

I General

1. Pipes and Fittings

(1) Name: NS ductile iron pipe

Abbreviation: NS

Symbol of joint: 

(2) Pipe size: 20" to 40" (500 mm to 1000 mm)

(3) Pipe wall thickness: Class S

(4) Types of Fittings: Triple Socket Cross, Double Socket Tee, Socket Spigot Reducer, Spigot Socket Reducer, Socket Spigot Bend, Double Socket Bend, Socket Flanged Tees with Flanged Branch, Flanged Spigot Tees with Flanged Branch, Socket Spigot Tees with Flanged Branch, Double Socket Level Invert Tees with Socket Branch, Collar, Flanged Socket, Flanged Spigot, Plug

(5) Nominal laying length of straight pipe: 19.69 feet (19' 8-1/4") [= 6 m]

(6) Standards: JWWA G 113 and JWWA G 114

2. NS Joint (20" to 40")

(1) Structure

1) Pipe

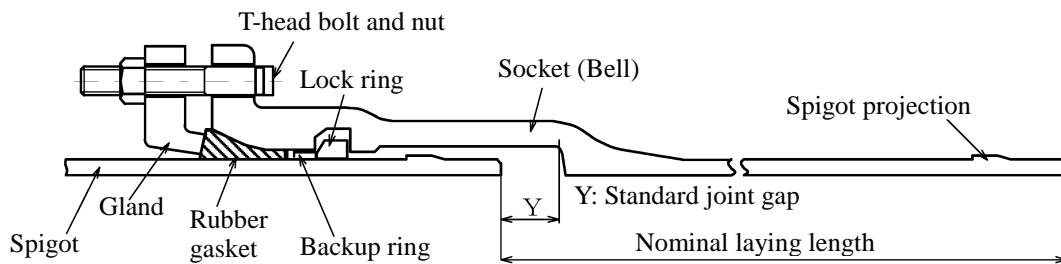


Figure-1 Joint structure of pipe

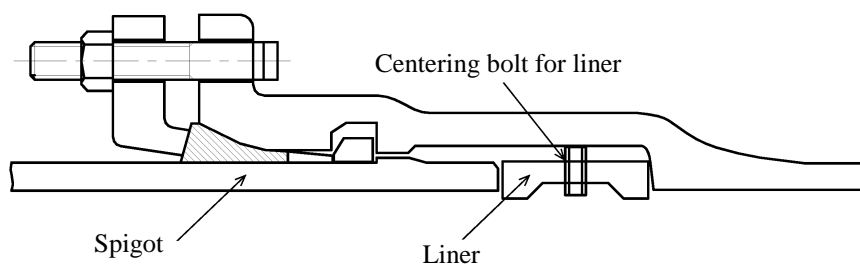


Figure-2 Joint structure of pipe with liner

2) Fittings

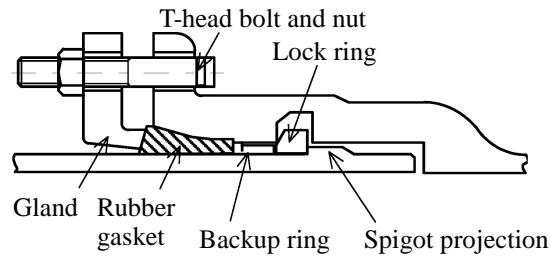


Figure-3 Joint structure of fittings

(2) Materials of Accessories

Table-1 Materials of Accessories

Name	Material
Rubber gasket	SBR (NBR, EPDM)
Gland	Ductile iron
T-head bolt and nut	Stainless steel
Backup ring	Polyamide resin (PA6)
Lock ring	Ductile iron
Liner	Ductile iron
Centering bolt for liner	Polyamide resin (PA6)
Spigot ring for cut pipe	Ductile iron
Attachments for liner, bolt, washer	Stainless steel

3. Standard performance

(1) Expansion and contraction

Table-2 shows the expansion and contraction of the pipe and collar.

Table-2 Expansion and contraction of pipe and collar

Pipe size	Pipe	Collar	
		Expansion	Contraction
20"	±2.4" [±60 mm]	2.4" [60 mm]	10.2" [260 mm]
24"	±2.4" [±60 mm]	2.4" [60 mm]	10.2" [260 mm]
28"	±2.4" [±60 mm]	2.4" [60 mm]	11.8" [300 mm]
32"	±2.4" [±60 mm]	2.4" [60 mm]	12.0" [305 mm]
36"	±2.4" [±60 mm]	2.4" [60 mm]	12.0" [305 mm]
40"	±2.4" [±60 mm]	2.4" [60 mm]	12.2" [310 mm]

(2) Allowable deflection angle

Table-3 lists the allowable deflection angles of the pipe and collar (on one side).

Table-3 Allowable deflection angles of pipe and collar (on one side).

Pipe size	Allowable deflection angle (at installation)	Maximum deflection angle
20"	3° 20'	7°
24"	2° 50'	7°
28"	2° 30'	7°
32"	2° 10'	7°
36"	2° 00'	7°
40"	1° 50'	7°

(3) Pull-out resistance force

Table-4 shows the pull-out resistance force of the joint.

Table-4 Pull-out resistance force

Pipe size	Pull-out resistance force (lbf)
20"	340,000 [1500 kN]
24"	408,000 [1800 kN]
28"	476,000 [2100 kN]
32"	544,000 [2400 kN]
36"	612,000 [2700 kN]
40"	680,000 [3000 kN]

II. NS Pipe assembly procedure

Assemble NS joint strictly following this manual. It is recommended to check the joint conditions with the "Joint check sheet" to ensure the assembled joint.

1. Pipe set-up

Lay the pipe at a designated place. Position the manufacturer's mark at the top. Adjust a bolt hole location so the manufacturer's mark is positioned at a straight angle between two bolt holes.

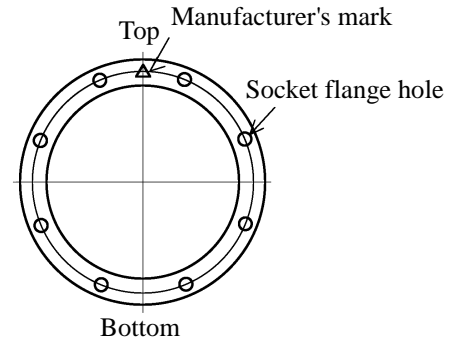


Figure-4 Pipe set-up

2. Cleaning and outside diameter check

Clean the socket surface (especially the rubber gasket groove) and spigot surface (to about 2 feet from the spigot end).

Remove all foreign materials, such as dirt, sand, and oil.

Check the outside diameter of the spigot conforms to the outside diameter range if necessary, especially when using a cut-end spigot.

3. Installing the lock ring

(1) As illustrated in Figure-5, install the lock ring so that the tapered side will face toward the spigot.

Hold both sides of the lock ring, ensuring the tapered side faces toward the socket end and the split portion (two white marks) is on top.

Turn the tapered side down to a horizontal position and push the lock ring into the socket, aiming at the spring line of the bell (keep the lock ring level).

Turn the lock ring toward the bell-end so the lock ring properly sits in the socket groove (a soft head hammer may be used to keep the lock ring in place.). Adjust and place the lock ring split portion to the top after confirming the lock ring position.

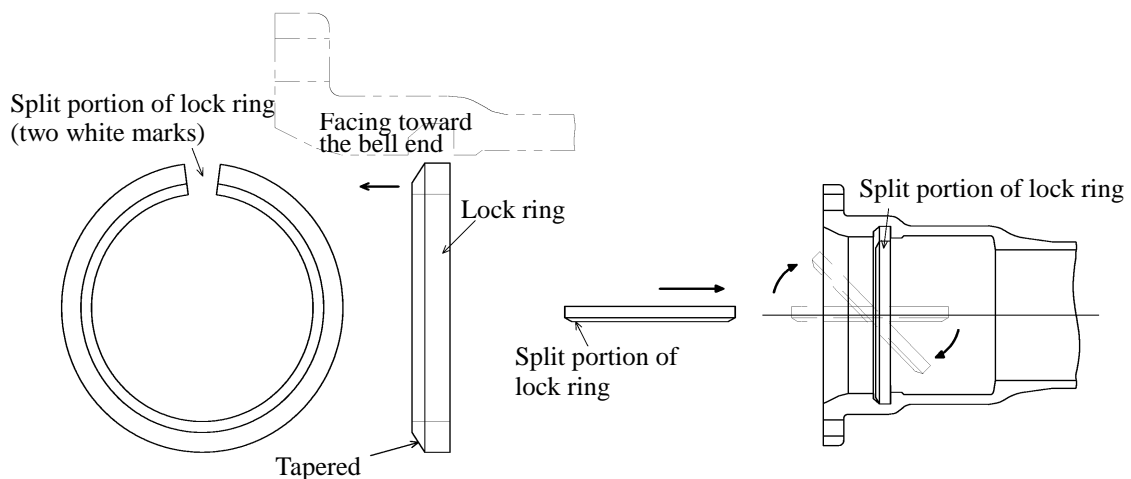


Figure-5 How to install the lock ring into socket



Do not put your hands between the socket and the lock ring while installing the lock ring. Your hands may be pinched, leading to a serious injury.



Install the lock ring correctly to maintain the full performance of the pull-out resistant function of the joint.

- (2) Place the lock ring expander in the split portion. As illustrated in Figure-6, spread the lock ring with the lock ring expander to the dimension "s" (reference values) shown in Table-5.

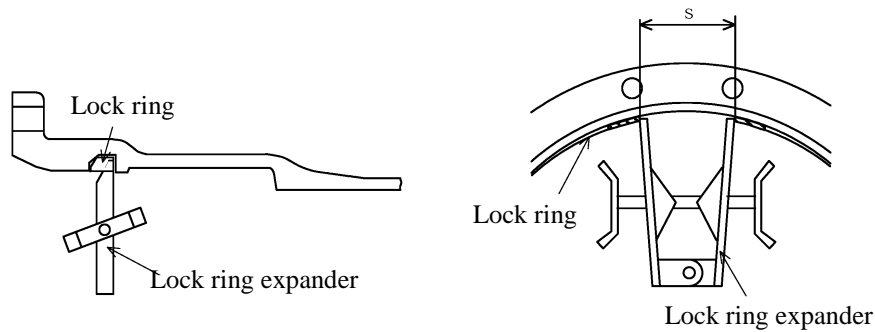


Figure-6 Installation of lock ring expander

Table-5 Dimension "s" (reference values)

Pipe size	Dimension "s"
20"	4.80" (122 mm)
24"	4.80" (122 mm)
28"	5.20" (132 mm)
32"	6.02" (153 mm)
36"	6.18" (157 mm)
40"	6.38" (162 mm)

- (3) Figure-7 illustrates the stopper for the lock ring. Adjust the stopper width at the same reference value as Table-5. Insert the stopper between the split portion and remove the lock ring expander (refer to Figure-8).

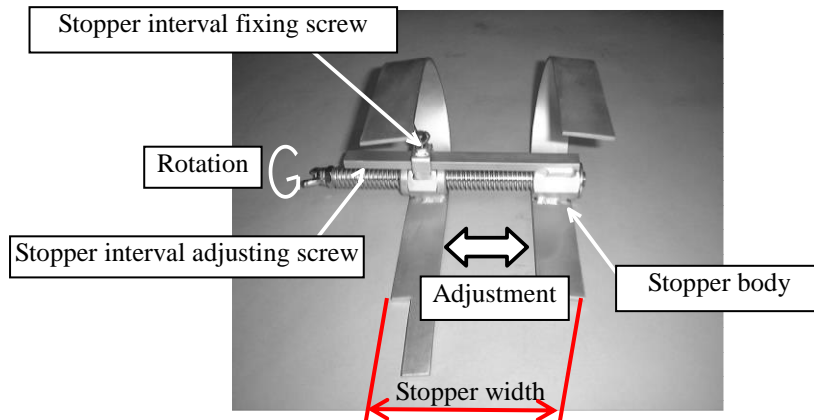


Figure-7 Stopper overview

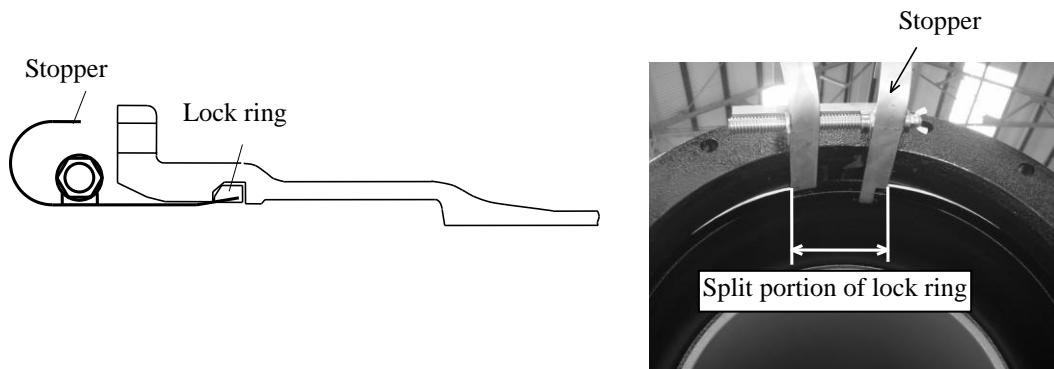


Figure-8 Stopper installation

Note: Re-adjustment of the stopper (additional expansion)

If the lock ring conflicts with the spigot passing through it, re-adjustment of the stopper (additional expansion) might be necessary. Follow the steps below to correct the conflict.

- 1) Pull out the spigot from the socket.
- 2) Spread the stopper 0.2" (5mm) wider.
- 3) Reinstall the stopper in the split portion.

4. Installation of the rubber gasket and backup ring

- (1) Clean the rubber gasket and confirm the indication mark ("NS") of the rubber gasket. And then, place the rubber gasket on the spigot, ensuring the direction of the gasket is the same as illustrated in Figure-9.
- (2) Clean the backup ring and put it on the spigot, confirming the direction of the backup ring is the same as illustrated in Figure-9.

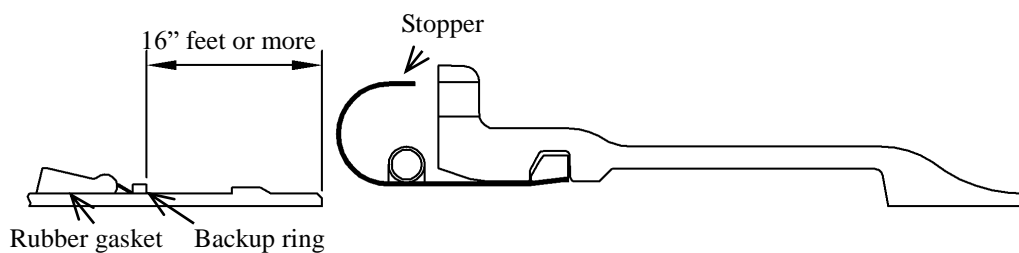


Figure-9 Position of the rubber gasket and the backup ring before jointing



Confirm the rubber gasket's and backup ring's orientation before placing them on the spigot. Incorrect positions of the accessories will lead to leaks.



Select the correct rubber gasket and backup ring conforming to the NS-type joint and pipe size. Incorrect accessories will lead to leaks.

**CAUTION**

Do not reuse a disassembled rubber gasket. Reuse of a disassembled rubber gasket will lead to leaks.

5. Lubrication

Apply lubricant to the inside surface of the socket, where the rubber gasket will be installed.
(See Figure-10.)

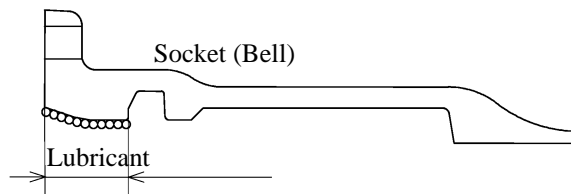


Figure-10 Application of lubricant

6. Alignment of socket and spigot

- (1) Lift the pipe with a crane to insert the spigot into the socket.
- (2) Keep pulling the spigot slowly until the white line A reaches the bell end, then stop pulling the spigot. (See Figure-11.)
- (3) Pull out the stopper, then confirm that the lock ring holds the spigot (the joint is locked).
If the stopper has been pulled out or dislocated before the joint is completely locked, repeat the same procedure from 3. (2).

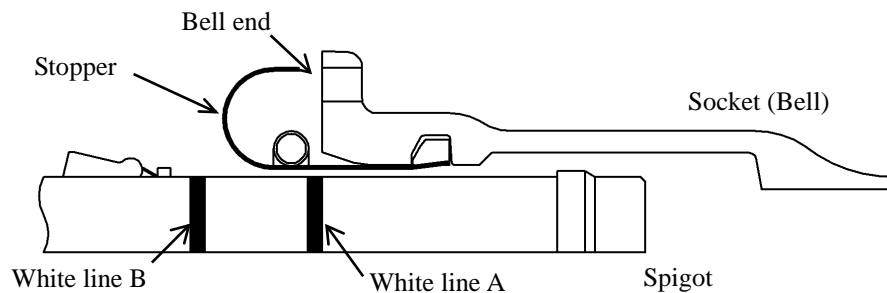


Figure-11 Inserting spigot into socket

Note: How to adjust the white line A and bell end

Adjust the position of the white line A and bell end by pushing in or pulling out after confirming the locking of the joint.

7. Installation of Backup ring

Align the pipes at the joint, maintaining an even clearance between the socket and the spigot around the joint, as illustrated in Figure-12. Install the backup ring with the insertion rod between the socket and the spigot. Insert the backup ring entirely into the socket until direct contact with the lock ring, keeping the pipe aligned while the joint is assembled, as illustrated in Figure-13.

Note: Hydraulic bottle jacks or chain lever hoists can be used to vertically adjust the pipe alignment if a crane is difficult to adjust the alignment of the joint.

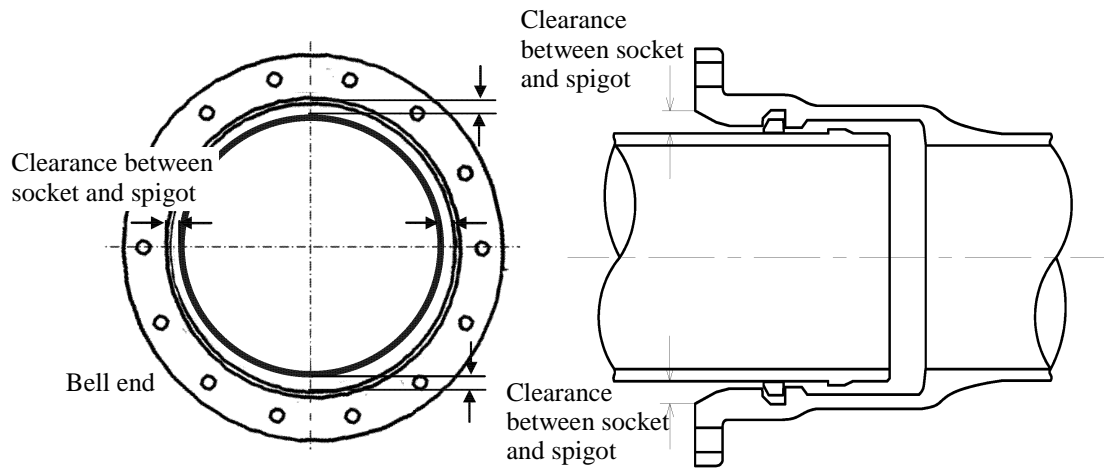


Figure-12 Pipe alignment

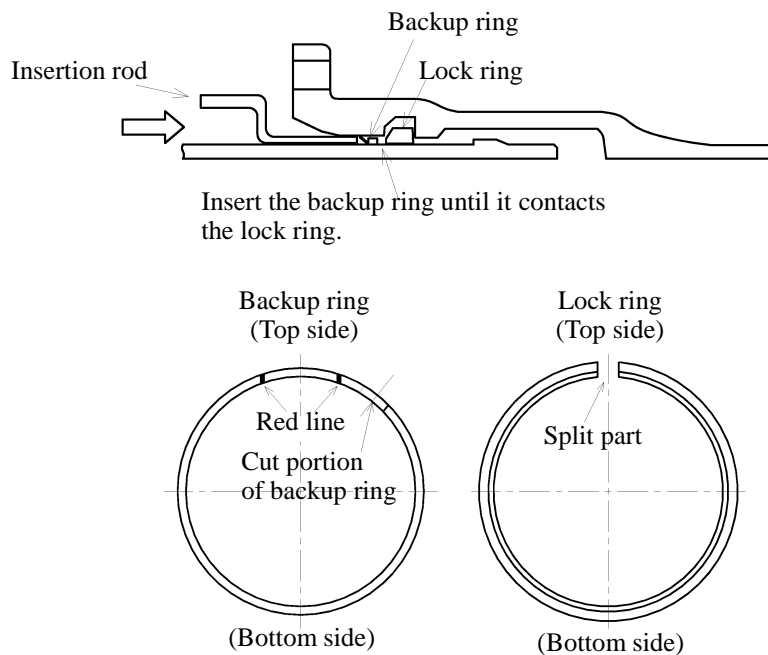


Figure-13 Backup ring insertion

Follow the steps below when inserting the backup ring.

- (1) Locate the two red lines marked on the backup ring at the center of the lock ring split portion to avoid the overlapped part of the backup ring from getting caught in the split portion of the lock ring. (See Figure-14.) Mark both locations of the lock ring edge on the bell end.
- (2) Ensure the tapered surface of the backup ring faces toward the socket. (See Figure-14.)
- (3) Ensure the split edges of the backup ring (diagonally cut) face correctly, not crossed over. (See Figure-14.)

- (4) Start inserting (stabbing) the backup ring with the insertion rod from the left side (facing toward the bell) of the split edge to the right (counterclockwise) so the overlapped part will be the last stabbing.

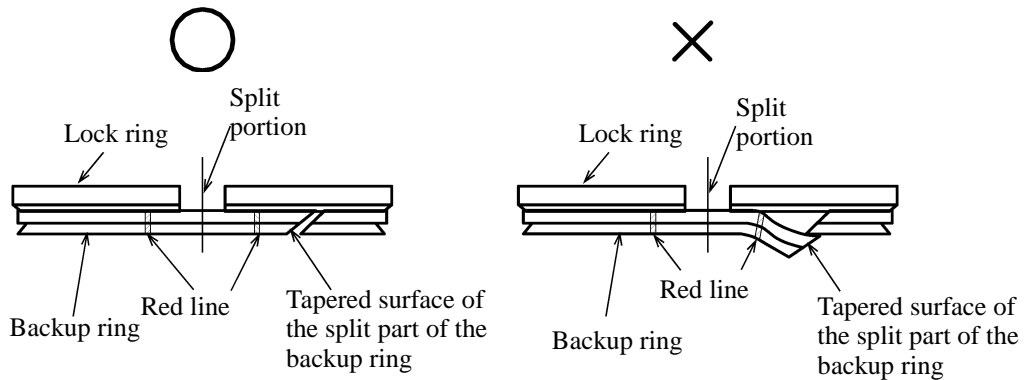


Figure-14 Check of the split part of the backup ring

8. Rubber gasket insertion

- (1) Apply lubricant to the outer surface of the rubber gasket, the spigot, and the socket. Figure-15 shows the area of lubrication.

The rubber gasket will not be properly compressed during bolt-up if the socket is incorrectly lubricated. Lubricate the inadequate area again if necessary.

- (2) Push the rubber gasket into the socket while the clearance of the joint is maintained uniformly in both horizontal and vertical directions.

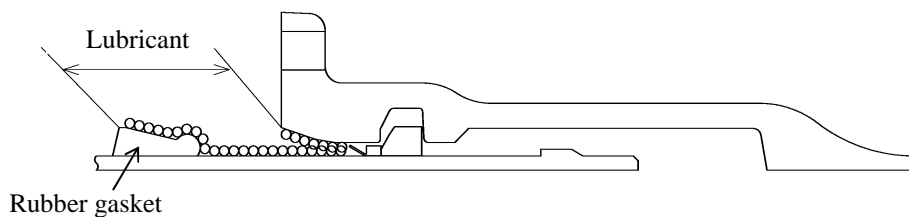


Figure-15 Lubrication to rubber gasket, spigot, and socket

9. Installation of the gland, T-head bolts and nuts

- (1) Installation of the gland

The NS Gland is composed of two identical segments (each segment is a half-ring).

Place the connecting part of the half-ring gland segment on top, as illustrated in Figure-16.

Place the second segment of the gland, ensuring both connecting parts are overlapped correctly (not staggered).

Set up T-head bolts and nuts in place. (The bolts at the connecting parts shall be installed first for your safety.)

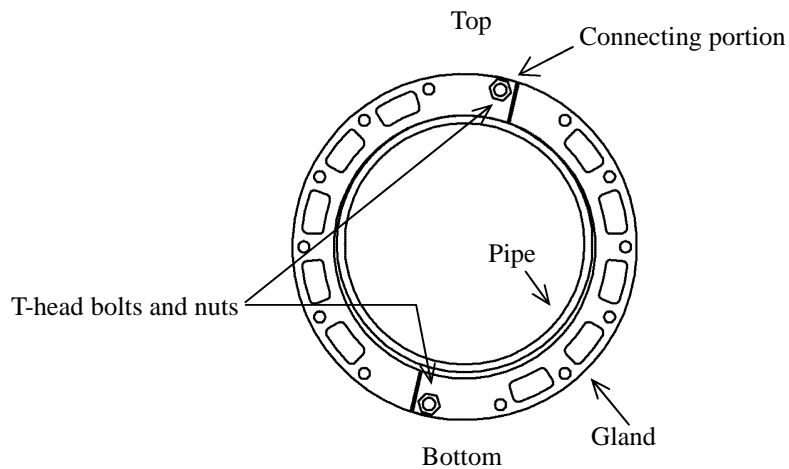


Figure-16 How to assemble the gland

**CAUTION**

Be careful not to drop the gland (foot injury). Hold the gland securely while bolts and nuts are installed.

**CAUTION**

Place the connecting parts of the gland segments on top and bottom. Ensure both connecting parts are overlapped correctly (not staggered) to avoid an assembly failure due to improper rubber gasket balance.

(2) Centering of the Gland

Center the gland with wedge, ensuring the bolt holes at the connecting parts are aligned, as illustrated in Figure-17. Confirm the centering position of the gland as the rest of the T-head bolts and nuts are tightened by hand.

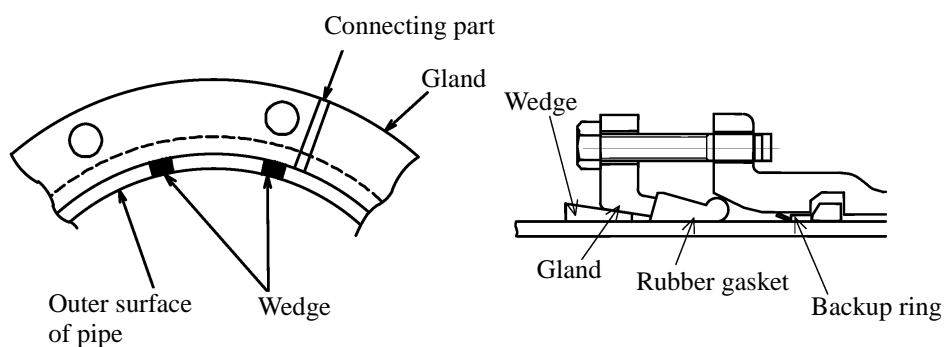


Figure-17 Centering of the Gland

10. Starting bolting up

(1) Adjustment of standard joint gap and snugging of bolts and nuts

The spigot tends to be pulled into the socket after the completion of bolting up, which means the gap in the joint becomes about 1" to 2" shorter than a preliminary setup.

Considering the tendency, the white line A might be set about ½" to 1" away from the bell end, which determines the final position of the spigot. The final position of the spigot (standard joint gap) is standardized in Figure-18, which is the distance between the white line B and the bell end [about 3" (80 mm)].

Start bolt up, ensuring all bolts and nuts are snug and tight in good balance. Ensure the round portion of the rubber gasket properly fits in the socket, as illustrated in Figure-19.

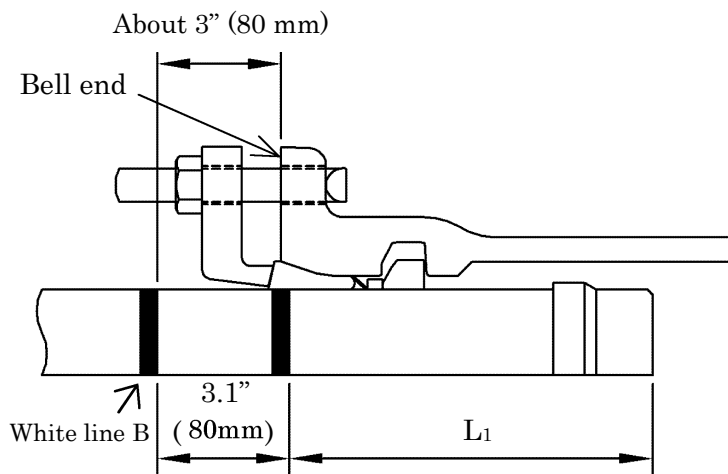


Figure-18 Standard joint gap

Table-6 L₁-dimension

Pipe size	L ₁
20"	8.7" (220 mm)
24"	8.7" (220 mm)
28"	10.1" (257 mm)
32"	10.4" (265 mm)
36"	10.4" (265 mm)
40"	10.6" (268 mm)

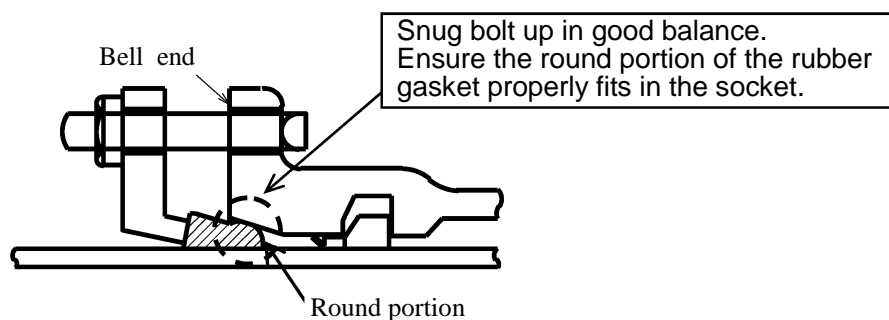


Figure-19 Starting Bolting up

(2) Finishing bolting up

Finish bolting up after confirming all bolts and nuts are snug and tight in good balance. Follow the steps below to properly finish bolting up.

- 1) Always start with the connecting parts of the gland (1st: top and bottom). Tighten these bolts and nuts simultaneously or alternately. (Refer to Figure-20).
- 2) Tighten the spring line bolts (2nd) in the same manner as the top and bottom. (Refer to in Figure-20).
- 3) Repeat the same process (1st: top, bottom, 2nd: spring lines), ensuring all bolts and nuts are gradually tightened in good balance. (alternate and diagonal cross pattern)

Shown below are the critical assembly points.

- Ensure the shape of the rubber gasket is entirely uniform, not partially pinched and unbalanced.
- When tightening the bolts and nuts, maintain a uniform distance between the bell end and the gland.
- Avoid overtightening bolts and nuts, as well as uneven balance. Tighten the bolts and nuts gradually, checking the bolt-up condition at every 1/4 inch of tightening.

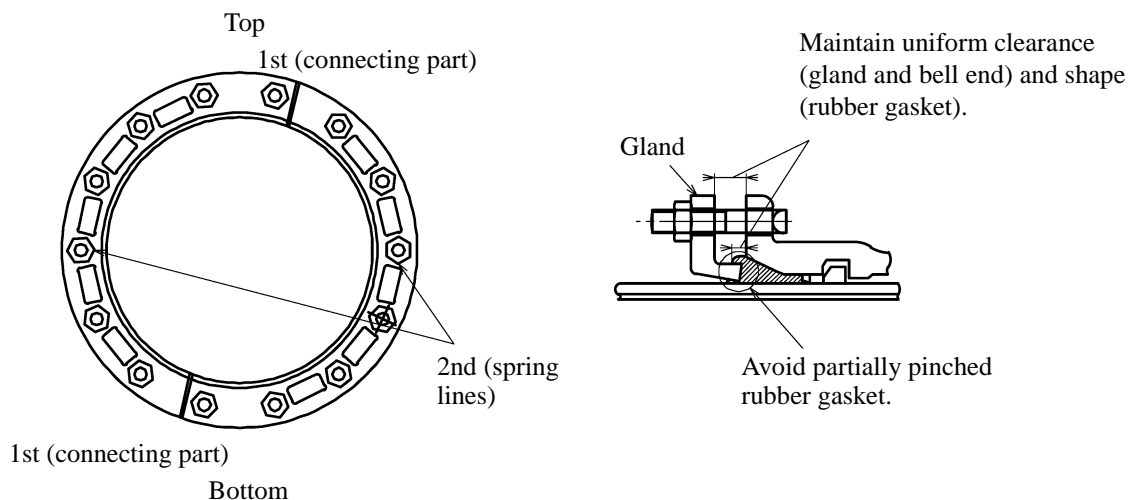


Figure-20 Tightening of bolts and nuts

- (3) Final bolting up before torquing

At this stage, since all bolts and nuts are nearly tightened at the designated torque, change the bolting method (alternate and diagonal cross pattern) for the bolting pattern shown in Figure-21. Repeat the bolting pattern (forward and backward) until all bolts and nuts are completely tightened in good balance, and the rubber gasket is formed in a uniform shape. Ensure all bolts and nuts are not overtightened and over-torqued.



CAUTION

Ensure to use a calibrated torque wrench.

Table-7 Standard tightening torque

Pipe size	Bolt diameter (mm)	Standard tightening torque (ft-lb)
20" and 24"	M20	73.7 [100 N-m]
28" and 32"	M24	103.2 [140 N-m]
36" and 40"	M30	147.4 [200 N-m]

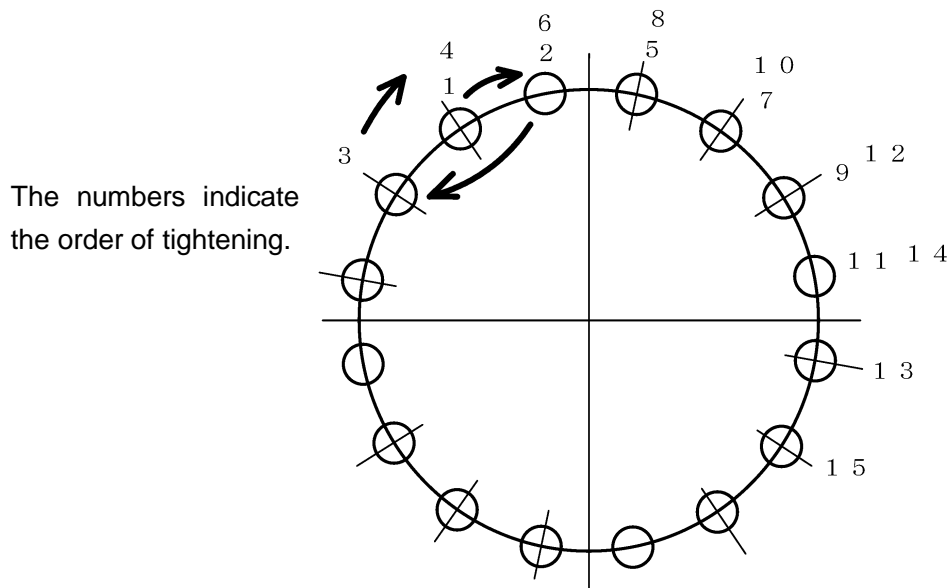


Figure-21 Bolting and torque pattern

(4) Torque check

Ensure to use a calibrated torque wrench and check the designated torque value.

Check the torque of all bolts and nuts in the same bolting manner as Figure-21. Refrain from over-torquing (only a one-time process is necessary.)



CAUTION Over-torquing will result in potential leaks.

11. Check the bolt-up condition

After tightening the bolts and the nuts, check the following items:

(1) Uniform tightening of bolts and nuts

- 1) As illustrated in Figure-22, measure the clearance between the gland and the bell end at four locations, and ensure that the clearance difference value does not exceed 0.2" (5 mm).
- 2) If the clearance difference value exceeds 0.2" (5 mm), disassemble the joint to inspect and check the joint, and then attempt assembling the joint again. In this case, replace the rubber gaskets, and the backup rings with the new ones.

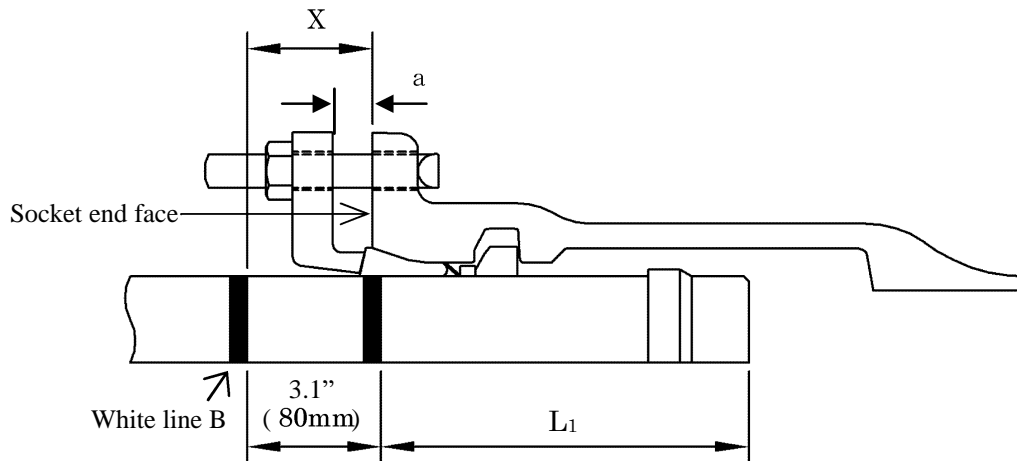


Figure-22 Measurement of clearance between bell end and gland, and clearance between socket end face and white line B

(2) Distance from bell end to white line

Measure the distance X from the bell end to the white line B. Ensure that the distance is about 3" (80 mm).

(3) Protrusion of rubber gasket

- 1) Check the protrusion of the rubber gasket from the bell end at four locations. (See Figure-23.) Ensure there are no simultaneous combinations of A and C or A, B, and C on the same circumference.
- 2) If there is any simultaneous combination of A and C or A, B, and C of the rubber gasket, disassemble the joint and then attempt assembling it again.

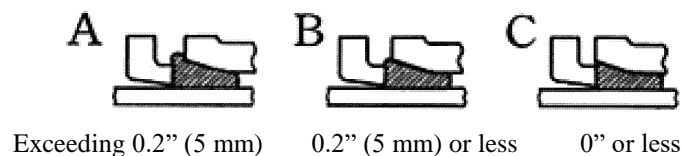


Figure-23 State of rubber gasket protrusion

3) Curling of rubber gasket

Ensure there is no abnormal state, such as "the edge of the rubber gasket overlapping the gland" or "local bulge of the rubber gasket" over the entire periphery, as illustrated in Figure-24.

It is not always easy to check the pipe bottom, but it must be checked by all means because failure tends to occur in this portion.

If the edge of the rubber gasket overlaps the gland or there is a local bulge of the rubber gasket, this shall be considered abnormal. Disassemble the joint and then assemble it again. In this case, replace the rubber gasket and backup ring with the new ones.

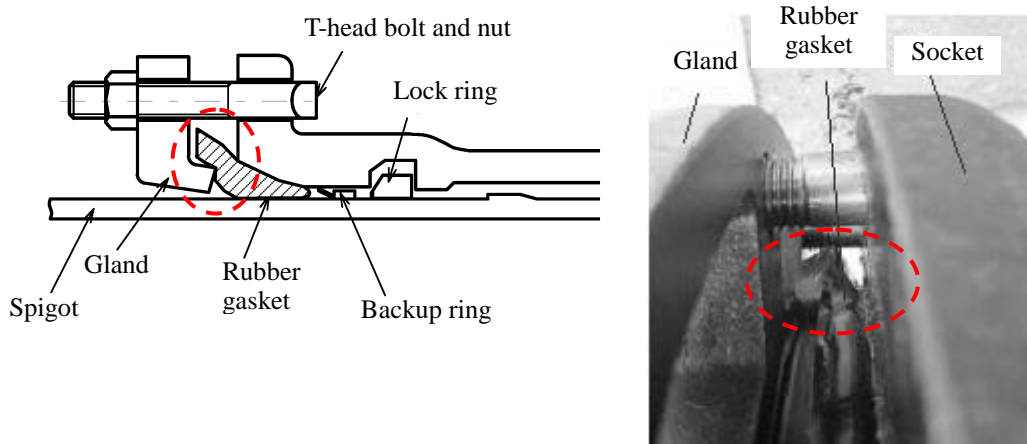


Figure-24 Overlapping of the rubber gasket (considered as connection failure)

12. Joint check sheet

Use the joint check sheet for quality management of the GX pipe assembly. Fill out the joint check sheet on site right after the assembly. (The check sheet is given by manufacture.)

13. Installation with a deflection at the joint

- (1) Follow "1. Pipe set-up" through "10. Starting bolting up (1)" in the above.

CAUTION

If the joint is deflected, the backup ring may not correctly overlap the rubber gasket, resulting in a leak.

- (2) Deflect the joint gradually. Tighten the bolts and the nuts up to the standard torque.
- (3) Table-8 lists the allowable deflection angle of the joint. Do not use a single pipe for deflecting a desired angle over the allowable deflection angle. Instead, deflect multiple pipes to the desired angle, if possible.

Table-8 Allowable deflection angles and offset

Pipe size	Allowable deflection angle θ	Dimension A_1-A_2 difference X	Allowable offset ¹⁾ δ
20"	3° 20'	1.2" (31 mm)	13.8" (35 cm)
24"	2° 50'	1.2" (31 mm)	11.4" (29 cm)
28"	2° 30'	1.3" (32 mm)	10.2" (26 cm)
32"	2° 10'	1.3" (32 mm)	8.7" (22 cm)
36"	2° 00'	1.3" (32 mm)	8.3" (21 cm)
40"	1° 50'	1.3" (32 mm)	7.5" (19 cm)

1) For 19.69ft. (6 m) pipe

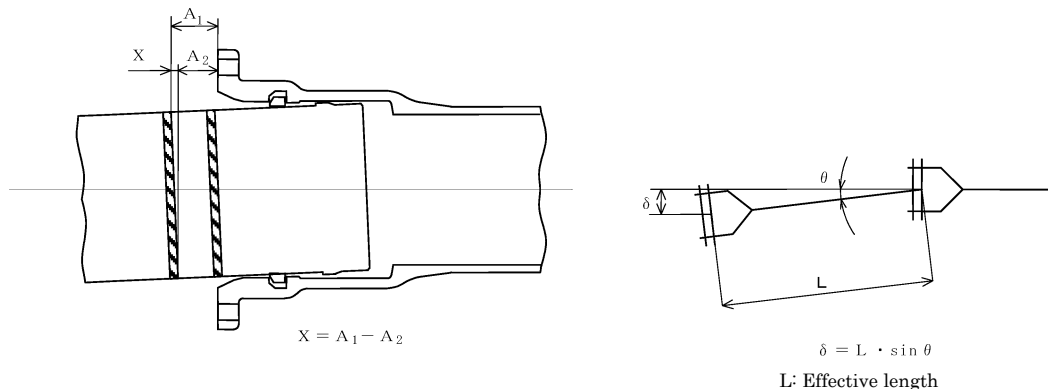


Figure-25 Allowable deflection angle and deviation

CAUTION

Do not deflect the joint over the allowable deflection angle to avoid a leak.

III. NS Fitting assembly procedure

1. Jointing the socket and spigot of fittings (or the fitting socket and the pipe spigot)

- (1) Follow "1. Pipe set-up" through "4. Installation of the rubber gasket and backup ring" in "II. NS Pipe assembly procedure".
- (2) Marking the depth of spigot insertion

Before insertion of the spigot into the socket, measure the socket depth (X) and draw a white line at the distance of X from the spigot end to indicate the insertion depth. The line shall be marked on the entire periphery of the outer surface of the spigot. (See Figure-26).

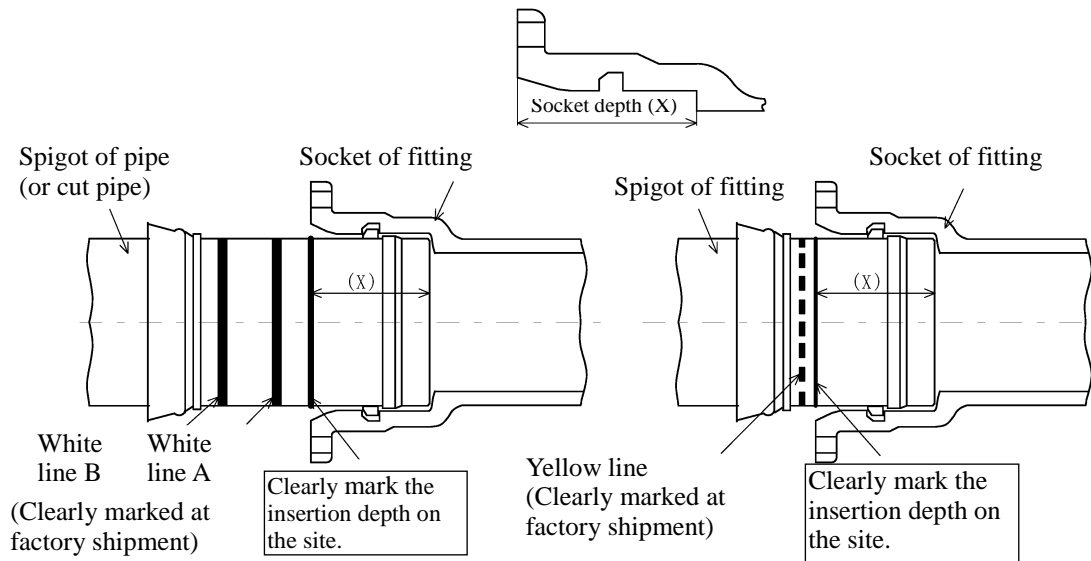


Figure-26 Marking of insertion depth



CAUTION

Mark the insertion depth on the spigot clearly. Otherwise, insertion depth cannot be verified and the spigot insertion can be insufficient. If the spigot projection is not inserted beyond the lock ring due to insufficient insertion, the pull-out resistance function may be spoiled.

(3) Inserting the spigot

- 1) Suspend the pipe by a crane. Under this condition, lead the spigot to the socket.
- 2) Insert the spigot slowly until the spigot end contacts the socket bottom.
- 3) Make sure that the white line marked on site has come to the position of the socket end face all around the circumference. After that, pull out the stopper to allow the lock ring to hold the spigot. If the spigot contacts the stopper during insertion of the spigot, the stopper may be disconnected. If the stopper is disconnected, repeat the procedure from step II 3. (2).

(4) Checking the lock ring position

Suspending the pipe by a crane, rock the spigot or socket vertically and laterally to confirm that the joint is not pulled out. If it is pulled out, disassemble the joint and join the parts again.


WARNING

If the spigot projection is not beyond the lock ring and the pipe is rocked, a serious accident may occur, such as the pulled-out pipe pinching a worker.

(5) Follow "7. Installation of Backup ring" through "12. Joint check sheet" in "II. NS Pipe assembly procedure".

IV. NS joint with the Liner

The Liner is installed in the socket of the pipe joint located within the range of the restrained length. The Liner is also required for the pipe joint with the fitting spigot. (See Figure-27.)


CAUTION

The thrust force might impact the joint into moving, resulting in buried structure damage or road surface collapse if the Liner is not installed where it is required.

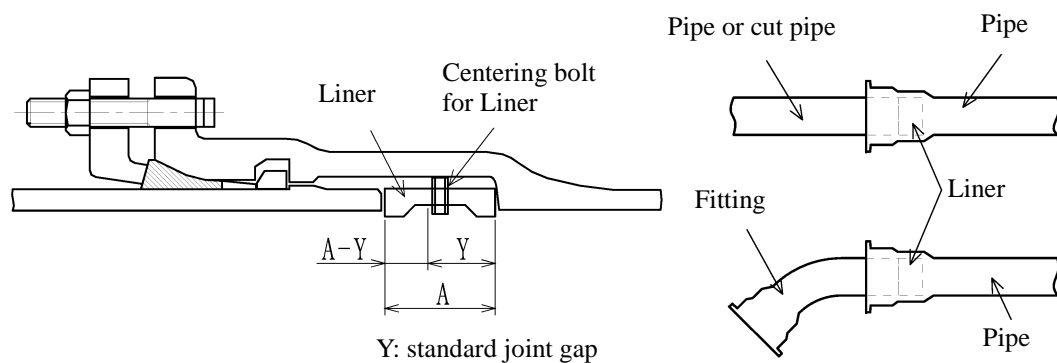


Figure-27 Structure of joint where the liner is installed

Table-9 Joint expansion when a liner is used for pipe socket

Pipe size	Liner width A	Standard joint gap Y	Joint expansion A-Y
20"	5.63" (143 mm)	2.95" (75 mm)	2.68" (68 mm)
24"	5.63" (143 mm)	2.95" (75 mm)	2.68" (68 mm)
28"	5.71" (145 mm)	2.95" (75 mm)	2.76" (70 mm)
32"	5.71" (145 mm)	2.95" (75 mm)	2.76" (70 mm)
36"	5.71" (145 mm)	2.95" (75 mm)	2.76" (70 mm)
40"	5.75" (146 mm)	3.15" (80 mm)	2.60" (66 mm)

Note) When the liner is installed in the pipe socket, the effective length of the pipe will be expanded by A-Y.

- (1) Follow "1. Pipe set-up" through "2. Cleaning and outside diameter check" in "II. NS Pipe assembly procedure".
- (2) Installation of the Liner
 - 1) Collect all segments of the liner to install in the pipe socket.
 - 2) Assemble all segments of the liner in the sequence (① → ② → ③) shown in Figure-28, with the liner holder, the liner bolt, and the liner washer. (See Figure-29.)

For the Liner of 24" or more, two persons shall cooperate with each other to install the liner. Be extra cautious not to drop the segment(s).

**CAUTION**

The above instructions must be followed to avoid hand and foot injuries. If not, the Liner may drop on your foot or pinch your hand.

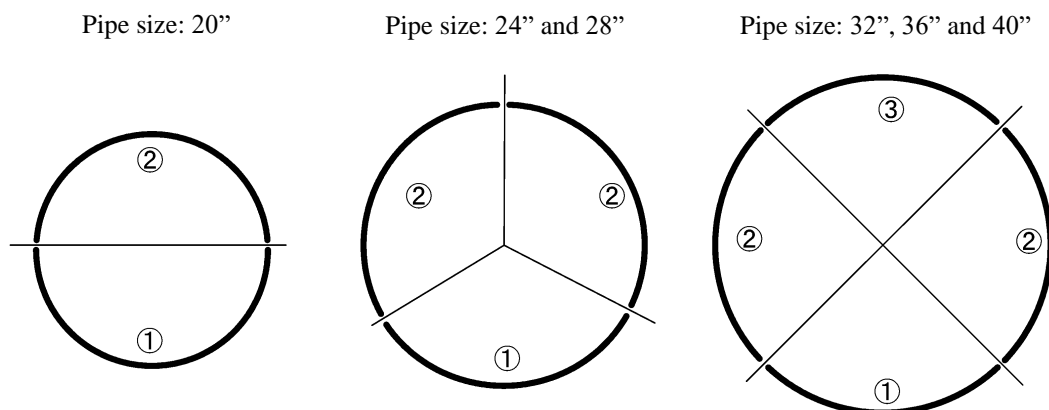


Figure-28 How to assemble the liner

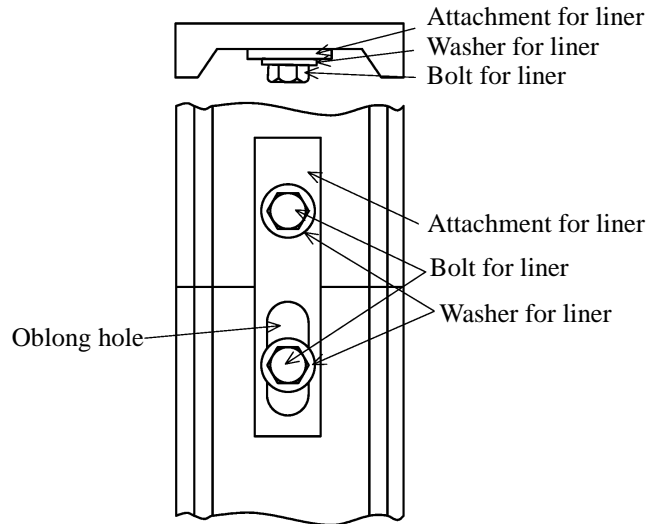


Figure-29 Attachment for liner, washer for liner and bolt for liner

(3) Aligning the Liner

- 1) Center the Liner with the centering screws (hex-key head stud bolts). Face the hex-key head of the screws on top to center the Liner. Place wedges underneath the lower segment of the Liner to position the Liner at the center before centering the Liner. (See Figure-30.)

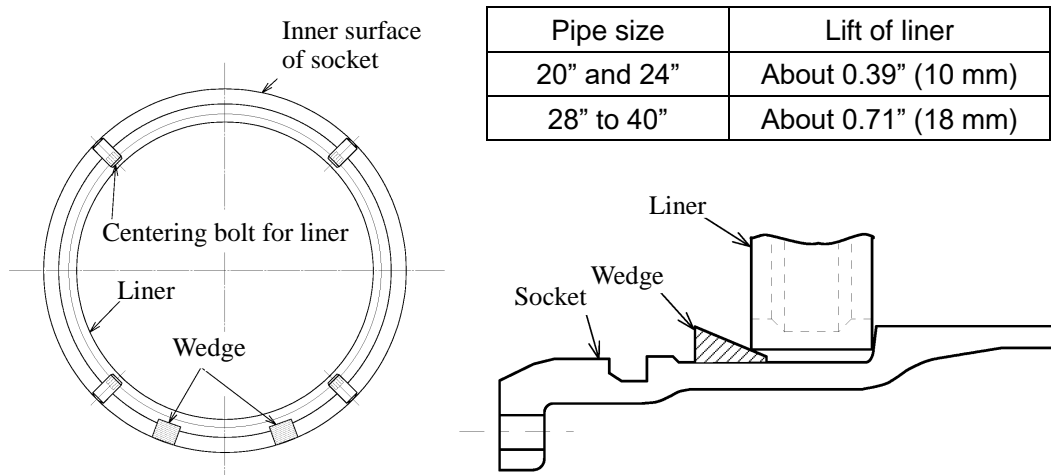


Figure-30 Prepositioning the liner with wedges (for reference)

- 2) Check the clearance around the Liner while centering the Liner with the screws (use a hex-key wrench). Maintain the uniform clearance around the Liner by checking vertical and horizontal measurements between the socket and the Liner. Ensure the vertical and horizontal clearance difference is within 0.08" (2 mm).
- 3) Remove wedges after centering if the Liner is wedged. Double-check that the vertical and horizontal clearance is within 0.08" (2 mm).
- 4) Finalize the installation by checking that the entire Liner is positioned against the socket bottom and that all centering bolts are in contact with the socket. (See Figure-31.)

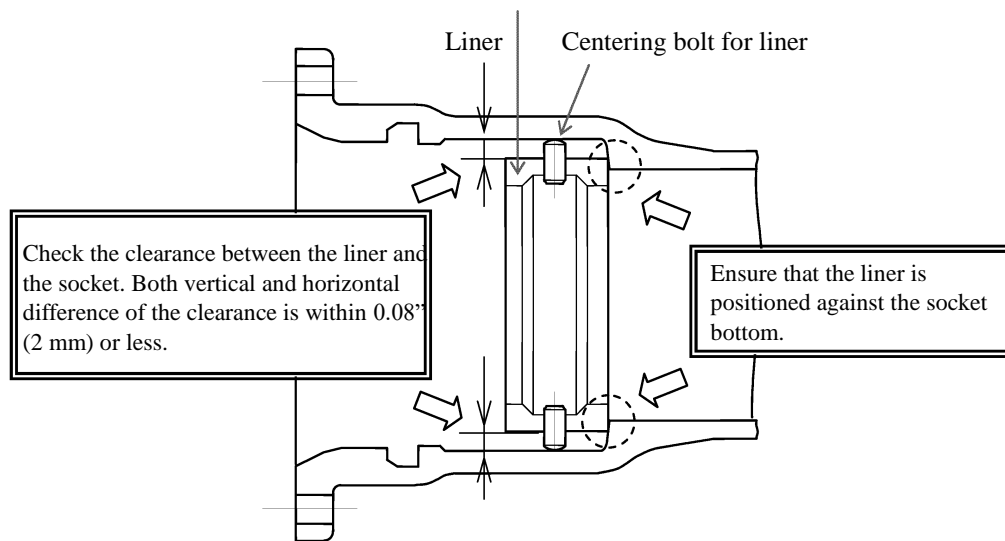
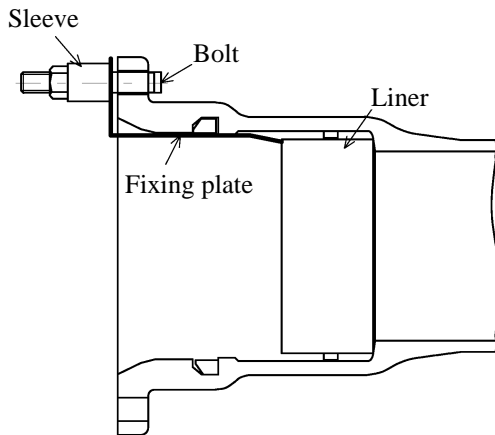


Figure-31 How to check the liner



CAUTION The joint function may not be fulfilled if the above instruction is not followed.

- 5) If the socket is tilted downward, the liner may fall from the socket. Retain the Liner in place with the Liner fixing jigs (consisting of the fixing plate, the sleeve, the bolt and the nut). (See Figure-32.)
Remove the liner fixing jigs after the spigot has been inserted into the socket.



Pipe size	Number of liner fixing jig used for installation
20"	2
24" and 28"	3
32" to 40"	4

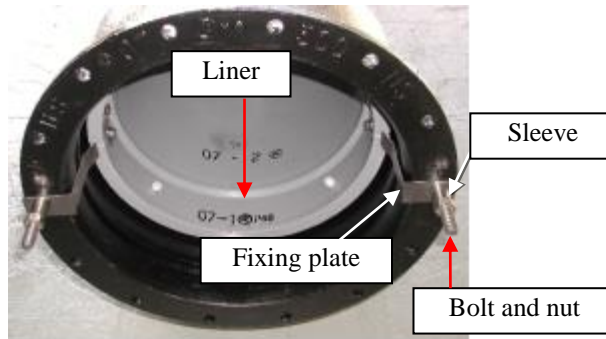


Figure-32 Liner fixing jigs



CAUTION

If the above instruction is not followed, the Liner may fall, resulting in a serious injury.

- (4) Follow "3. Installing the lock ring" through "4. Installation of the rubber gasket and backup ring" in "II. NS Pipe assembly procedure".
- (5) Follow "1. (2) Marking the depth of spigot insertion" through "1. (4) Checking the lock ring position" in "III. NS Fitting assembly procedure". Figure-33 shows where to mark white lines on the spigot to confirm the insertion depth.

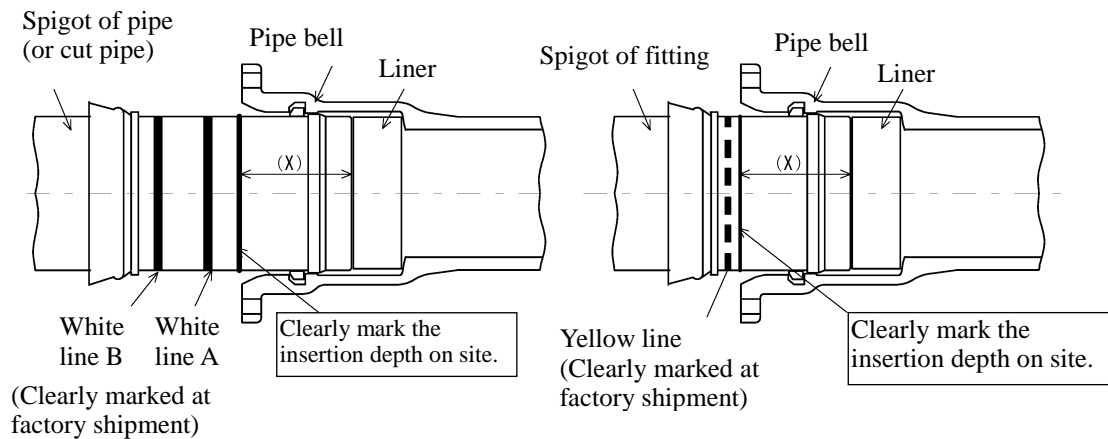


Figure-33 Marking of insertion depth

**CAUTION**

Mark the insertion depth on the spigot. Otherwise, insertion depth cannot be verified, and insertion can be insufficient. The pullout resistance function may fail if the spigot projection is not inserted beyond the lock ring due to insufficient insertion.

- (6) Follow "7. Installation of Backup ring" through "12. Joint check sheet" in "II. NS Pipe assembly procedure".

V. Connecting two pipes with collar

1. Connecting two pipes directly with collar

- (1) Install the rubber gasket and backup ring on the spigot of the previous pipe (already installed pipe) and the spigot of the next pipe (pipe to be connected to the laid pipe). (See Figure-34 (a).)
- (2) Expand the lock ring of the collar on the side of the previous pipe with the stopper. And then, install the collar on the previous pipe, and pull out the stopper. (See Figure-34 (b).)
- (3) Expand the lock ring of the collar on the side of the next pipe with the stopper. And then, insert the next pipe to the collar, and pull out the stopper. (See Figure-34 (c).)
- (4) Adjust the distance (L' in Table-10) between the socket end and white line B on the spigot. (See Figure-34 (d).)
- (5) Assemble the joints of the collar with the same procedure as pipes. (See Figure-34 (e).)

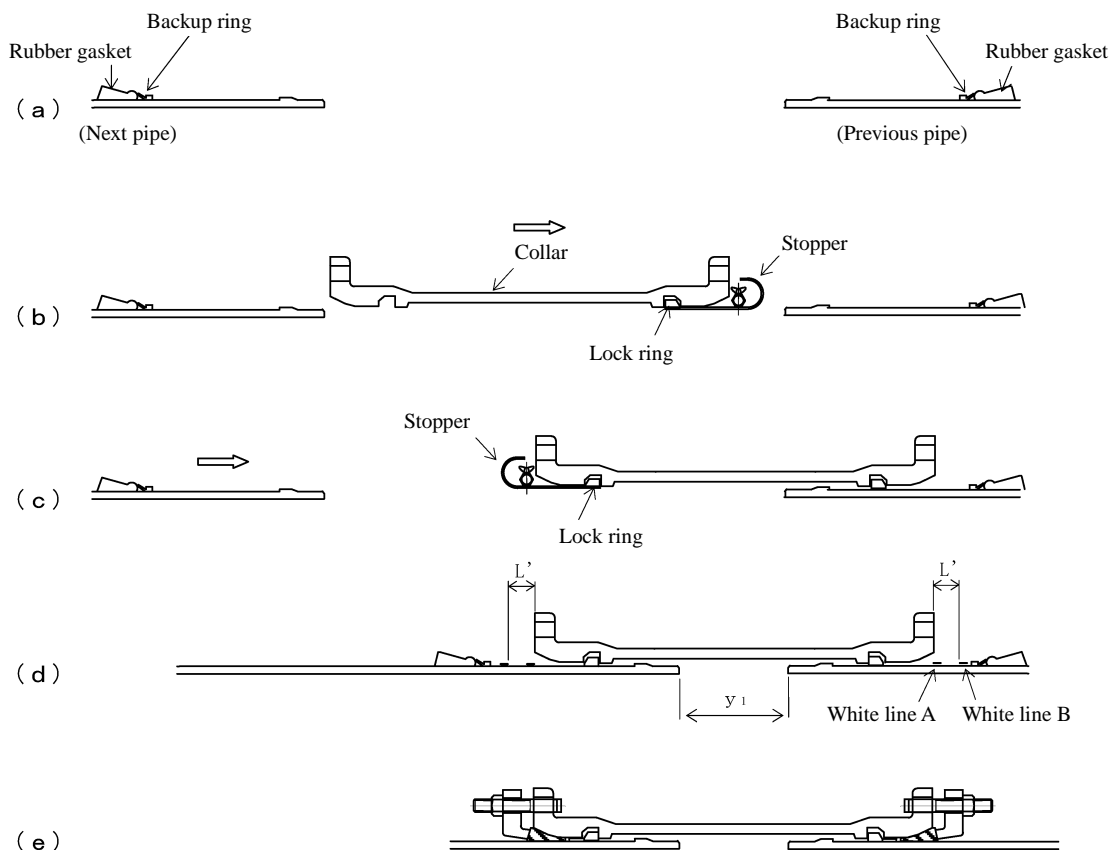
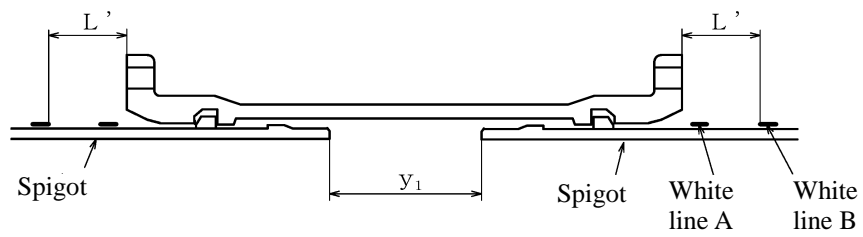


Figure-34 Connecting two pipes with collar (installing pipes sequentially from one side)

Table-10 Collar position

Pipe size	y_1	L'
20"	10.2" (260 mm)	4.1" (105 mm)
24"	10.2" (260 mm)	4.1" (105 mm)
28"	11.8" (300 mm)	3.4" (87 mm)
32"	12.0" (305 mm)	3.9" (98 mm)
36"	12.0" (305 mm)	3.9" (98 mm)
40"	12.2" (310 mm)	4.1" (103 mm)



2. Connecting two pipes for a tie-in with collar

- (1) Ensure that the previous pipe and the next pipe are aligned.



CAUTION If the previous pipe is misaligned with the next pipe, the connecting may fail.

- (2) Install the rubber gasket and backup ring on the spigot of the previous pipe.
- (3) Remove the lock ring of the collar on the side of the next pipe.
- (4) Expand the lock ring of the collar close to the previous pipe with the stopper. And then, install the collar on the previous pipe and pull out the stopper. (See Figure-35 (a).)
- (5) Install the rubber gasket and the backup ring on the spigot of the next pipe. And then, align the next pipe with the previous pipe keeping the distance between the two pipes at y_1 in Table-10. (See Figure-35 (b).)
- (6) Slide the collar to the position shown in Figure-35 (c), and put the lock ring inside the socket of the collar close to the next pipe. The lock ring easily enters the socket inside if it is squeezed with a lashing belt or the like. (See Figure-36.)



CAUTION

When squeezing the lock ring with a lashing belt, wind the belt around the lock ring tightly so that the belt will not be removed from the lock ring. If the belt has been removed, the squeezed lock ring may get released and pinch your hand or finger.

- (7) Expand the lock ring of the collar on the side of the next pipe with the stopper. After that, slide the collar onto the next pipe and pull out the stopper. (See Figure-35 (d).)
- (8) Assemble the joints of the collar with the same procedure as pipes. (See Figure-35 (e).)

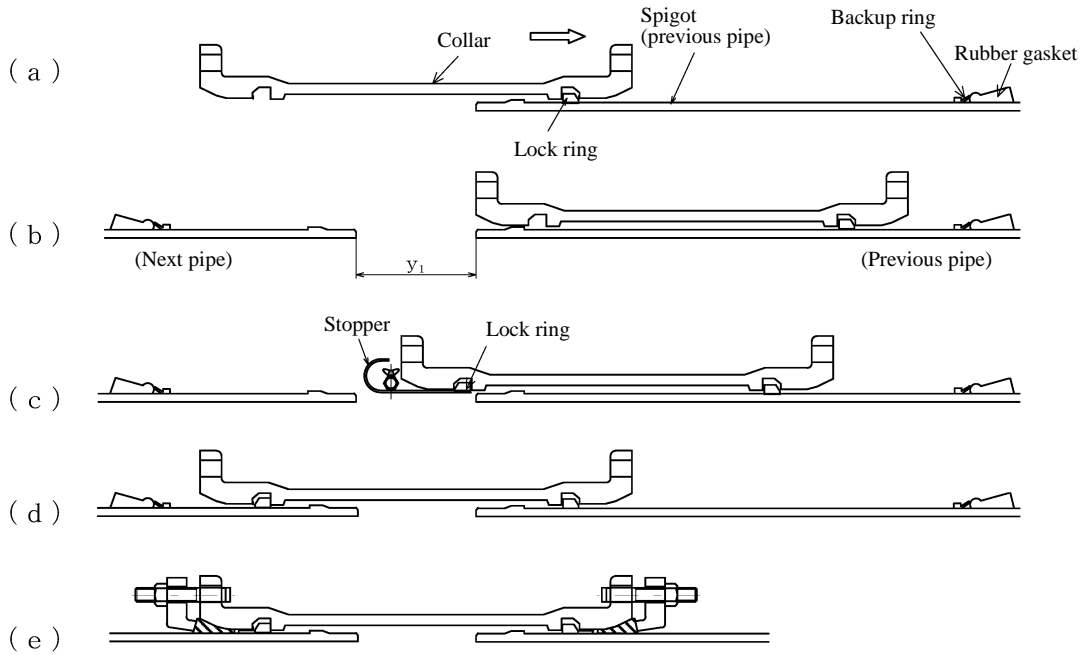


Figure-35 Connecting two pipes to tie in with collar

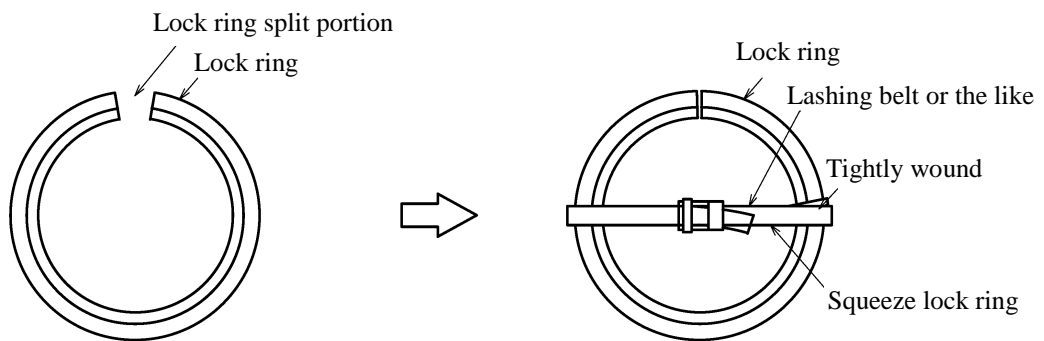


Figure-36 Squeezing lock ring

3. Precautions

- (1) The allowable deflection angle of the collar is the same as that of pipe.
- (2) Fittings must NOT be connected to collar.



CAUTION It will lead to leaks to connect the collar with the fittings.

- (3) Do not pull out the stopper until the spigot projection passes through the lock ring.

VI. Plug jointing procedure

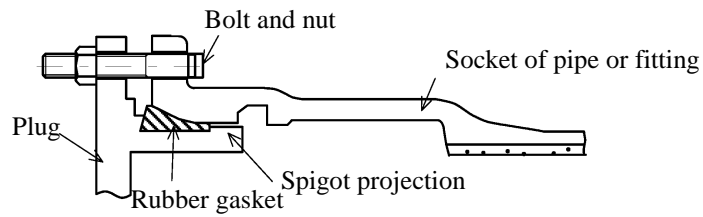


Figure-37 Structure of plug

Place a rubber gasket on the plug. (See Figure-38.)

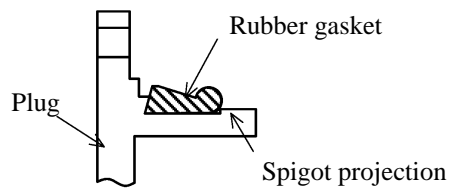


Figure-38 Rubber gasket of plug

Insert the plug to the socket and tighten the T-head bolts and the nuts. To connect the plug, neither the backup ring nor the lock ring is needed.

VII. Pipe cutting procedure

1. Pipe cutting and grooving

- (1) When cutting a pipe, use a pipe designated for cutting which is called "gauged pipe." The gauged pipe can be identified by a white line marked around the socket neck. If the gauged pipe is not available, measure the pipe's outer periphery and outer diameter at the portion to be cut and confirm the outer periphery and outer diameter are within the range of dimensions in Table-11.

Table-11 Outer diameters and lengths of outer periphery of NS-type ductile iron pipe

Pipe size	Outer diameter	Outer diameter tolerance ¹⁾	Outer diameter range	Outer peripheral length range
20"	20.79" (528 mm)	±0.08" (±2 mm)	20.71–20.87" (526–530 mm)	65.08–65.55" (1653–1665 mm)
24"	24.83" (630.8 mm)		24.76–24.91" (628.8–632.8 mm)	77.80–78.23" (1976–1987 mm)
28"	28.86" (733 mm)	+0.08" (+2 mm) -0.12" (-3 mm)	28.74–28.94" (730–735 mm)	90.31–90.91" (2294–2309 mm)
32"	32.91" (836 mm)		32.80–32.99" (833–838 mm)	103.0–103.6" (2617–2632 mm)
36"	36.97" (939 mm)		36.85–37.05" (936–941 mm)	115.8–116.4" (2941–2956 mm)
40"	40.98" (1041 mm)		40.87–41.06" (1038–1043 mm)	128.4–129.0" (3261–3276 mm)

- 1) If the outer diameter calculated from the measured outer periphery is within the range of the above Table, the outer diameter as shown in the column "outer diameter range" in Table-11 is further tolerated on the negative side by 0.02" (0.5 mm) for 20" and 24" pipe, and 0.04" (1.0 mm) for 28" to 40" pipe.



CAUTION If the outer diameter and outer peripheral length of the pipe are out of the specified range, it will cause the joining failure or leak.

- (2) When the spigot of the cut pipe is connected to the socket of pipe, it is necessary to form the spigot projection by grooving the spigot end and installing the spigot ring for cut pipe in the groove (Figure-39).

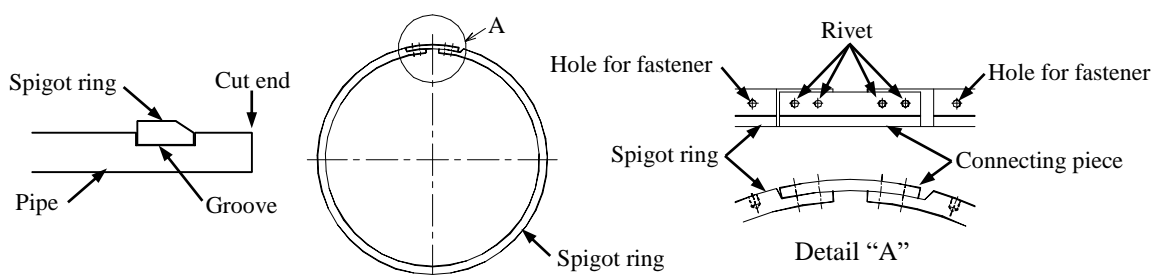
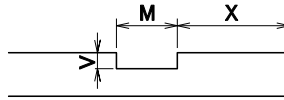


Figure-39 Spigot ring for spigot projection

- (3) Cut the pipe into the required length and groove the spigot with the designated machine such as Keel cutter. The position and dimensions of the groove are shown in Table-12.

Table-12 Position and dimensions of groove



Pipe size	V		M		X	
20" and 24"	0.12" (3 mm)	+0.04" (+1.0 mm)	0.87" (22 mm)	+0.06" (+1.5 mm)	1.57" (40 mm)	±0.08" (±2 mm)
28" to 36"	0.16" (4 mm)	-0.02" (-0.5 mm)	1.06" (27 mm)	-0.02" (-0.5 mm)	2.17" (55 mm)	±0.16" (±4 mm)
40"	0.20" (5 mm)	-0.02" (-0.5 mm)	1.26" (32 mm)	-0.02" (-0.5 mm)	1.97" (50 mm)	±0.16" (±4 mm)

- (4) Bevel the corner of the groove and the cut end of the pipe with a file or a grinder.
 (5) Apply suitable coating to the exposed iron at the groove and the cut end of the pipe. If the cement mortar lining is damaged at the cut end, repair the damaged lining.

2. Installing spigot ring for cut pipe

- (1) Confirm that there are no foreign materials such as sand in the groove of the spigot.
 (2) Put a spigot ring in the groove on the spigot. Using a spigot ring fastener, make the spigot ring fixed in the groove. (See Figure-40.)

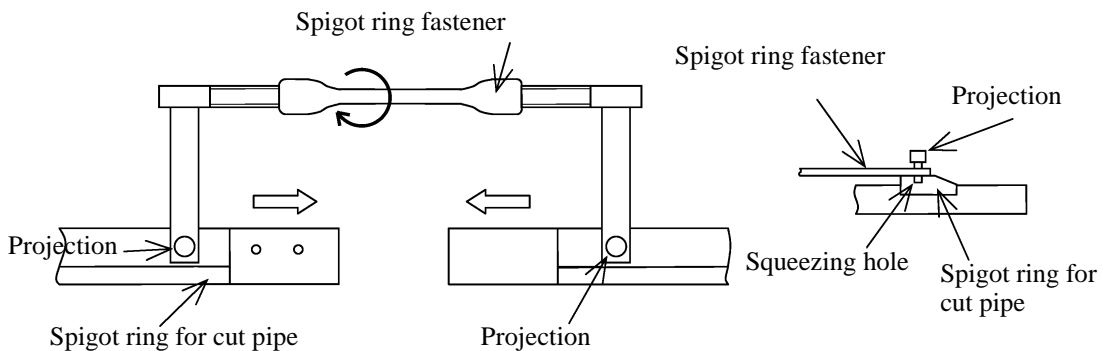


Figure-40 Spigot ring fastener

- (3) Tamp the spigot ring lightly with plastic head hammer until the tapered side touches the wall of the groove at the spigot end side (see Figure-41).

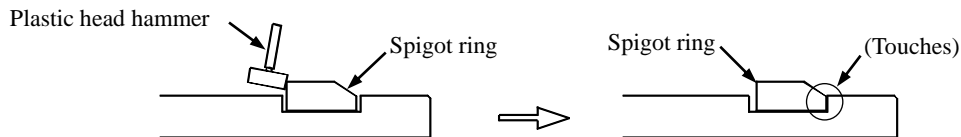


Figure-41 Correct position of spigot ring in the groove

- (4) Confirm by hand that the spigot ring does not move laterally and circumferentially. If the spigot ring moves, re-install it again. Also, confirm that there a 0.02"-thick gauge cannot go under the spigot ring.
- (5) Attach the connecting piece on the spigot ring by inserting the rivets into the holes of spigot ring and connecting piece (①, ② of Figure-42). Fix the spigot ring and the connecting piece with a clamp. Mark the riveting positions on the spigot ring by drilling shallow holes with drilling machine through the holes of the connecting piece (③, ④ of Figure-42). Use 0.130" (3.3 mm) or 0.134" (3.4 mm) diameter drill for 20" and 24" pipe, and 0.161" (4.1 mm) or 0.165" (4.2 mm) diameter drill for 28" to 40" pipe.

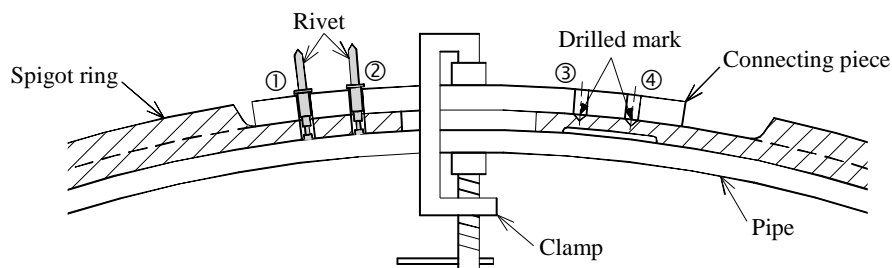


Figure-42 Assembly of spigot ring

- (6) Remove the clamp and then take out the spigot ring from the groove of the spigot.
Drill two penetrated holes on the spigot ring at the drilled mark (③ and ④ of Figure-42).
- (7) Confirm that there are no foreign materials such as sand in the groove of the spigot and on the spigot ring.
Put the spigot ring in the groove of the spigot, and then fix it to the groove by spigot ring fastener in accordance with above (2) to (4).
- (8) Align the drilled holes on the spigot ring and the connecting piece and then insert the rivets into the holes of the spigot ring and connecting piece. Fix them with a clamp to the groove, and then rivet them in the order of Figure-43 (①, ②, ③ and ④). Repeat to squeeze the handle trigger of the riveter until the rivet attaches.

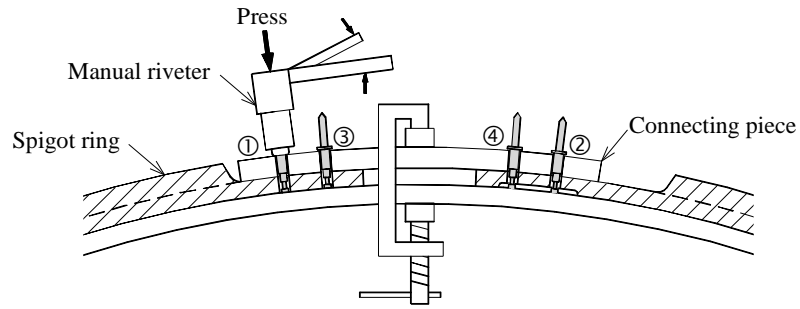
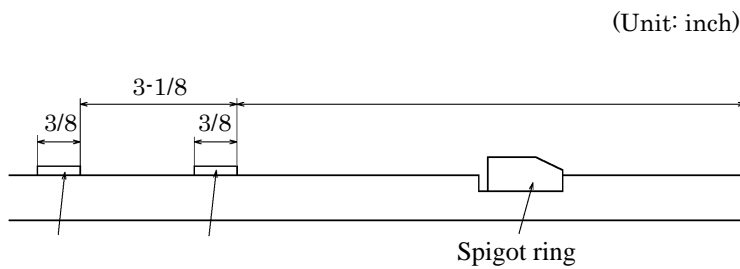


Figure-43 Riveting of spigot ring and connecting piece

(9) Remove the clamp. Confirm by hand that the spigot ring does not move circumferentially and laterally. If the spigot ring moves, re-install it again.

(10) Clearly indicate the white lines A and B on the spigot. (See Figure-44)



Pipe size	L ₁
20"	8.7" (220 mm)
24"	8.7" (220 mm)
28"	10.1" (257 mm)
32"	10.4" (265 mm)
36"	10.4" (265 mm)
40"	10.6" (268 mm)

Figure-44 Indicating white lines on the spigot

VIII. Disassembling procedure

(1) Bolt removal

- 1) For 20" and 24" pipe, holding each part of gland by hand, remove the bolts and the nuts except ones at the connecting part portion of the gland. After that, remove the bolts and the nuts at the connecting part of the gland. (See Figure-45.)

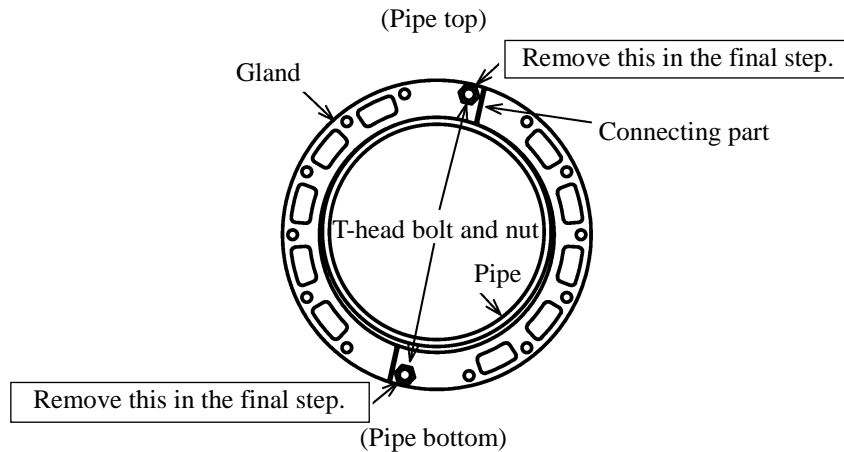


Figure-45 Removing gland (for 20" and 24" pipe)



CAUTION

The above instructions must be followed to avoid hand and foot injuries. If not, the gland may drop on your foot or pinch your hand.

- 2) For 28" to 40" pipe, remove the bolts and the nuts at the connecting part (on the pipe top and bottom) first, and then connect the two parts of the gland with these bolts and nuts at the connecting part as shown in Figure-46. After that, remove the remaining bolts and nuts.

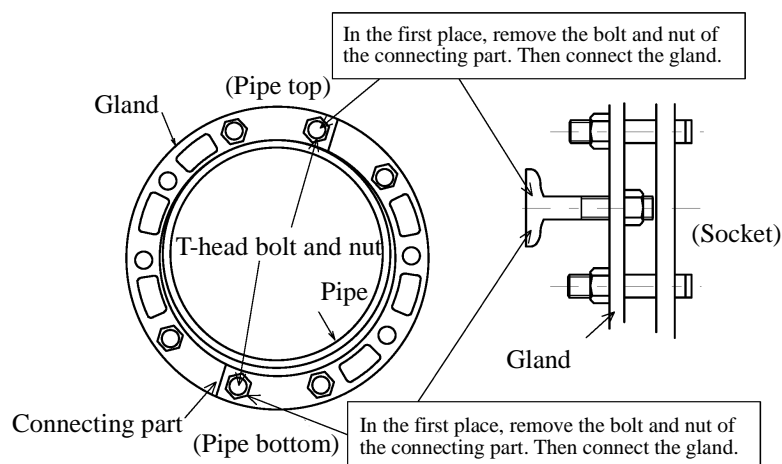


Figure-46 Removing gland (for 28" to 40" pipe)

**CAUTION**

If the above instruction is not observed, the gland may overturn or fall down, and your hand or foot may be pinched.

Slide the gland away from the socket with the bolts and nuts left at the connecting part. Make sure not to damage the bolts.

- (2) Remove the rubber gasket and the backup ring. Do not use them for jointing work again. If you use them again, it will lead to leaks.
- (3) As illustrated in Figure-47, drive a slotted head screwdriver in between the lock ring and the spigot, and then insert approximately six thin plates for disassembly into the clearance in the circumferential direction. The thin plates shall be inserted beyond the spigot projection.

The spigot should be pulled out a little to locate the spigot projection close to the lock ring so that it is easier to insert the thin plates.

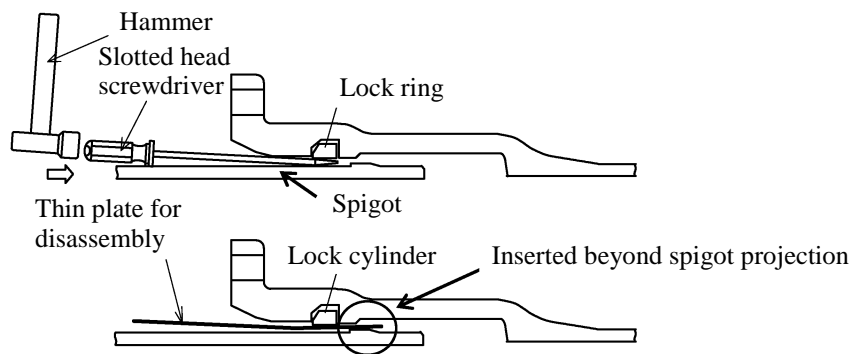


Figure-47 Inserting thin plates for disassembly

- (4) Align the pipe with a crane, and then pull it out. (See Figure-48.)

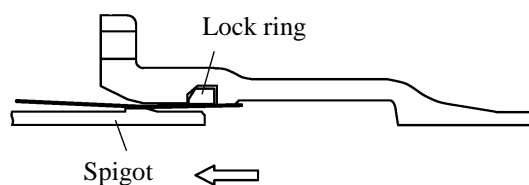


Figure-48 Pulling out the pipe

- (5) When disassembling the joint with a liner inside the socket, pull out the pipe first, and then disassemble the liner and remove it from the socket or take measures to ensure that the liner does not fall from the socket before lifting up the pipe.
- If the socket faces downward, never stand under the socket as the liner may fall from the socket when pulling out the pipe.

**CAUTION**

The above instructions must be followed to avoid the serious injuries. If not, the liner may drop on you.

- (6) When removing the plug from the dead end of pipeline, take the following procedures:

For a plug with a bolt for vent and drain

- 1) Loosen the bolt for vent and drain until the air starts escaping and the internal air pressure reduces. After that, remove the bolt.
- 2) After confirming that the pressure inside the pipe is reduced, remove the plug.

For a plug without a bolt for vent and drain

- 1) Replace the bolts of the plug with approximately 2" (50 mm) longer bolts than the specified dimension, and tighten them. When replacing the bolts, do it one by one.
- 2) After replacing all the bolts, loosen the bolts and the nuts uniformly by 0.16" to 0.20" (4 mm to 5 mm).
- 3) If the plug is not moved by the pressure inside the pipe, insert a crowbar between the plug and the socket end face, and pry the plug.
- 4) Repeat the steps 2) and 3) until the air starts escaping and reduce the internal pressure sufficiently.
- 5) After confirming that the pressure inside the pipe is reduced, remove the plug.

Do not stay in front of the plug during the above procedures.

**CAUTION**

The above instructions must be followed to avoid serious disasters due to the plug or other parts discharged by internal pressure.

Annex

Special Tools for NS Joint

	Description	Quantity	Remarks
NS			
Assembly/disassembly	(1) Lock ring expander (NS-type)	1	
	(2) Lock ring stopper (NS-type)	1	
	(3) Insertion rod	1	
	(4) Combination wrench (19 mm)	1	
	(5) T handle socket wrench (10 mm)	1	
	(6) Impact wrench (1/2 in drive)	1	
	(7) Impact socket	1	
	(8) Universal impact joint (Swivel)	1	
	(9) Ratchet wrench (30 mm)	1	
	(10) Torque wrench (140 N-m)	1	
	(11) Torque wrench socket (30 mm)	1	
	(12) Flat head driver	2	for disassembly
	(13) Thin plate shim	6	for disassembly
Field cutting/grooving	(14) Keel cutter N600	1	
	(15) Guide ring	1	
	(16) Cutting wheel	1	
	(17) Grooving wheel	1	
	(18) Pipe roller	4	
	(19) Water tank	1	
	(20) Spigot ring fastener	1	
	(21) Stainless steel ruler (0.5 mm)	1	
	(22) Clamp (2 in)	1	
	(23) Drill bits (1/8 in)	1	Drilling machine to be provided by user.
	(24) Riveter	1	
	(25) Plastic head hammer	1	
	(26) Steel head hammer	1	