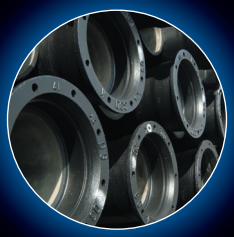
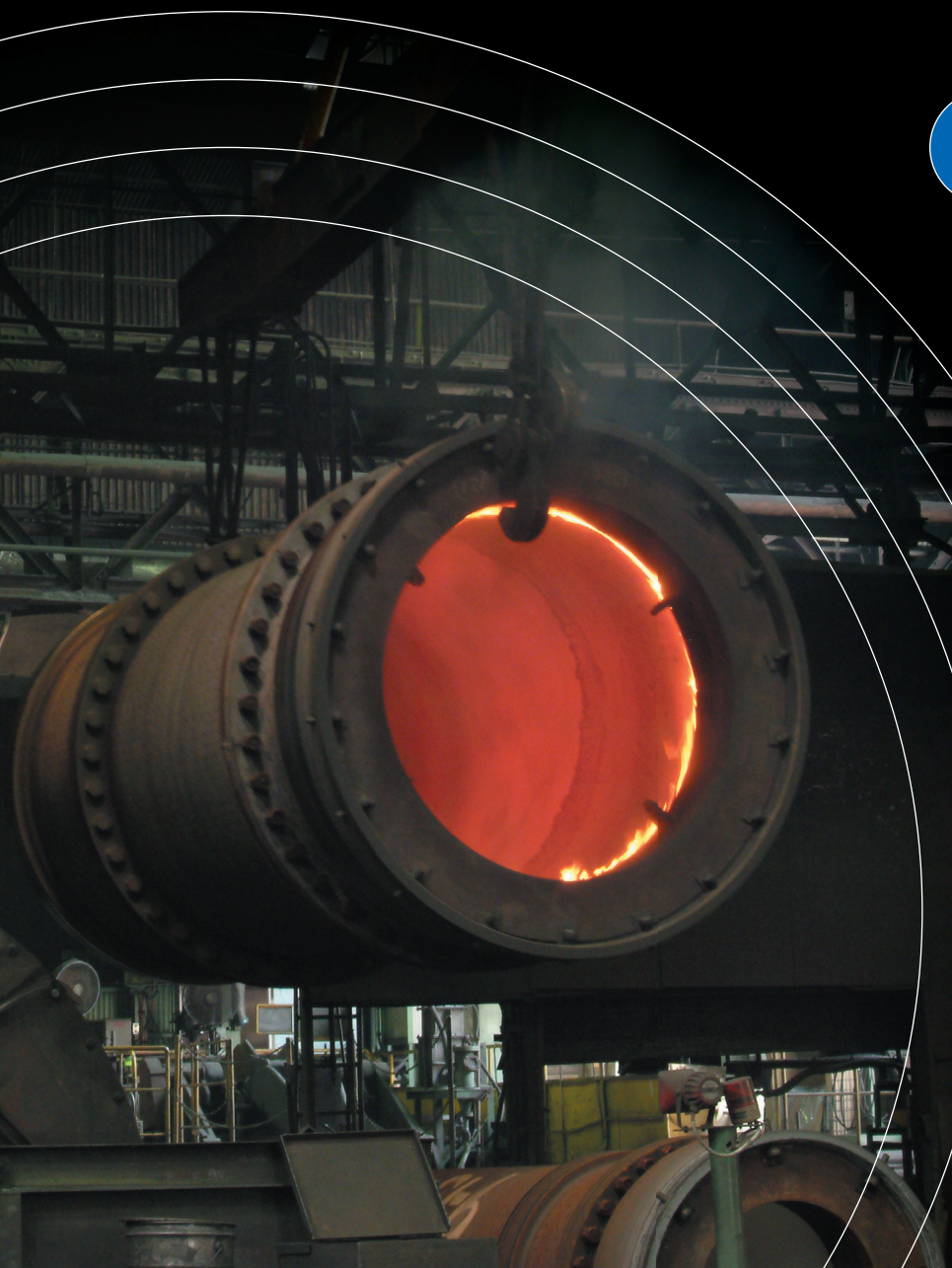




DUCTILE IRON PIPES

(JIS G 5526・5527)

KURIMOTO
JAPAN



CONTENTS

Lots of pipes run deep underground and crawl across the surface of the land.
Pipes carry critical drinking water, beneficial irrigation water, and gas that serves as an energy source, supporting our everyday lives.
And it is not only water and gas that they carry.
There are pipes to keep rivers from overflowing their banks, and pipes to provide water after earthquakes or other disasters occur.
Pipes support our society simply and in a wide variety of fields. It is safe to say that pipes can truly serve as lifelines.
A network of pipes continues to grow, from the private realm of your homes to industries that contribute to the economy.
Kurimoto Ductile Iron Pipes are part of that expansion. The active inclusion of new technologies at Kurimoto allow us to manufacture and provide ductile Iron pipes,
and with leading-edge technologies we aim to offer the best pipe networks for each and every field,
realizing the optimal environment for both homes and business in the process.

Pipe supports our Lives and our Society

① Strength

The most important element of a pipe is its strength, regardless of its use.
How does the strength of Ductile Iron Pipe compare to pipes made from other materials?
Therein lies the key in pipe selection.

Strength of Ductile Iron Pipe.

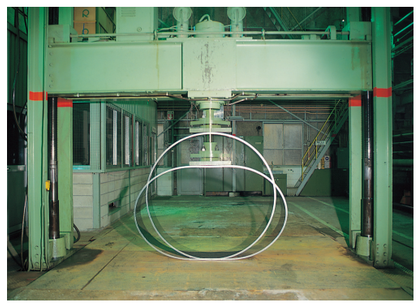
Ductile Iron Pipe far outshines other pipe materials in terms of strength; this owes to the spherical shape of the graphite in its composition. The spherical shape minimizes the surface area, maintaining the connectivity of the iron base, which yields our superior strength ratings.
Spherical graphite crystals are made by adding small amounts of magnesium and cerium during the casting process. The resulting stress on the graphite is low, even when focused, yielding remarkable improvements in mechanical properties.
The chart below compares Ductile Iron Pipe to pipe made from other materials.

Physical and Mechanical Properties

Physical and Mechanical Properties of Different Types of Pipe

Mechanical Properties \ Material	Ductile Iron Pipe	Steel pipe	FPRM pipe	PVC pipe
Tensile strength (N/mm^2)	min.420	min.400	————	min.49(15℃)
Bending strength (N/mm^2)	min.600	min.400	216-284(*1) 14.7-73.5(*2)	8-10
Elongation (%)	min.10	min.18	————	50-150
Elastic modulus (kN/mm^2)	157-167	205	14.7-21.6	2.6-2.9
Hardness	max.230 HBW	140 HBW	Barcol min.35	Rockwell 115
Poisson's ratio	0.28 - 0.29	0.3	0.3	0.37
Specific gravity	7.15	7.85	2.0	1.43
Thermal expansion coefficient	1.0×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	6~8×10^{-5}

(*1) circum (*2) axis

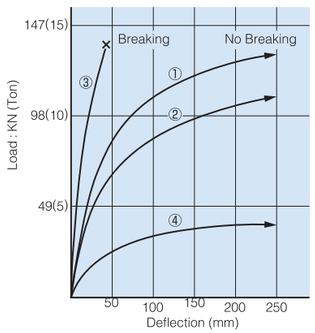


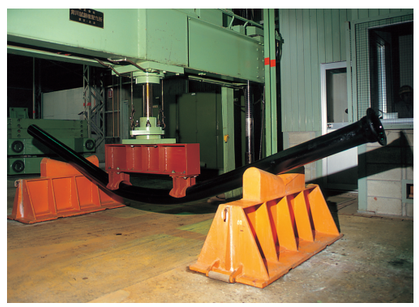
Ring Test

Ductile Iron Pipe will not break even if it is flexed as shown in the picture.

Ring Test of DN 1500 (test width 1000mm)

No.	Kind of pipe	Wall thickness
①	Ductile Iron Pipe	15.0mm
②	Ductile Iron Pipe	13.5mm
③	Gray cast iron pipe	22.0mm
④	steel pipe	9.0mm



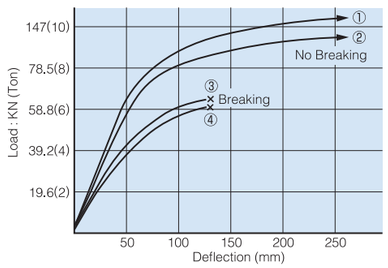


Bending Test

Ductile Iron Pipe will not break even if it is bent as shown in the picture.

DN 150×5m Bending Test

No.	Kind of pipe	Wall thickness
①	Ductile Iron Pipe	7.9mm
②	Ductile Iron Pipe	7.5mm
③	Gray cast Iron Pipe	8.5mm
④	steel pipe	8.2mm



② Water-tightness

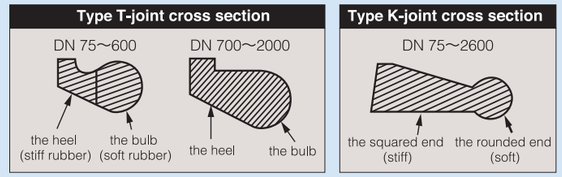
Critical features for pipe includes the ability to prevent the leaking of precious drinking water and the penetration of foreign matter internally. Not only do pipes need to be strong, as the network of pipes grows, they need to be water-tight and air-tight as well.

Can you completely prevent leaks and penetration of foreign matter?

No matter how they are used, all pipe networks comprise pipes and the joints between them. As a result, to prevent the leaking of internal liquids, including water, and to prevent the penetration of external foreign matter, both pipes and joints must be extremely water-tight.
The joints used to connect Ductile Iron Pipes are constructed to withstand high levels of hydraulic stresses, and do not leak or in other ways fail.

The Rubber Gasket of the Joint lasts as Long as the Pipe Itself

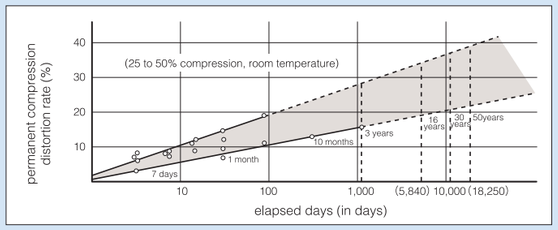
The rubber gasket used in Ductile Iron Pipes directly contributes to the water-tightness of the joint. Rubber gaskets used in buried pipe will suffer little deterioration as a result of ultraviolet radiation or heat and can last as long as the pipe itself (although it may be necessary to change the gasket material based on the content carried by the pipe).



Stress Impacts Shape in Only Minor Ways

There are cases where water-tightness is compromised when rubber loses some of its flexibility after being continually compressed for a long period of time.
In tests examining the change in rubber gaskets after periods of stress (permanent compression distortion), even after dozens of years, the permanent compression distortion was around thirty percent (estimated value), as indicated in the graph. As a result, we can see that the rubber gasket maintains sufficient water-tightness.

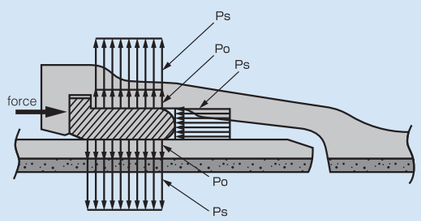
Permanent Compression Distortion and the Number of Elapsed Days in relation to the Rounded Rubber gaskets used in Joints (K-joints)



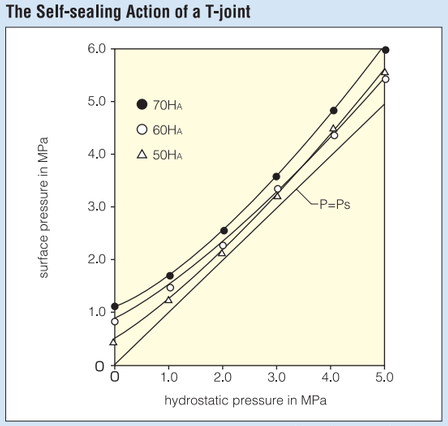
Self-sealing Action

Among the joints used in Ductile Iron Pipe, the T-joint features a rubber gasket that is self-sealing when pressed up against another surface, which allows it to maintain higher levels of water-tightness.

P = surface pressure in MPa = Po + Ps
Po = surface pressure at connection in MPa
Ps = hydrostatic pressure in MPa



The Self-sealing Action of a T-joint



HA = durometer hardness

③ Corrosion Resistance

Pipes not only need to be strong and water-tight, they need to resist corrosion.
Given that much pipe is laid underground, it is critical to prevent the onset and spread of corrosion.
This leads to a longer lifecycle for pipe.

Is it possible to prevent the onset and spread of corrosion?

The electrical resistance of Ductile Iron Pipe is very high; this is one factor helping to prevent corrosion. In addition, the carbon and silicon molecules within the pipe structure form a protective layer, which serves to markedly prevent the spread of corrosion. What's more, the rubber in the joints acts as an insulator, minimizing the impact of electrical currents. When all of these elements work together, they not only prevent the onset and spread of corrosion, they allow for Ductile Iron Pipe to be used for longer periods of time. When laying pipe in corrosive soils (acidic soils), a polyethylene sleeve will further work to prevent corrosion (see the table below).

Electrical Resistance in Ductile Cast Iron and Steel

Material	Electric Resistance ($\mu\Omega$-cm)
Ductile Iron Pipe	50～70
Steel pipe	10～20

Polyethylene sleeves being used to protect Ductile Iron Pipe.

What types of soils engender corrosion?

In addition to corrosion caused by electrical currents, it can arise from the soil in which pipe is laid. Ductile Iron Pipe is sufficiently corrosion resistant in ordinary soils, but in highly acidic soils or areas with high concentrations of salts, areas with large amounts of underground waste or soils with high levels of clay, corrosion can be a significant issue, and a polyethylene sleeve is required as a further defense. In addition to preventing contact between the pipe and the soil, the polyethylene sleeve will prevent corrosion from acids dissolved in any water that might penetrate the sleeve, and will last for a long time within the earth.

Pipes and Fittings

SPECIFICATION (JIS G 5526・5527)

Tensile strength and elongation of pipes and fittings

Pipes

Tensile strength N/mm²	Elongation %
min.420	DN75 to DN2600 min.10

Remarks: In the case of doubt, the hardness shall be measured. In this case, the hardness shall not exceed 230 HBW.

Fittings

Tensile strength N/mm²	Elongation %
min.420	DN75 to DN2600 min.10

Remarks: In the case of doubt, the hardness shall be measured. In this case, the hardness shall not exceed 250 HBW.

Specified hydrostatic pressure and holding time

Pipes

DN mm	Hydrostatic pressure MPa	Holding time sec
75 ～ 250	6.0	min.5
300		min.10
350 ～ 600	5.0	
700 ～ 1000	4.0	
1100 ～ 1500	3.0	
1600 ～ 2600	2.5	

Fittings

DN mm	Hydrostatic pressure MPa	Holding time sec
75 ～ 300	3.0	min.10
350 ～ 600	2.5	
700 ～ 1000	2.0	
1100 ～ 2600	1.5	

Standard coating and lining

Pipes

Coating & Lining	DN mm	Detail
External Coating	75 to 250	● Metallic Zinc plus Synthetic Resin Coating ● Zinc Rich Paint plus Synthetic Resin Coating
	300 to 2600	● Synthetic Resin Coating*
Internal Lining	75 to 2600	● Mortar Lining in accordance with JIS A 5314
	75 to 1500	● Epoxy-powder Coating in accordance with JIS G 5528
	1600 to 2600	● Liquid Epoxy Resin Coating

*Metallic zinc or zinc rich paint is available under synthetic resin coating.

Fittings

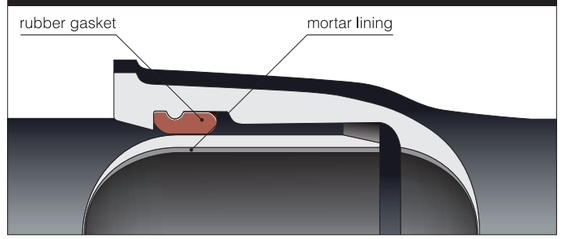
Coating & Lining	DN mm	Detail
External Coating	75 to 2600	● Synthetic Resin Coating*
Internal Lining	75 to 1500	● Epoxy-powder Coating in accordance with JIS G 5528
	1600 to 2600	● Liquid Epoxy Resin Coating

*Metallic zinc or zinc rich paint is available followed by synthetic resin coating.

Other specifications are available on request.

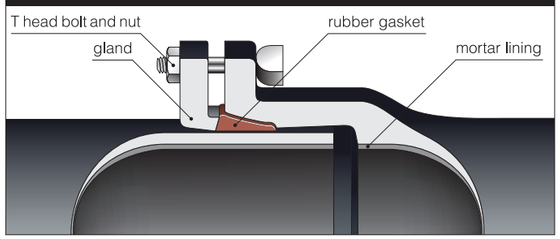
JOINT STRUCTURE

TYPE T PUSH ON JOINT



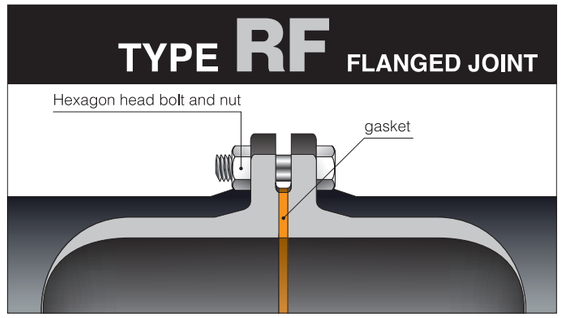
Simply by inserting the spigot into a socket with a rubber gasket attachment, the connection is made easily, quickly and completely.
With just a rubber gasket to connect the pipes, our process is much more economical. By inserting the spigot, the valve of the rubber gasket is contracted, maintaining a water-tight seal. The heal portion of the gasket adheres to the concave portion of the socket, which prevents the gasket from coming loose. The spigot has a gradient, which makes it easy to lay pipe. If the internal pressure increases, the rubber gasket becomes even stronger, blocking the water surface; it has a self-sealing functionality that allows it to respond to changes in hydraulic pressure, and aiding in its tight connection to the socket.

TYPE K MECHANICAL JOINT



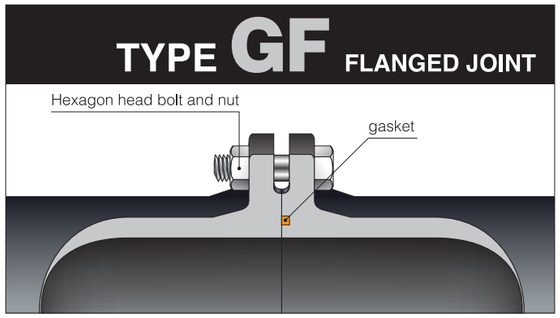
Mechanical joint is usually used, and extremely water-tight, making it perfect for larger diameter pipes, high-pressure pipes or situations involving high external pressure. The rubber gasket, which combines square and rounded rubber components, is bolted through the gland, squeezing the rounded portion, and, increasing the level of watertightness as same as T-joint. It also provides expansion, contraction and defection as well.

TYPE RF FLANGED JOINT



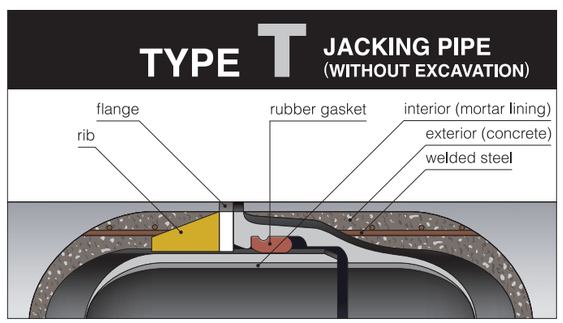
Flanged Joint (TYPE RF) is usually used in the low pressure pipe line. This joint type itself doesn't have expansion and contraction due to being rigidity.

TYPE GF FLANGED JOINT

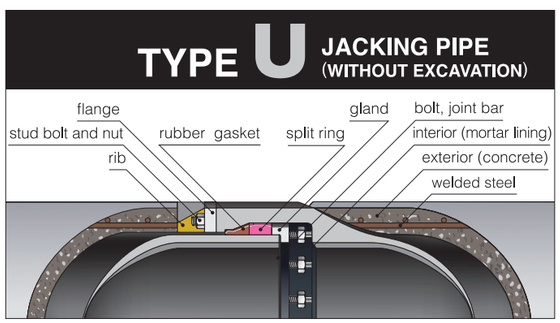


Flanged Joint (TYPE GF) is usually used in the high pressure pipe line.

TYPE T JACKING PIPE (WITHOUT EXCAVATION)



TYPE U JACKING PIPE (WITHOUT EXCAVATION)



The exterior of T and U type joint pipes (JIS) is wrapped in reinforced concrete, with the exterior diameter of the pipe and joint made to match, smoothed, and the flange and rib welded on the circumference of the spigot have contact with the end surface of the socket; thus transferring force.

Type T

Description		DN	Effective length
DI Pipes	Socket and Spigot Pipe	75 to 100	4M
		150 to 250	5M
		300 to 1500	6M
		1600 to 2000	4M or 5M

Type U

Description		DN	Effective length
DI Pipes	Socket and Spigot Pipe	800 to 1500	6M
		1600 to 2000	4M or 5M

Type K

Description			DN	Effective length
DI Pipes	Socket and Spigot Pipe		75 to 100	4M
			150 to 250	5M
			300 to 1500	6M
			1600 to 2000	4M or 5M
DI Fittings	Socket and spigot cross with socket branches		75 to 900	
	Socket and Spigot Tee with socket brabch		75 to 2600	
	Reducer	socket and spigot reducer		
		spigot and socket reducer		
	Socket and spigot bend	90°		
		45°		
		22.5°		
		11.25°		
		5.625°		
	Socket and spigot tee with socket branch			
	Double socket level insert tee with socket branch			
	Collar			
	Connecting piece(Socket and flange type)			
	Connecting piece(Flange and spigot type)			
	Plug		75 to 1500	

Type Flange

Description			DN
DI Fittings	Double flanged pipe		Type RF : DN75 to DN600 Type GF : DN75 to DN1500
	Flange and spigot Pipe		
	All flanged tee		
	Flange and spigot tee with flange branch		
	Double flanged reducer		
	Double flanged bend	90°	
		45°	
	Blank flange		
	Flanged bellmouth		

●Accessories for TYPE-T, K, U and FLANGE Type-RF,GF

MANUFACTURING PROCESS

Ductile Iron Pipe for a variety of customer needs are made in a manufacturing venue that incorporates the latest in casting technology.

A

Melting

With a maximum capacity of 20 tons per hour, melting created in the cupolas have their temperatures and compositions adjusted in channel-type low-frequency furnaces. Management of the entire process, including the weighing of raw materials, addition of materials to the cupolas and the pouring of the melting is controlled by computers. Although cast iron is ordinarily resistant to corrosion, we add magnesium as part of the ductile process as a means to improve product strength.

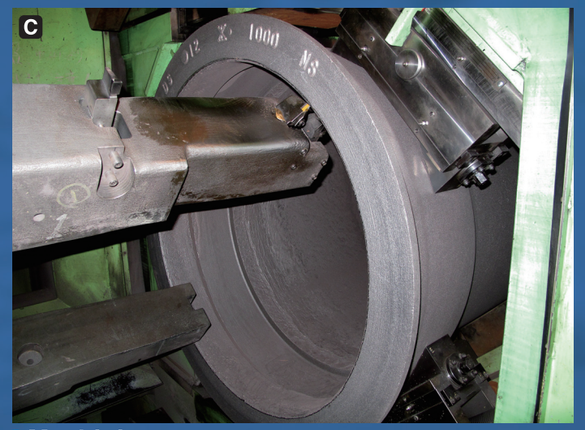
B

Casting

Molds are placed on a top of the caster, and the melting is carefully poured into the molds as they are revolved. Once the melting has been poured in, the revolution speed increases and continues until the product hardens.

Adjusting Melting

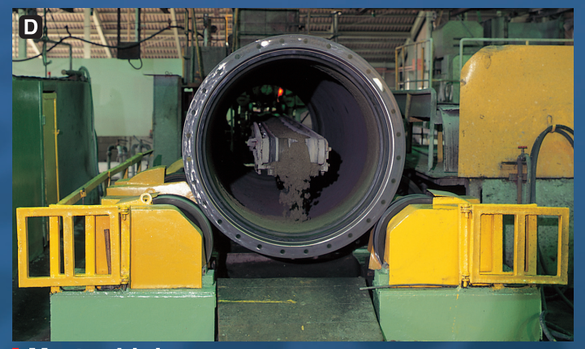
C



Machining

Finishing is implemented, including the treatment of the internal and the opening of any flange holes.

D



Mortar Lining

The internal surface is lined with mortar to improve corrosion-resistance and to maintain smooth flow rates. Once the pipes are cured with steam, a seal coating is applied.

E

Epoxy Powder Coating

After grinding the internal surface, heating it and baking on an epoxy powder coating, a pinhole inspection takes place, after which pipes are released to shipping.

F

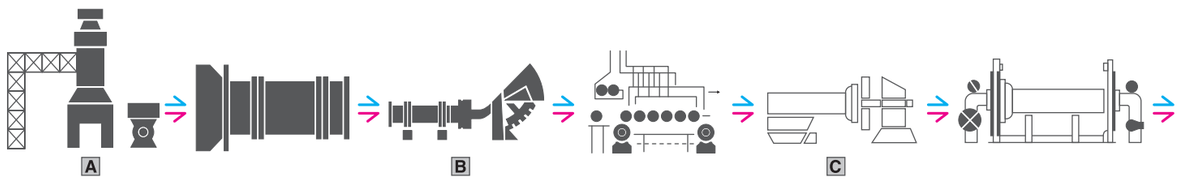
Shipping

Kurimoto's primary products are Ductile Iron Pipes and Ductile Iron Fittings, providing completed products for a variety of fields.

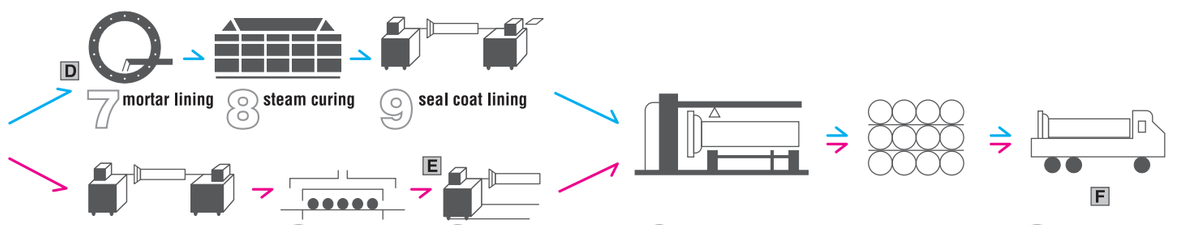
Manufacturing Process of Ductile Iron Pipe

mortar lining process
epoxy powder coating process

* The order may change based on plant and product.



1 Melting
2 Preparing Molds
3 Casting
4 Annealing
5 Machining
6 Hydrostatic pressure, shape and dimension inspections Material inspection



7 mortar lining
8 steam curing
9 seal coat lining
7 internal surface grinding
8 heating
9 powder coating
10 external surface coating
11 coating inspection or lining inspection
12 inspection before shipping /shipping

KURIMOTO, LTD.

QUALITY CONTROL

Thorough inspections and a comprehensive quality control system were implemented to realize higher levels of quality.

Spectormetric Analysis
The spectormetric analysis room performs compositional analysis on the liquid metals.

Microscope Inspection
Portable microscopes are used to measure the degree of graphite spherization and to inspect the composition of the base material.

Materials Testing
The tensile strength tester that inspects the tensile strength of sample pipes.

Mass, Shape, Measurement Inspections
Precise quality inspections use form measuring equipment, scales, etc.

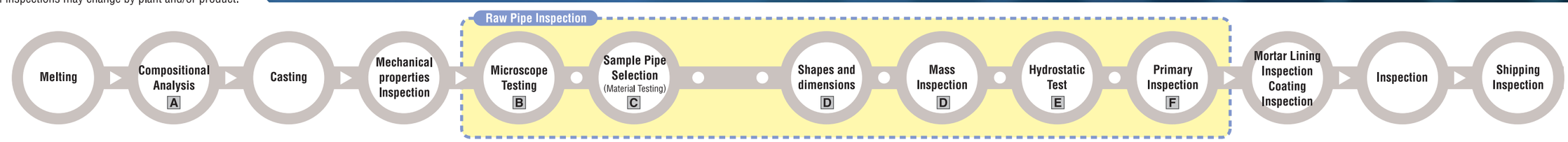
During the production phase, an emission spectrum analysis device (the cantback) allows for a thorough review of the dissolved content within the Ductile Iron Pipe products. In addition, completed ductile iron pipe products pass through a comprehensive quality control system, including computerized management processes, to assure that our product reliability is the best it can be for the various fields in which it is used. A complete round of detailed checks is performed. The iron undergoes microscopic inspection, hydrostatic testing, and external appearance, shape and measurement inspections for all products during quality inspections, with tensile strength and elongation and hardness testing performed on each lot. Once the pipes pass inspection, they undergo mortar lining, seal coating or powder painting processes, from which they move on to a final inspection, which they must pass before shipping.

Hydrostatic Test (Ductile Iron Fittings)
Each pipe passes through the hydrostatic tester, confirming its level of water-tightness.

Inlet Measurement Inspection
All pipes are visually inspected using gauges.

Quality Control Pipes Inspection Flowchart

*The order and content of inspections may change by plant and/or product.



		total inspection	sampling inspection	total inspection	total inspection	total inspection	total inspection	total inspection	total inspection	total inspection
Inspection Type		•mass/wall thickness •circumference/ external appearance	•percentage of spherical graphite •base composition (cementite/pearlite)	•tensile strength •elongation	•external appearance/ dimension •shape/markings pipe •thickness/length	•mass	•hydrostatic	•external appearance/ shape •markings	•external appearance •mortar or coating layer thickness, display markings •peeling, cracks •seal coat	•external appearance	•external appearance •quantities
Inspection Tools	spectormetric analysis	scale calipers tape measure visual inspection	portable microscopes (100X magnification)	load cell method universal tester, etc.	visual inspection, gauge calipers, tape measure, vernier calipers, linear scale	scale	hydrostatic tester	visual inspection	visual inspection,linear scale, electro-magnetic micro-thickness gauge, feeler gauge,test hammer, holiday detector	eyesight, electro-magnetic micro-thickness gauge, holiday detector	visual inspection

FACTORY

Centered on our production facilities in Kagaya and Sakai, we manufacture Ductile Iron Pipes for a variety of applications.

KAGAYA FACTORY

As one of the factories manufacturing Ductile Iron Pipes, its involvement in research and development into the latest iron casting technologies makes it central to our production work.
Producing Ductile Iron Pipe and Ductile Iron Fittings in diameters ranging from 300 to 2,600 millimeters, factory can respond to any of our customers' needs.

Founded	November 1940
Products	Ductile Iron Pipes, Ductile Iron Fittings
Output Capacity	4,000 tons (monthly)
ISO Certification	ISO9001 ISO14001
Address	1-64 Izumi 2-chome, Suminoe-ku,Osaka 559-0023,Japan

SAKAI FACTORY

Located in a corner of the Sakai Seaside Industrial District, the Sakai Factory has been promoting a full automated production line and quality control system in advance of other plants.
Factory specializes in the production of Ductile Iron Pipes using a centrifugal mold casting method, producing Ductile Iron Pipes in diameters of 50 to 250.

Founded	August 1963
Products	Ductile Iron Pipes
Output Capacity	10,000 tons (monthly)
ISO Certification	ISO9001 ISO14001
Address	14-1 Ishizunishi-machi, Sakai,Osaka 592-8332,Japan

BACKGROUND

Feb.1909: The late Mr.Yunosuke Kurimoto. the founder. estsblished KURIMOTO Tekkosho (KURIMOTO Ltd.). a limited partnership. at the site of the present Chishima Factory. and scarted the manufacture of cast iron pipes for water and gas supply

June.1951: The Kagaya Factory was completed with a cast iron pipe manufacturing shop employing the centrifugal casting method.

Oct.1958: Ductile Iron Pipe manufacturing equipment was completed at the Kagaya Factory.

Dec.1972: The Sakai Factory was constructed at Ohamanishi-machi, Sakai City. for the manufacture of steel frame products.

Mar.1974: Superlarge-diameter Ductile Iron Pipe casting equipment was completed at the Kagaya Factory.

Apr.1975: Acquired the entire stock of Shin-Nippon Pipe Co.,Ltd.

Apr.1987: Absorbed Shin-Nippon Pipe Co.,Ltd. and renamed as the Sakai Factory.

Jan.1995: Ductile Iron Pipe Div. of Kagaya Factory won an ISO 9002 certification.

Oct.1995: Sakai Factory won an ISO 9002 certification.

Dec.1999: Sakai Factory won an ISO 14001 certification.

Feb.2000: Kagaya Factory won an ISO 14001 certification.

Aug.2003: Kagaya Factory won an ISO 9001 certification.
(Transition from ISO 9002)

Nov.2003: Sakai Factory won an ISO 9001 certification.
(Transition from ISO 9002)

OFFICES

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