pipes. Instead, attach them over insulation sheathing (as shown in Figure 3-9-3).

   Select proper sizes for piping support that accommodate the thickness of insulation sheathing.

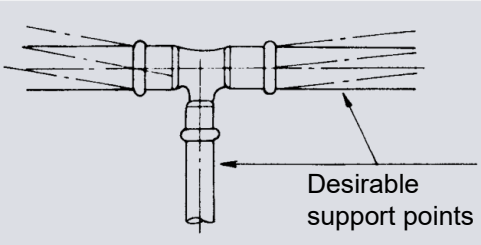


Figure 3-9-2 Support points

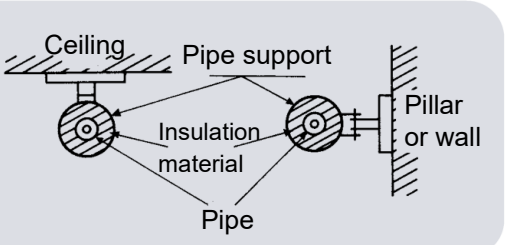


Figure 3-9-3 Pipe supporting that absorbs heat expansion

Long exposure to vibrations can causes accidents. Please hang the pipework directly from the ceilings or beams. If the pipe suspension is too long, fixate the pipe with extra supporting materials.

3-9-3 Additional Notes on Thermal Expansion

A hot fluid causes the pipes to expand and change their shapes. This may damage pipe supports and other piping equipments.

Stainless steel pipes have roughly the same coefficient of thermal expansion as copper pipes (Stainless Steel: 17.3 x 10^{-6}/°C, Copper pipes: 17.6 x 10^{-6}/°C), which is 1.5 times greater than that of carbon steel pipes. Designers and engineers need to take this into account.

One common method for absorbing thermal pipe expansion is to use bellows expansion joints. Single type bellows expansion joints are ideally installed at intervals of 20 meters (40 meters for dual types). Attach the joint firmly to the frame of the building to get the best effect. For pipe supports, use roller types or sleeve types to give enough room for the pipes to expand.

To reduce the stress on the fittings, use swivel type joints to connect branch pipes to the main pipe.

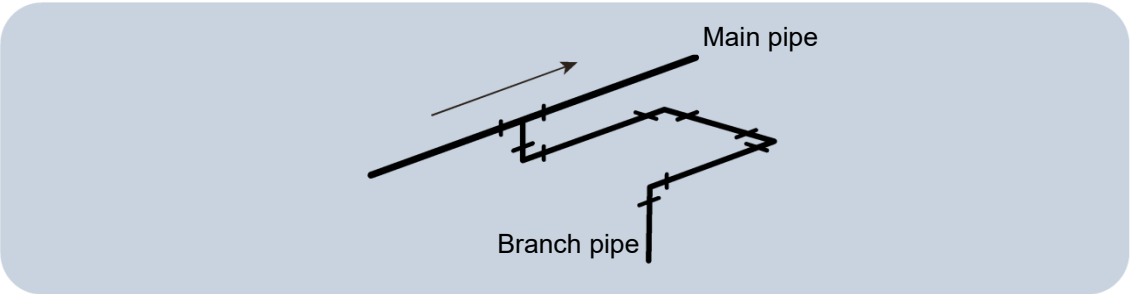


Figure 3-9-2 Application of Swivel Joint

Please take thermal expansion into account in designing piping systems.

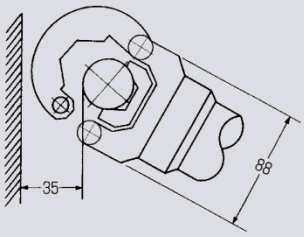
Straight pipework may increase mechanical stress to the pipes, fittings, supports and other components.

4 BENKAN PRESS TOOLS

4-1 Minimum Distance between the Pipe and Wall

The Figure below shows the minimum distance from the pipe and the wall / ceiling, which can allow the

BPD-08, BPD-15R (Size 15-28)



BPN-16R (Size 15-28)

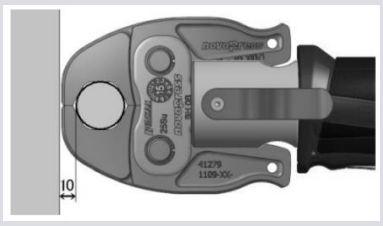


Figure 4-1-1 Distance between the pipe and wall

Do not touch the crimp jaws and dies while operating the tool as it may lead to severe injuries.

When replacing dies or during maintenance, please leave the tool unplugged.

Do not use other oils than specified in the users' manual.

Never use other tools than authorized by Benkan Corporation for installation of Molco Joint, as it may lead to installation failure.

The press tool may fail to provide sufficient pressure due to aging or other issues. Unsuccessful press can cause water leakage. Please check for a secure connection by applying the hexagonal gauge.

Please contact the provider when the tool is broken. There are cases where accidents result from tools not maintained for a long time. Regular maintenance of your press tool (at least, once a year) is recommended for the safety of users. Please keep records of maintenance date.

4-2 Trouble-shooting on Tools

- **General Problems**

Problems	Possible Causes	Solutions
The piston does not work	1) Not enough oil in the tank	Please consult the manufacturer for repair
	2) Air trapped inside the pump	
	3) Failure in the hydraulic circuit	
Insufficient press force (Use the hexagonal gauge to check →p.20)	1) Not enough oil in the tank	Please consult the manufacturer for repair
	2) Failure in the hydraulic circuit	
The piston does not return	Air trapped inside the pump	Please consult the manufacturer for repair
Oil leakage from the tool / noise during operation		Please consult the manufacturer for repair
The moving die falls off	Aging of the rubber base	Replace the rubber base
The tool works too slow	Oil is frozen	Leave the tool in a room temperature for a while
Others		Please consult the manufacturer for repair

- **Problems specific to AC powered tools**

Problems	Possible Causes	Solutions
The piston does not work	1) Air trapped inside the pump	Release the air from the pump
	2) Not enough oil in the oil tank	Replenish the oil
The tool does not operate	1) The power cable is damaged	Please consult the manufacturer for repair
	2) Aging of carbon brush	Replace the carbon brush with a new one.
Insufficient press force (Use the hexagonal gauge to check →p.20)	Power shortage	Stop powering multiple apparatuses with a single generator at the same time

- **Problems specific to battery powered tools**

Problems	Possible Causes	Solutions
The tool does not operate	1) Battery pack is not fully charged	Recharge the battery pack
	2) Battery pack is not fully inserted	Make sure the battery pack is fully inserted
The battery cannot be recharged	1) Aging of the battery pack	Try a new battery pack
	2) Battery charger is broken	Consult the manufacturer or try a new battery charger
	3) Dirt and debris between the battery and charger terminals	Remove any debris from the battery and charger terminals
	4) Others	Discharge the battery fully, and then recharge it. Repeat this process once or twice. If the performance does not improve, consult the manufacturer for repair.
The piston does not return (BPD-15R)	1) The battery ran out	Recharge the battery pack
	2) Pressing was not completely finished	Reactivate the tool and finish the pressing
The slide pin is broken or stuck (BPD-15R)	Pressing was started without properly locking the slide pin	Please consult the manufacturer for repair

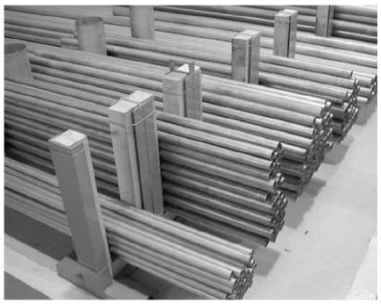
- ◆ If you are having problems not listed above, please consult the manufacturer.
- ◆ The tool requires regular maintenance (preferably **once a year**).
- ◆ Please carefully read the user's manual of the tool.
- ◆ If you find it difficult to repair your tool on your own, please consult the manufacturer.

5 STORING BENKAN PRODUCTS

5-1 Storing Stainless Steel Pipes

When you store light-weighted, thin-walled stainless steel pipes, please follow the instructions below to keep them in a good condition.

1) Store stainless steel pipes indoors, where the humidity is low.
2) If you store stainless steel pipes outdoors, protect them from dirt and pebbles by covering them with a plastic sheet.
3) Place the pipes horizontally to the floor. Use wooden pipe sleepers to stabilize the pipes. If you need to pile up the pipes, make sure they won't deflect under their own weight.
4) If you need to lean the pipes against the wall, make sure they won't deflect or buckle. Also, take necessary measures to keep the pipes from falling.
5) Keep the pipes out of direct contact with other metals.
6) Keep the pipes free from dirt and grime.
7) When removing corrosion, apply water to cloth and wipe it off.



5-2 Storing Stainless Steel Fittings

1) Stainless steel fittings should be stored in the same manner as pipes.
2) Keep the inner surface of the fittings clean and free from dust and dirt.
3) Keep the fittings (especially the rubber ring) out of direct contact with the sun.
4) To protect the rubber ring from dust and dirt, please store fittings inside plastic bags etc.

6 TROUBLE SHOOTING ON BENKAN FITTINGS

Problems	Solutions
Difficulty in inserting a pipe into a fitting	Apply water to the pipe surface
The pipe end is deformed or damaged	Cut off the damaged part of the pipe
Cut a pipe to a wrong length	Prepare a new pipe
Cut the rubber O ring by mistake	Prepare a new fitting
Installed fittings in a wrong position/angle	Cut away the fitting and replace it with coupler or slip coupling
Pressing was not complete	Repress the fitting. When you set the fitting on the tool head, always the same sides must be facing the dies.
Heating up a frozen pipeline	Consult the manufacturer of the heater. Do not use electric heater.
Hexagonal gauge does not fit	Repress the fitting.
	Try another press tool

- If you are using lease tools, please be careful not to lose the tools and their accessories. If such cases occur, we ask for compensation for the lost items.
- Benkan Corporation is not held liable for any damage or loss, including leakage, arising from negligence in testing the water quality, fire, earthquake, actions of the third party, users' intention, mistakes and misuse, and other unexpected conditions.
- Benkan Corporation is not held liable for any damage or loss resulting from misuse or unavailability of our products.