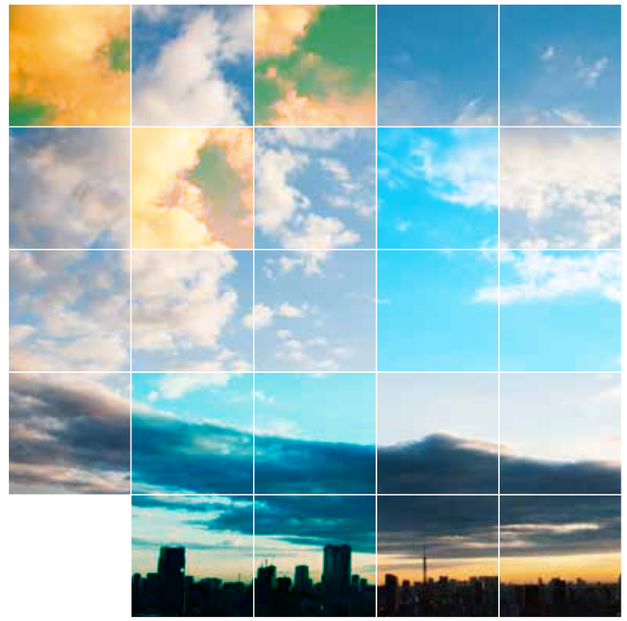
Utilizing 70% post-consumer recycled paper pulp

For Earth, For Life

Kubota



KUBOTA
DUCTILE IRON PIPE

Kubota

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E-mail : kbt_g.ironpipe@kubota.com

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ERDIP Dept. / LA Office

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Ductile Iron Pipes WEBsite

Facebook

Cat.No.0100 Printed in Japan. '22.7. KES

CONNECT TO THE FUTURE

COMPANY PROFILE

Corporate Name
KUBOTA Corporation

Established
1890

Capital
￥84.1 billion（as of April 25,2017）

Revenues (Consolidated)
￥1,596.1 billion
（Fiscal Year ended December 31,2016）

Number of employees(Consolidated)
38,291（as of December 31, 2016）
**The number of full-time employees.*

CONTENTS

KUBOTA PIPELINE SYSTEM

Drainage Pump with Vehicle

Ductile Iron Water Well Casing Pipe

Ductile Iron Pipe (Earthquake Resistant Joint)

FCC Slide Valve

Double Disc Wedge Gate Valve

Dam

Water Treatment Plant

Water System

Sewage System

Refinery Plant
Petrochemical Plant

Seawater Desalination Plant

Sewage Treatment Plant

Lifting Pumping Station

Vertical Mixed Flow Pump

Double Suction Volute Pump

Butterfly Valve

Resilient Seated Gate Valve

Ductile Iron Pipe

Vertical Shaft Volute Type Mixed Flow Pump

Ductile Iron Pipe (Jacking Pipe)

High Pressure Pump

KUBOTA'S HISTORY WITH DUCTILE IRON PIPE

KUBOTA 48 inch pipes & valves, Osaka city, Japan. (1914)

History

1890	Established as a foundry. Started production of castings for weighting equipment and daily commodities.
1893	Started production of cast iron pipe for water supply.
1897	Changed the corporate name from Oide Chuzo-jo (Oide Foundry) to Kubota Tekko-jo (Kubota Iron Works). Started production of waterworks equipments such as fire hydrant and gate valve.
1917	Supplied cast iron pipes and valves to Indonesia, our first experience of export.
1930	Developed high-grade cast iron.
1941	Started production of centrifugal cast iron pipe.
1954	Started production of Ductile Iron pipe.
1957	Started production of centrifugal Ductile Iron pipe.
1971	Started production of the world's largest DN2600 pipe.
1982	Started production of the world's longest 9-meter length pipe.
1985	Produced the world's largest DN2900 pipe.
1990	Celebrated our 100th year in business. Changed the corporate name to KUBOTA Corporation.
2009	Started production of restrained joint pipe (TLH-type).
2012	Supplied Earthquake Resistant Ductile Iron Pipe (ERDIP) to the United States.
2014	Supplied a huge number of Ductile Iron pipe to Mega Reservoir Project in Qatar, one of the Middle East's largest water supply project.

Founder of KUBOTA Group
Gonshiro Kubota (1870-1959)

PLANT INFORMATION

Where the world's largest DN2600 Ductile Iron pipe is manufactured.

Hanshin Plant

Site area
Main Plant
141,000m^2
Marushima Factory
159,000m^2
Amagasaki Plant
54,000m^2

Employees
850

Production capacity
Pipe 20,000 ton / month
Fitting 550 ton / month

Main products
Pipe DN75 to DN2600
Fitting DN900 to DN2600

(as of January 1, 2016)

Where the world's longest 9-meter length Ductile Iron pipe is manufactured.

Keiyo Plant

Site area
Main Plant
300,300m^2
Logistics center
142,000m^2

Employees
439

Production capacity
Pipe 17,000 ton / month

Main products
Pipe DN75 to DN1500
9-meter length pipe DN600 to DN1600

(as of January 1, 2016)

Certificates

Both Hanshin Plant and Keiyo Plant are ISO 9001 and ISO 14001 certificated.

ADVANTAGES OF DUCTILE IRON PIPE

Ductile Iron

Ductile iron is a family of cast iron. The difference between ductile iron and cast iron is in the graphite formation in the metal. Cast iron is characterized by a random flake graphite pattern. In ductile iron, the graphite form is small spheroids rather than flakes. This creates fewer discontinuities in the structure of the metal and produces a stronger ductile iron.

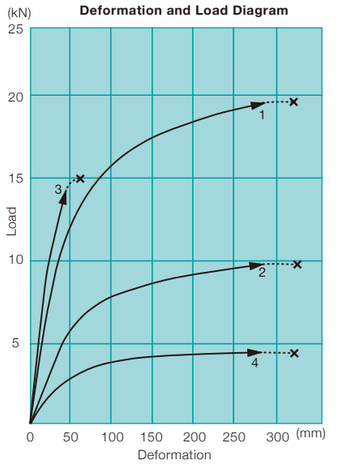
Microstructure of ductile cast iron (left) and cast iron (right).

1. Tough and Strong

Ductile Iron pipe has excellent strength and ductility. It is flexible and will not crack even if passably deformed. It is suitable for high pressure or under main road pipeline.

Mechanical properties

	Ductile iron Pipe	Cast Iron Pipe	Steel Pipe
Tensile Strength(N/mm)²	min.420	150-260	min.400
Bending Strength(N/mm)²	min.590	200-360	min.400
Elongation(%)	min.10	Negligible	min.18
Modulus of Elasticity(N/mm)²	15-17x10⁴	10-12x10⁴	approx.20x10⁴
Hardness(HBW)	max.230	max.230	approx.140



Ring action strength

(mm)

No.	Pipe Material	Wall Thickness
1	Ductile Iron Pipe	18
2	Ductile Iron Pipe	14
3	Cast Iron Pipe	23.5
4	Steel Pipe	10

DN1100×1,000mm long Pipe Ring

Beam action strength

DN	Pipe Material	Wall Thickness (mm)	Maximum Load (kgf)	Maximum Deflection (mm)	Span (m)	Remarks
100	Ductile Iron PIpe	6.0	>4,000	>400	3.6	No Collapse
	Cast Iron Pipe	7.5	3,500	135	3.6	Collapsed
150	Ductile Iron PIpe	6.0	>7,000	>450	4.8	No Collapse
	Cast Iron Pipe	8.0	6,600	150	4.8	Collapsed
200	Ductile Iron PIpe	8.0	>14,000	>450	4.8	No Collapse
	Cast Iron Pipe	8.8	12,700	125	4.8	Collapsed
250	Ductile Iron PIpe	6.0	>24,000	>400	4.8	No Collapse
	Cast Iron Pipe	9.5	21,000	100	4.8	Collapsed
300	Ductile Iron PIpe	5.5	>32,000	>450	5.8	No Collapse
	Cast Iron Pipe	10.0	23,200	130	5.8	Collapsed
400	Ductile Iron PIpe	7.0	>50,000	>130	5.8	No Collapse
	Cast Iron Pipe	11.5	46,900	100	5.8	Collapsed

2. Long-term Durability

Corrosion Resistance

Ductile iron is well known as a highly resistant material to corrosion all over the world. This is because ductile iron contains a certain amount of carbon and silicon.
For example, we found pipe body and cement mortar lining remained usable condition. There was no leakage after hydraulic pressure test. This proves that Ductile Iron pipe has corrosion resistance and long life service.
In addition, Ductile Iron pipeline is insusceptible to electric corrosion. This is because the rubber gasket set in every joint works as an insulator.

Chemical composition

(%)

	Ductile Iron Pipe	Cast Iron Pipe	Steel Pipe
Carbon	3.2-3.8	3.2-3.8	0.1-0.2
Silicon	1.7-2.7	1.4-2.2	0.15-0.4
Manganese	max. 0.4	0.4-0.6	0.3-0.6
Phosphorus	max. 0.1	max. 0.5	0.02-0.03
Sulfur	max. 0.02	max. 0.1	0.02-0.03
Magnesium	min. 0.02	-	-

The pipes after 53 years in service

The pipes are tested by hydraulic pressure.

Electric resistance of ductile iron and steel

	Electric Resistance(μ Ω·cm)
Ductile Iron	50～70
Steel	10～20

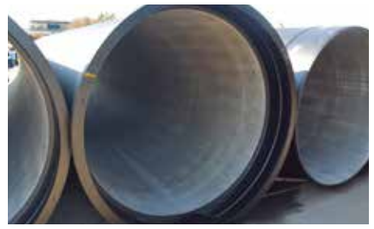
Internal Lining and External Coating

Internal cement mortar lining or epoxy coating, and external zinc and bitumen synthetic resin coating work as corrosion protection systems of Ductile Iron pipe and fitting. Polyethylen sleeve also can be applied to ductile iron pipes to improve corrosion resistance.

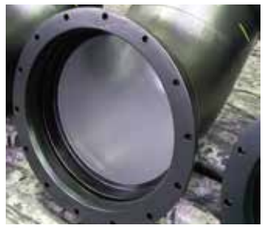
We continue developing new types of coating for higher corrosion resistance.

As a new type of superior corrosion protection method, “Zinc Alloy Coating” was developed. It is applied on the external surface of a pipe body, which brings excellent self-healing performance against scratches caused by transportation and handling. Zinc ions gradually dissolve out from the zinc alloy layer, and zinc compounds are formed on the scratched area. Thus, it prevents corrosion from proceeding. Duration of this sacrificial protection effect is much longer than that of normal zinc coating.

Upon request,other types of coating or lining may be applied.



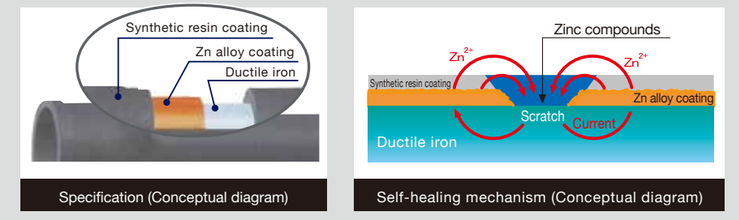
Cement mortar lining



Epoxy coating

External zinc and bitumen coating

Polyethylen Sleeve



Zinc Alloy Coating

ADVANTAGES OF DUCTILE IRON PIPE

3. Adaptability against Various Situations

Flexible Joint (See page 11)

A joint of Ductile Iron pipe is composed of a spigot and socket with a rubber gasket for sealing. It is flexible since it allows a certain amount of deflection, expansion and contraction. Because of its flexibility, small curves in a pipeline can be easily accommodated without use of bends. Furthermore, some ground movement can be also absorbed.

Restrained Joint (See page 11 and 12)

Restrained joints can be used to protect bends, tees or tapers from the thrust force caused by the internal pressure of a pipeline instead of using thrust concreate blocks.

Kubota has several types of Restrained Joint. The appropriate type is selected depending on the pipe diameter and operating pressure of a pipeline.

Earthquake Resistant Joint (See page 13 and 14)

Ground movement due to earthquake or soft ground could cause expansion and contraction forces and the bending moment to a pipeline. Kubota offers Earthquake Resistant pipe to withstand such ground undulations.
Pipeline with earthquake resistant joints is called Chain Structure pipeline. Even when large ground displacement occurs and one joint fully expands/contracts, the joint can pull/push the adjacent pipes one after another like a buried chain.

Kubota's Earthquake Resistant Ductile Iron Pipes (ERDIP) has had no documented damages or leaks in the past major earthquakes whose magnitude is larger than 6, including the 2011 Great East Japan magnitute 9.0 earthquake. The excellent performance of ERDIP is highly appreciated in many Japanese water agencies.

Besides the earthquake resistant purpose, Kubota ERDIP effectively performs against ground deformation and subsidence as “Pullout Prevention Pipe”.
Ground deformation occurs in such cases of landslide and uneven settlement/movement by underground structures and faults.Ground subsidence may occur in a tunnel construction for “subway”, mass transportation system.

Chain Structure pipeline can adjust ground deformation with joint deflection performance.

NS-type DN150 (6”) after landslide

Joint performance of ERDIP

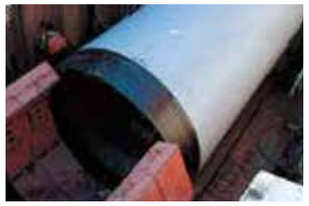
Property	Perforamce	ISO 16134
Amount of expansion/contraction	±1% of L*1	Class S-1
Slip-out resistance	3D kN*2	Class A
Joint deflection angle	6-8°*3	

*1:L is the nominal length, in millimetres (mm).
*2:D is the nominal dlameter of pipe, in millimetres (mm).
*3:The joint deflection angle differs depending on a pipe diameter.

Hanging test of earthquake resistant joint

Jacking Method (See page 12)

For road, railway and river crossing, Kubota offers special pipes for jacking method. This method enable to jack the pipe directly into the ground without sleeve pipes. As the result, the installation cost and time period can be reduced, and the installation work can be also carried out safely without disturbing traffic.



Jacking Method

Usage example

4. Easy and Quick Installation

There is no need of skilled operators/special tools for assembling ductile iron pipes. Ductile iron pipes can be also installed in the rain. Furthermore, ductile iron pipes can be immediately backfilled after its assembling.

In case of Push-on Joint (T-type), simply install a rubber gasket in the socket and apply lubricant paste both on the rubber gasket and the pipe spigot end. After alignment of the pipe, just insert the spigot end to the socket with lever hoists or a simple tool.

General assembling time

DN	T-type (min)	NS-type (min)
DN500	10	16
DN1000	20	24

*Source : Technical reference of Japan Ductile Iron Pipe Association

Jointing work of push-on joint (GX-type)

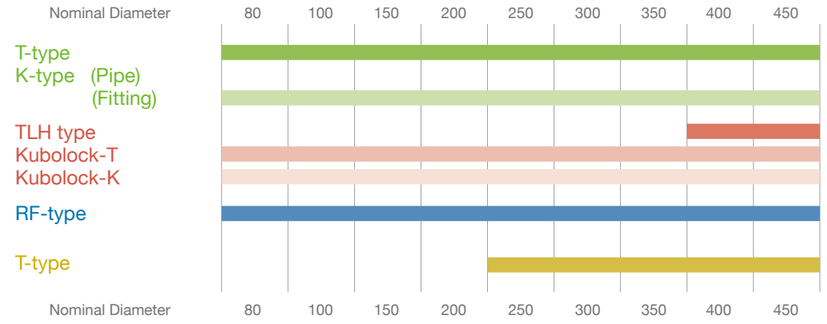
LINE UP

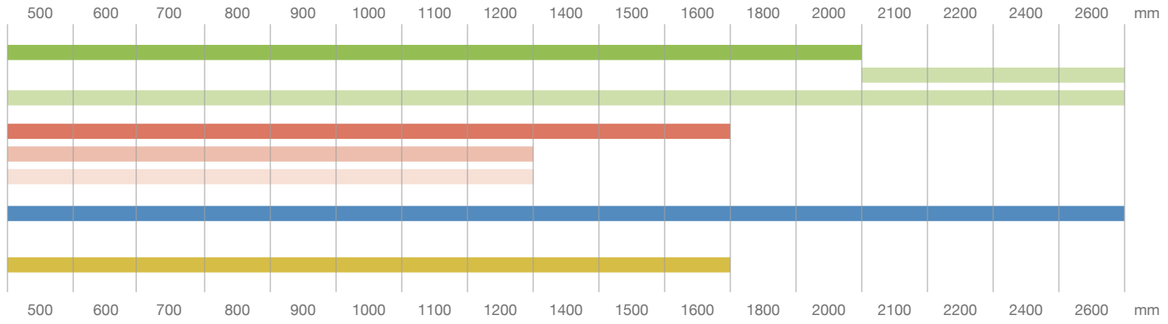
Flexible Joint

Restrained Joint

Flanged Joint

Jacking Pipe



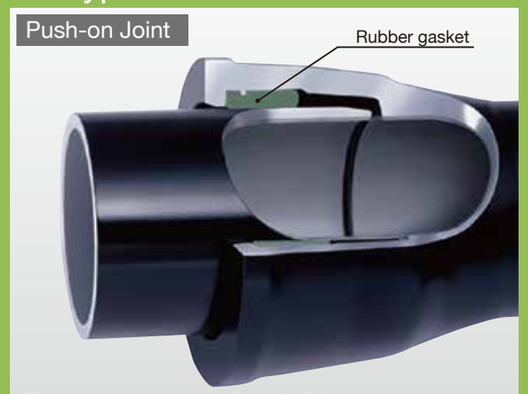


Flexible Joint

T-type

DN80-DN2000

Push-on Joint

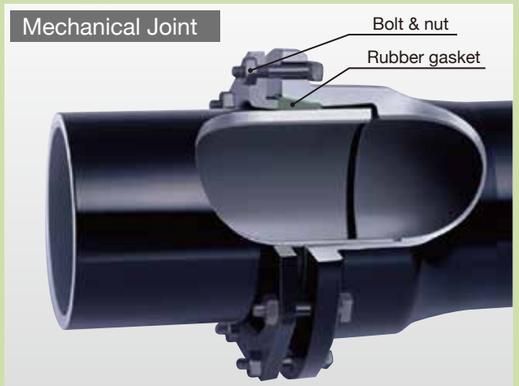


T-type joint is push-on joint. It has flexibility and excellent water tightness.

K-type

Pipe:DN2100-DN2600
Fitting:DN80-DN2600

Mechanical Joint

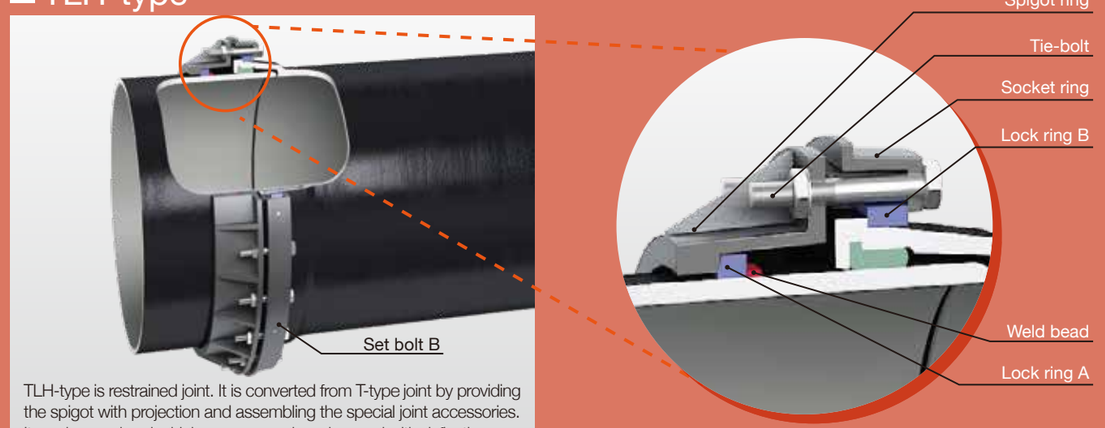


K-type joint is mechanical joint. It has flexibility and excellent water tightness.

Restrained Joint

TLH-type

DN400-DN1600

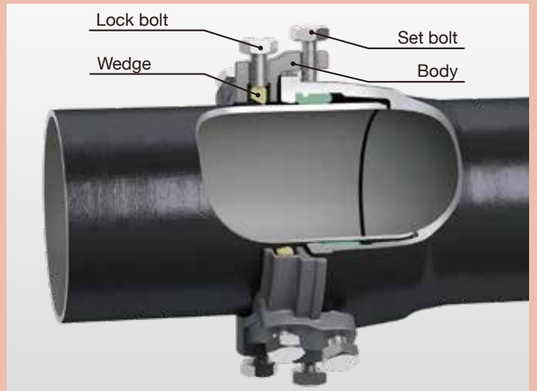


TLH-type is restrained joint. It is converted from T-type joint by providing the spigot with projection and assembling the special joint accessories. It can be used under high pressure and can be used with deflection.

Restrained Joint

Kubolock-T

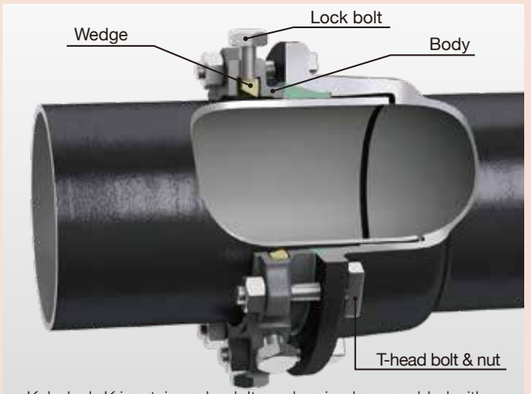
DN80-DN1200



Kubolock-T is restrained coupling. It can be simply assembled with T-type joint for restrained mechanism.

Kubolock-K

DN80-DN1200



Kubolock-K is retainer gland. It can be simply assembled with K-type joint for restrained mechanism.

Flanged Joint

RF-type

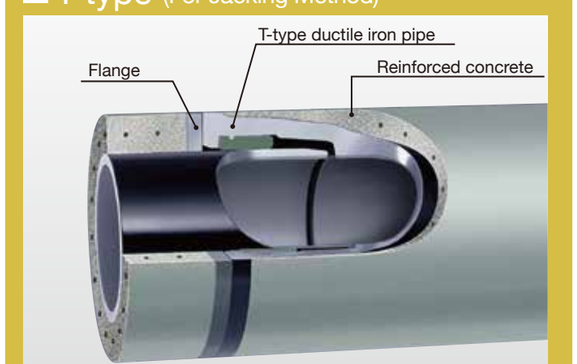
DN80-DN2600

RF type is rigid joint.
Generally, it is used to joint valves and other parts.

Jacking Pipe

T-type (For Jacking Method)

DN250-DN1600

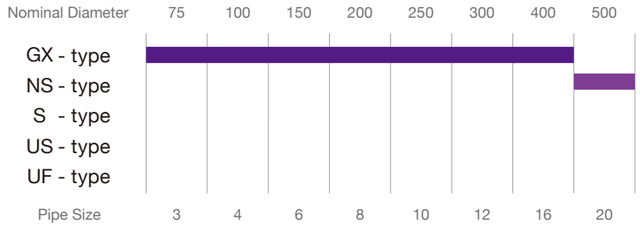


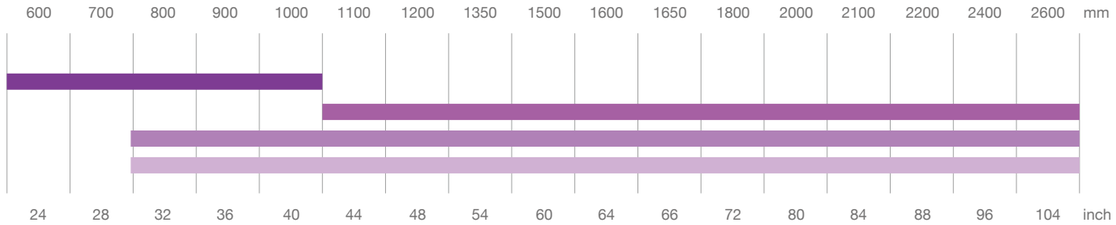
Jacking method is used to install a pipeline without trench excavation. Pipe is covered with reinforced concrete, which allows the pipe to be jacked directly into the ground without a pipe casing.

LINE UP

Earthquake Resistant Joint

The Earthquake Resistant Ductile Iron Pipe (ERDIP) absorbs the large ground displacement such as ground subsidence and crack by joints expansion/contraction, deflection, and anti-pull out structure.



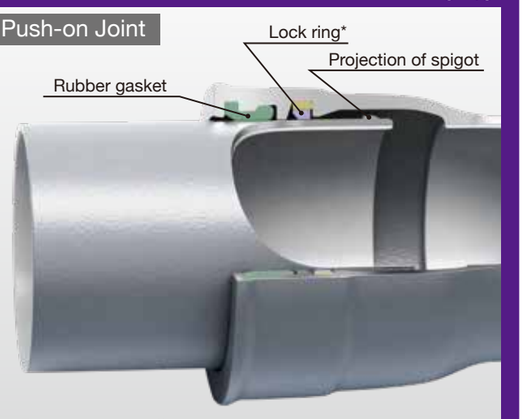


Pipes

GX-type

DN75-DN400
3"-16"

Push-on Joint



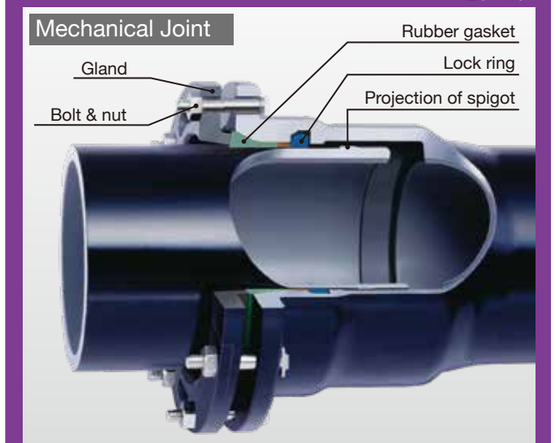
*External coating: C-protect

*Lock ring is preset.

NS-type

DN500-DN1000
20"-40"

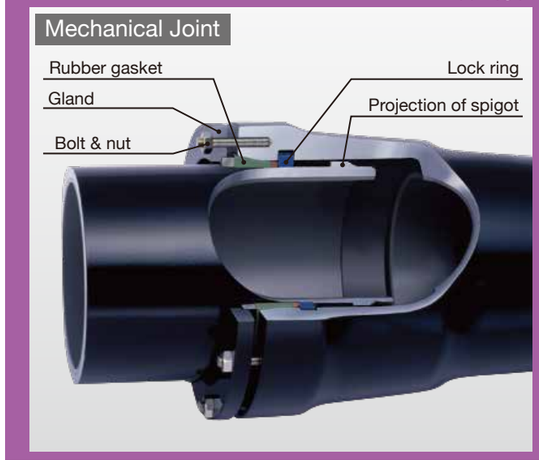
Mechanical Joint



S-type

DN1100-DN2600
44"-104"

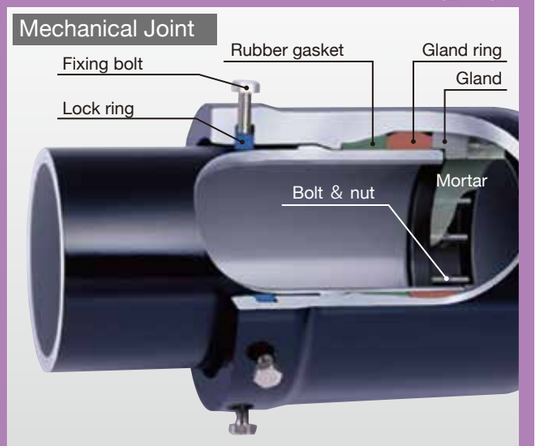
Mechanical Joint



US-type

DN800-DN2600
32"-104"

Mechanical Joint

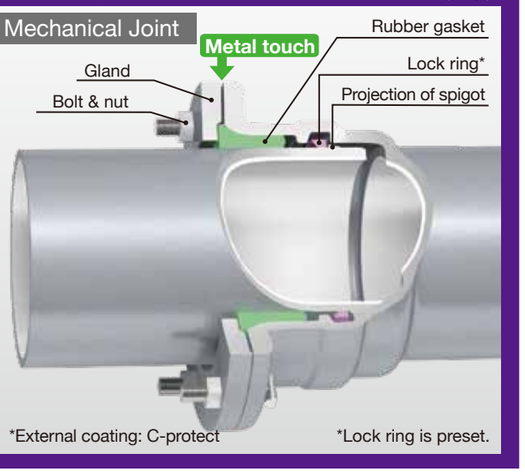


Fittings

GX-type

DN75-DN400
3"-16"

Mechanical Joint



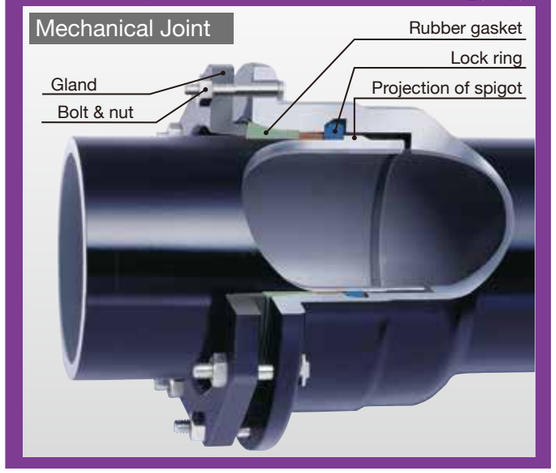
*External coating: C-protect

*Lock ring is preset.

NS-type

DN500-DN1000
20"-40"

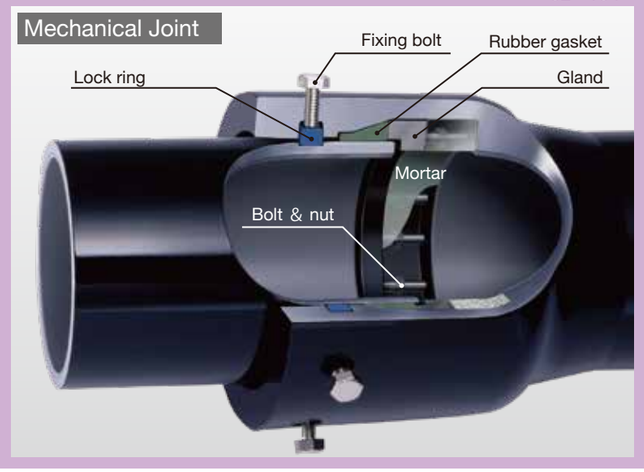
Mechanical Joint



UF-type

DN800-DN2600
32"-104"

Mechanical Joint



MANUFACTURING PROCESS AND QUALITY CONTROL

Pipe Casting

Selection of Material

-Best raw materials (pig iron, steel scrap, coke, limestone, etc.) are selected for casting ductile iron pipes.

Melting in Hot Blast Cupola

Composition Adjustment

-If the composition of molten iron is outside the standards, it will be adjusted by adding alloy and other elements.

Desulfurization

-Calcium carbide (CaC2) is added to molten iron in order to remove Sulfur.

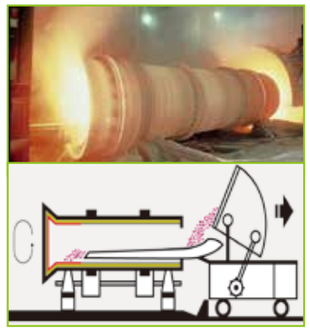
Magnesium Treatment

-Magnesium, in a small quantity, is added to the molten iron in order to promote the formation of spheroidal graphite microstructure.
The addition of magnesium is done by pressure plunging method. This method was developed by Kubota.

Centrifugal Casting

-Pipes are casted by centrifugal casting method.

small diameter pipes



middle and large diameter pipes

Annealing

-Annealing is a heat treatment process undertaken to improve the mechanical properties of the pipes.
In annealing, cementite of the as-cast pipes is decomposed to obtain high toughness ferrite.

small diameter pipes

middle and large diameter pipes (Hanshin Plant)

Treatment and Machining

-Pipes which passed the strict inspections are surface-treated and machined to specified shape and dimension.

Inside Cement Mortar Lining, Steam Curing

-Cement Mortar lining is applied inside the pipe for corrosion protection.

Outside Coating

-Zinc and bitumen/ synthetic resin coatings are applied outside of the pipe for corrosion protection.

Shipping

-Pipes are shipped all over the world.

Fitting Casting

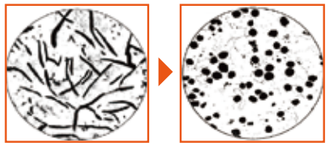
-Fittings are casted by sand mold.

Spectrographic Analysis

-Composition is analyzed by using spectrographic analyzer.

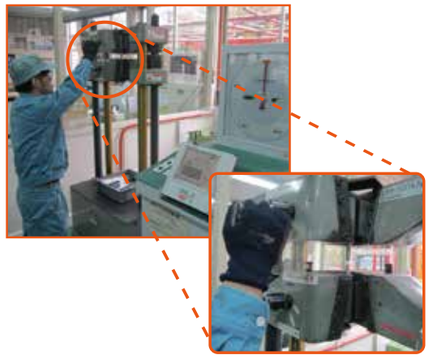
Inspection of Spheroidal Graphite

-Spheroidal graphite microstructure is examined by microscopic test.



Insepection of Heat TreatmentEffect

-Tensile test
-Hardness test



Hydrostatic Pressure Test

-All pipes are subjected to hydrostatic test to check water-tightness.

Inspection of Appearance and Dimensions

Final Inspection

-Pipes are inspected carefully before shipping.

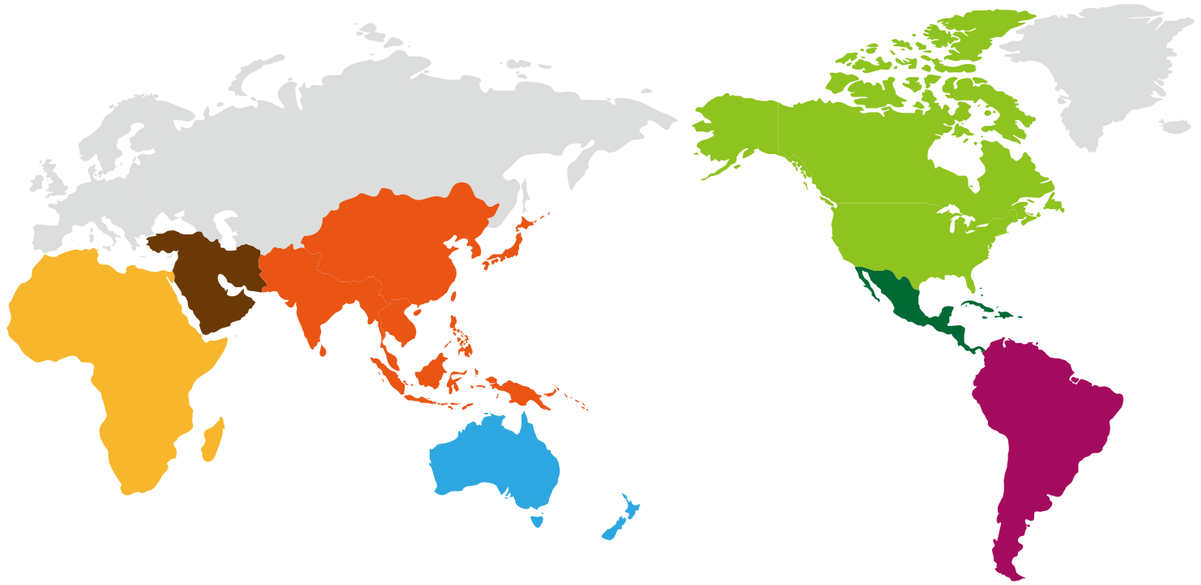
SUPPLY RECORD

Kuwait

Project Name	MEW/19
Year	2012-2013
End User	Ministry of Electricity and Water
Size	DN2200-DN2400
Length	1.8km

Qatar

Project Name	Pipelines for Mega Reservoirs Corridor Main 2 (GTC599/2013 Package B)
Year	2014-2016
End User	Qatar General Electricity and Water Corporation (KAHRAMAA)
Size	DN600-DN1600
Length	88km



Africa
Congo, Egypt, Ethiopia, Guinea, Kenya, Libya, Malawi, Mali, Mauritius, Nigeria, Seychelles, Sierra Leone, South Africa, South Sudan, Sudan, Tanzania, Zambia, Zimbabwe

Middle East
Bahrain, Iran, Iraq, Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, Syria, UAE, Yemen

Asia
Afghanistan, Bangladesh, Brunei, Cambodia, China, East Timor, Hong Kong, India, Indonesia, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam

Oceania
Australia, Marshall Islands, Palau, Papua New Guinea, Tonga

North America
Canada, USA

Central America
Guatemala, Haiti, Honduras, Jamaica, Nicaragua

South America
Bolivia, Chile, Ecuador, Peru

United States of America

Project Name	Seismic Improvement Project at Northridge Hospital
Year	2014-2015
End User	Los Angeles Department of Water and Power (LADWP)
Size	DN100-DN300
Length	4.3km

Bangladesh

Project Name	Karnaphuli Water Supply Project C-2
Year	2011-2014
End User	Chittagong Water Supply and Sewerage Authority (CWASA)
Size	DN300-DN1200
Length	70km