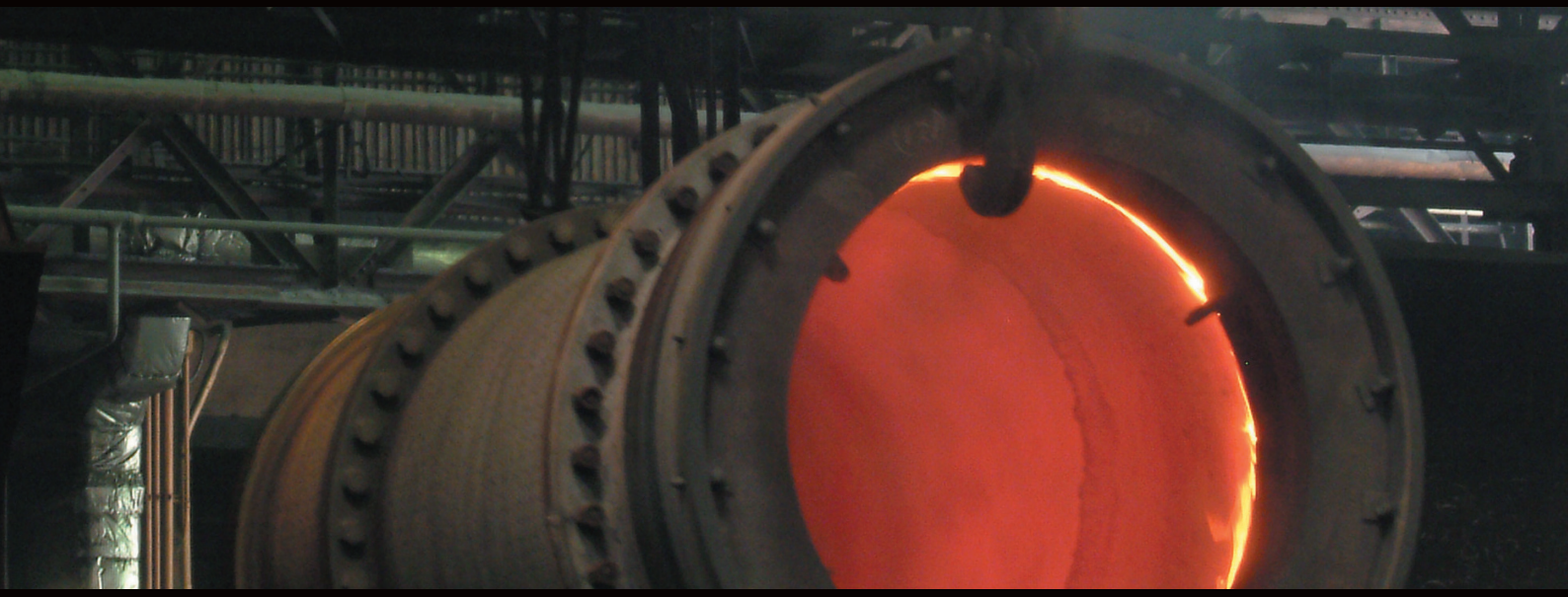


DUCTILE IRON PIPES

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.

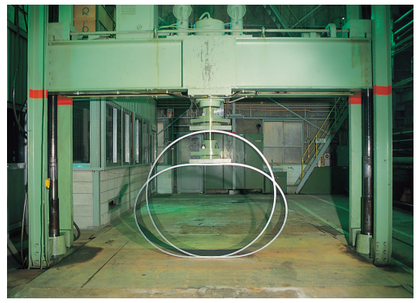
Ductile Iron Pipe far outshines other pipe materials in terms of strength; this owes to the spherical shape of the graphite in its composition. The spherical shape minimizes the surface area, maintaining the connectivity of the iron base, which yields our superior strength ratings.
Spherical graphite 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.

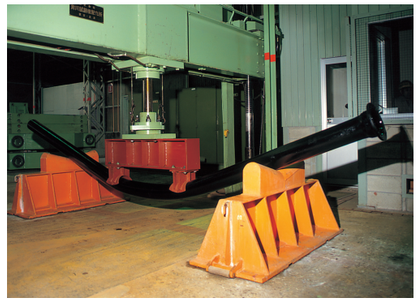
Physical and Mechanical Properties

Physical and Mechanical Properties of Different Types of Pipe

Material / Mechanical Properties	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 50-60	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



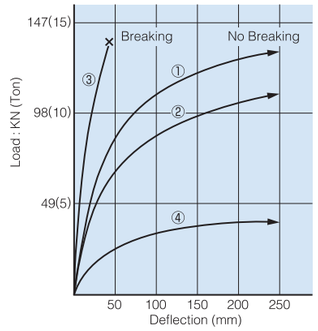


Ring Test

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

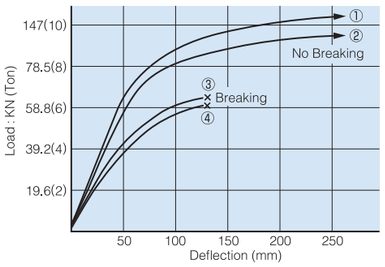


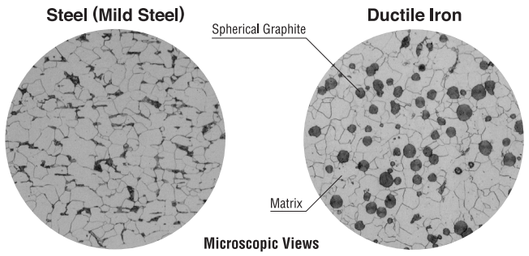
Bending Test

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





The difference between ductile iron and steel.

Both are made primarily from iron, but ductile iron is made from austenite (a combination of gamma iron and carbon) with 2.0% carbon or higher, and steel is made from austenite with less carbon. The higher amount of carbon in ductile iron separates out as graphite. Ductile iron features spherical graphite, however. Cast iron is superior in many regards, but it is particularly vulnerable to impacts, but spherical graphite gives our Ductile Iron Pipe the strength of steel while remaining cast iron. Ductile iron, to be precise.

② Water-tightness

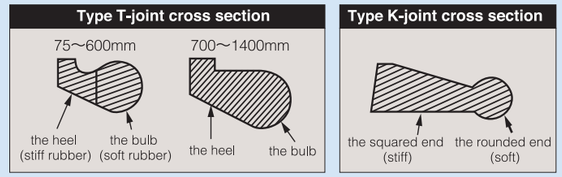
Critical features for pipe includes the ability to prevent the leaking of precious drinking water and the penetration of foreign matter internally. Not only do pipes need to be strong, as the network of pipes grows, they need to be water-tight and air-tight as well.

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 Ring of the Joint lasts as Long as the Pipe Itself

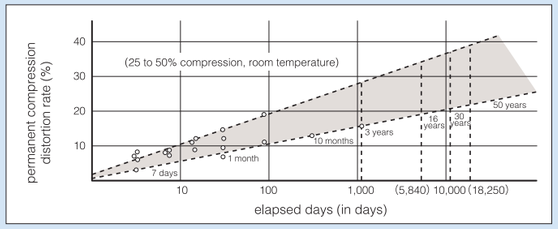
The rubber ring used in Ductile Iron Pipes directly contributes to the water-tightness of the joint. Rubber rings used in buried pipe will suffer little deterioration as a result of ultraviolet radiation or heat and can last as long as the pipe itself (although it may be necessary to change the ring 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 rings 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 ring maintains sufficient water-tightness.

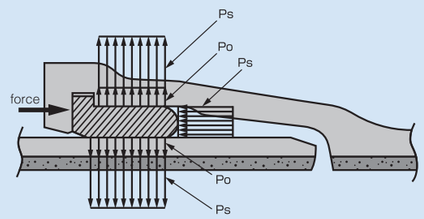
Permanent Compression Distortion and the Number of Elapsed Days in relation to the Rounded Rubber Rings used in Joints (K-joints)



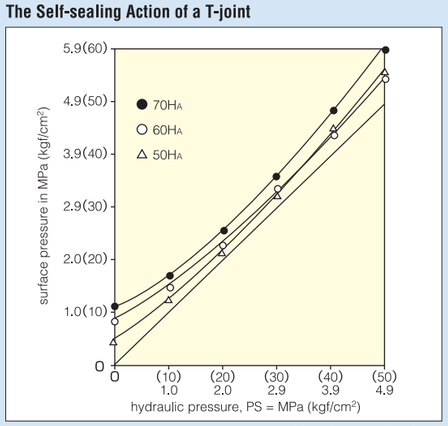
Self-sealing Action

Among the joints used in Ductile Iron Pipe, the T-joint features a rubber ring 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 (kgf/cm^2) = Po + Ps
Po = surface pressure at connection in MPa (kgf/cm^2)
Ps = hydraulic pressure in MPa (kgf/cm^2)



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

BS EN 545/598
ISO 2531

Tensile strength and elongation of pipes and fittings

Pipes

Tensile strength N/mm²	Elongation %	
min.420	DN80 to DN1000	DN1100 to DN1400
	min.10	min.7

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	DN80 to DN1400
	min.5

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 bar	Holding time s
80 to 300	50	min.15
350 to 600	40	
700 to 1000	32	
1100 to 1400	25	

Fittings

DN mm	Hydrostatic pressure bar	Holding time s
80 to 300	25	min.15
350 to 600	16	
700 to 1400	10	

Standard coating and lining

Pipes

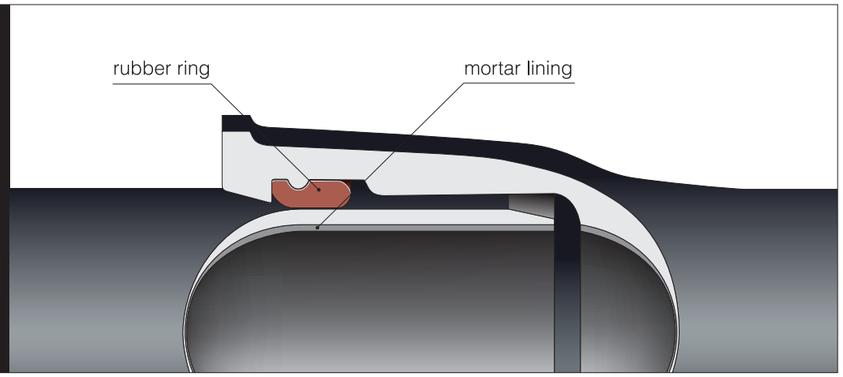
Application area	Detail
External Coating	•Metallic Zinc plus Bitumen coating in accordance with ISO 8179-1 •Zinc Rich Paint plus Bitumen coating in accordance with ISO 8179-2
Internal Lining	Sulphate Resisting Mortar, Portland Cement Mortar or High Alumina Cement in accordance with ISO 4179

Fittings

Application area	Detail
External Coating	•Metallic Zinc plus Bitumen coating in accordance with ISO 8179-1 •Zinc Rich Paint plus Bitumen coating in accordance with ISO 8179-2
Internal Lining	Fusion Bonded Epoxy Paint up to DN1000 Epoxy Paint coating over DN1100

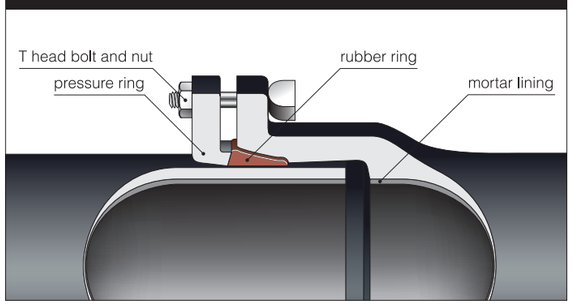
JOINT STRUCTURE

TYPE T
PUSH ON JOINT



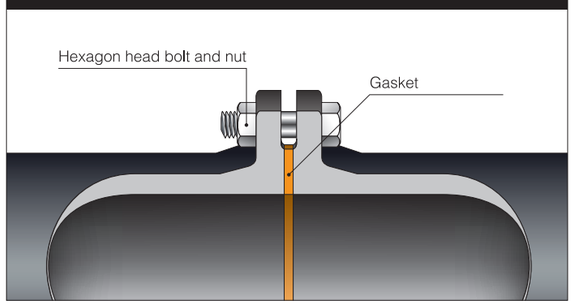
Simply by inserting the outlet pipe into an inlet pipe with a rubber ring attachment, the connection is made easily, quickly and completely.
With just a rubber ring to connect the pipes, our process is much more economical. By inserting the outlet pipe, the valve of the rubber ring is contracted, maintaining a water-tight seal. The heal portion of the ring adheres to the convex portion of the inlet pipe, which prevents the ring from coming loose. The outlet has a gradient, which makes it easy to lay pipe. If the internal pressure increases, the rubber ring 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 inlet pipe.

TYPE K
MECHANICAL JOINT



Our standard mechanical joint is extremely water-tight, making it perfect for larger diameter pipes, high-pressure pipes or situations involving high external pressure. The rubber ring, which combines square and rounded rubber components, is bolted through the insert ring, squeezing the rounded portion, and, as in the T-joint, increasing the level of watertightness. It also provides a degree of give as well.

TYPE FLANGE
FLANGED JOINT



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

PIPES

●DI Pipes

Description	DN	PN
Socket and Spigot Pipe	80 to 1400	

FITTINGS

●DI Fittings

Description	DN	PN
Flanged Socket	80 to 1400	10,16,25
Flanged Spigot	80 to 1400	10,16,25
MJ Collar	80 to 1400	
Double Socket Bend 90°	80 to 1400	
Double Socket Bend 45°	80 to 1400	
Double Socket Bend 22.5°	80 to 1400	
Double Socket Bend 11.25°	80 to 1400	
All Socket Tee	80 to 1400	
Double Socket Tee with Flange Branch	80 to 1400	10,16,25
Double Socket level invert Tee with Flange Branch	80 to 1400	10,16,25
Double Socket Taper	80 to 1400	
Double Flanged Bend 90°	80 to 1400	10,16,25
Double Flanged Bend 45°	80 to 1400	10,16,25
Double Flanged Bend 22.5°	80 to 1400	10,16,25
Double Flanged Bend 11.25°	80 to 1400	10,16,25
All Flanged Tee	80 to 1400	10,16,25
Double Flanged Taper	80 to 1400	10,16,25
Blank Flange	80 to 1400	10,16,25
Double Flanged Pipe on cast Length (up to 1M)	80,100	10,16,25
Double Flanged Pipe on cast Length (up to 2M)	150 to 1400	10,16,25
Double Flanged Duckfoot Bend 90°	80 to 1400	10,16,25
Flanged Bell mouth	80 to 1400	10,16,25

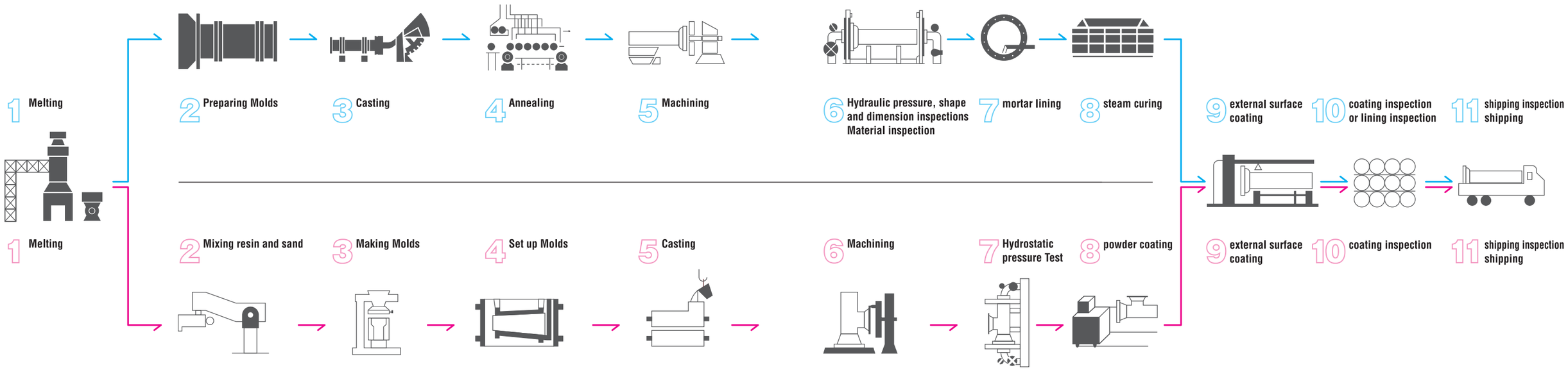
●Accessories for TYPE T, TYPE K and TYPE FLANGE

MANUFACTURING LINE

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

* The order may change based on plant and product.

Straight Ductile Iron Pipe Manufacturing Process



Ductile Iron Fittings Manufacturing Process

QUALITY CONTROL

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

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

Straight Ductile Iron Pipe Quality Control System

Chemical Analysis	Microscopic Examination	Mechanical Test	1st Inspection	Hydrostatic Pressure Test	2nd Inspection	Pre-shipment Inspection
• Chemical Composition	• Spheroidal Graphite Rate • Matrix Structure (Pearlite etc.)	• Tensile Strength • Elongation • Proof Stress • Brinell Hardness Test	• Dimensional Inspection (Thickness, Length, etc.) • Appearance Inspection (Shape, Marking, etc.)		• Cement Mortar Lining • Exteral Coating (Spray Marking included)	

Ductile Iron Fittings Quality Control System

Chemical Analysis	Microscopic Examination	Mechanical Test	Hydrostatic Pressure Test	1st Inspection	2nd Inspection	Pre-shipment Inspection
• Chemical Composition	• Spheroidal Graphite Rate • Matrix Structure (Pearlite etc.)	• Tensile Strength • Elongation • Proof Stress • Brinell Hardness Test		• Dimensional Inspection (Thickness, Length, etc.) • Appearance Inspection (Shape, Marking, etc.)	• Fusion Bonded Epoxy Coating • Exteral Coating	

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.

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