



المؤسسة العامة القطرية للكهرباء والماء
Qatar General Electricity & Water Corporation

CONTRACT No GTC 626/2014A

**CONSTRUCTION OF MEGA RESERVOIR PRPSs
(PACKAGE A - UMM BIRKA)**

**CONTRACT DOCUMENTS
(VOLUME 12 OF 19)**



**CONSOLIDATED CONTRACTORS GROUP S.A.L. (OFFSHORE) (CCC) &
TEYSEER CONTRACTING COMPANY W.L.L.
JOINT VENTURE**

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List of Proposed Suppliers

#	PROPOSED MATERIALS	PROPOSAL # 1	Catalogues	PROPOSAL # 2	Catalogues	PROPOSAL # 3	Catalogues	PROPOSAL # 4	Catalogues
1	PUMPS	KSB	✓	KUBOTA		TORISHIMA		PENTAIR	
2	DUCTILE IRON PIPE & FITTINGS	1.0 US PIPES (GLOBE CONSTRUCTION) P.O. BOX 10521, DOHA, QATAR	✓	SAINT GOBAIN (MANNAI TRDG. COMPANY) P.O. BOX 76, DOHA, QATAR	✓	KUBOTA (AL HASHEMI GROUP) P.O. BOX 187, DOHA, QATAR	✓	ACIPCO - OITC GROUP P.O. BOX 4844, DOHA, QATAR	
		2.0 DUKER (TROUVAY & CAUVIN GULF) P.O. BOX 2117, DOHA, QATAR							
3	CARBON STEEL PIPE	SEAH (PETROFAC INTERNATIONAL LTD) P.O. BOX 55031, DOHA, QATAR	✓	SEAH (PETROFAC INTERNATIONAL LTD) P.O. BOX 55031, DOHA, QATAR	✓	SEAH (PETROFAC INTERNATIONAL LTD) P.O. BOX 55031, DOHA, QATAR	✓	SEAH (PETROFAC INTERNATIONAL LTD) P.O. BOX 55031, DOHA, QATAR	✓
4	GATE VALVES	VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR		SAINT GOBAIN (MANNAI TRDG. COMPANY) P.O. BOX 76, DOHA, QATAR		SAINT GOBAIN (MANNAI TRDG. COMPANY) P.O. BOX 76, DOHA, QATAR		SAINT GOBAIN (MANNAI TRDG. COMPANY) P.O. BOX 76, DOHA, QATAR	
5	BUTTERFLY VALVES	1.0 SAINT GOBAIN (MANNAI TRDG,COMPANY) P.O. BOX 76, DOHA, QATAR		TTV (FIELD INDUSTRIAL SUPPLIES) P.O. BOX 55735, DOHA, QATAR		DUKER (TROUVAY & CAUVIN GULF) P.O. BOX 2117, DOHA, QATAR		VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR	
		2.0 VAG for diameter >2000mm							
6	NON-RETURN VALVES	VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR		VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR		VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR		VAG (PETROFAC INTERNATIONAL LTD.) P.O. BOX 55031, DOHA, QATAR	
7	COUPLINGS & ADAPTORS	DUTCO TENNANT QATAR WLL P.O. BOX 3288, DOHA, QATAR	✓	VIKING JOHNS (AL OBEIDLY & GULF ETERNIT) P.O. BOX 1965, DOHA, QATAR		UPE (AHMAD ALUTHMAN & BROS) P.O. BOX 218, DOHA, QATAR		UPE (AHMAD ALUTHMAN & BROS) P.O. BOX 218, DOHA, QATAR	
8	SWITCHGEARS	ABB	✓	SIEMENS		SCHNEIDER		SCHNEIDER	
9	MOTOR CONTROL CENTERS	ABB		SIEMENS		BIN GHALIB		BIN GHALIB	
10	VARIABLE SPEED DRIVES	ABB	✓	SIEMENS	✓	SCHNEIDER	✓	SCHNEIDER	✓
11	TRANSFORMERS	ABB		SIEMENS		SCHNEIDER		SCHNEIDER	
12	GENERATORS AND FUEL SYSTEM	CUMMINS		CUMMINS		CUMMINS		CUMMINS	
13a	CONTROL SYSTEM EQUIPMENT	ALLEN BRADLEY		SIEMENS	✓	SIEMENS	✓	SIEMENS	✓
13b	CONTROL SYSTEM SERVERS & SWITCHES	SISCO		SISCO		SISCO		SISCO	
14	CONCRETE	BETON WLL P.O. BOX 22581, DOHA, QATAR		QATAR ALPHA BETON P.O. BOX 23952, DOHA, QATAR		KHALID CEMENT INDUSTRIES P.O. BOX 3246, DOHA, QATAR		REDCO INTERNATIONAL P.O. BOX 16750 DOHA, QATAR	

Data sheet



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

item no.: 100

Date: 19/06/2014

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Omega 300-435 A GC G F

Version no.: 1

Operating data

Requested flow rate	566 l/s	Actual flow rate	566 l/s
Requested developed head	49 m	Actual developed head	49 m
Pumped medium	Water	Efficiency	86.0 %
	Clean water	Power absorbed	316 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	1490 rpm
Ambient air temperature	50.0 °C	NPSH required	7.5 m
Fluid temperature	20.0 °C	NPSH 3%	6.9 m
Fluid density	998 kg/m³	Discharge press.	4.80 bar.g
Fluid viscosity	1.00 mm²/s	Shut off head	75 m
Suction pressure max.	0.00 bar.g	Max. allow. flow	675 l/s
Max. power on curve	330 kW	Design	Single system 1 x 100 %
Min. allow. flow for continuous stable operation	140 l/s	Performance test	Yes

Design

Pump standard	KSB axially split volute casing pump	Impeller diameter	443 mm
Design	Pump and motor on common Base frame (3E)	Minimum impeller diameter	354.0 mm
Orientation	Horizontal	Full impeller diameter	465 mm
Suction flange (AS) drilling+seal face according to	EN 1092-2 / DN 400 / PN 10 21B / RF	Free passage size	45.0 mm
Discharge flange (AD) drilling+seal face according to	EN 1092-2 / DN 300 / PN 10 21B / RF	Direction of rotation from drive	Clockwise
Shaft seal	Single acting mechanical seal	Bearing seal driver side	Lip seal
Manufacturer	Burgmann	Bearing type driver side	Anti-friction bearings
Type	HJ92N	Lubrication type driver side	Grease
Mechanical Seal Form	Balanced	Bearing sealing end side	Lip seal
Material code	BQ1VGG	Bearing type end side	Anti-friction bearings
Sealing plan	EC Single acting mechanical (external circulation with cyclone separator)	Bearing lubrication end side	Grease with
Dirty water operation: Pumped liquid with max 100 mg/l solids.		Temperature measurement tapping	
Wear ring	Casing/impeller wear ring	Temperature indicator, local pump/non-drive side	with
Wear ring type	Standard design	Temperature indicator, local motor side	with
		Temperature signal processing without Vibration measurement tapping with	
		Vibration measurement accessory	Vibration sensor and monitoring driver and end sides

Data sheet



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 100

Date: 19/06/2014

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Omega 300-435 A GC G F

Version no.: 1

Driver, accessories

Manufacturer	Siemens Flender	Driver type	Electric motor, suitable for speed regulation
Coupling type	Arpex JUN	IEC	IEC
Nominal size	210-6	Model (make)	Siemens or equiv.
Spacer length	280.0 mm, insulated	Drive supplied by	Motor supplied by KSB
Coupling guard type	Heavy duty ZN3230 solid sheet, 1.5 mm	Motor const. type	B3
Guard size	SA 4	Motor speed	1490-1023 rpm
Guard material	Steel	Frequency	50 - 34 Hz
Base plate type	Pump and motor on common base frame (3E) – light execution with drip pan	Rated voltage	415 V
Base plate size	special	Rated power P2	460kW
		Number of poles	4
		Starting mode	by variabel speed drive
		Motor cooling method	Surface cooling
		Motor material	Grey cast iron GG/CAST IRON

Scope of mounting parts : Base frame for pump set incl. foundation bolts,

Features : Base frame not suitable for pump set transport / With drip pan and piping from went, leakage and drain to drip pan,
Instrumentation panel for manometer gauges and vibration monitoring , locally mounted on base frame,
Special name plate acc. Specif.

Delivery : Pump, Motor and base frame separately

Materials GC

Notes

general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <=250 mg/kg. chlorine (Cl2) <=0.6 mg/kg.

Ammonium (NH4+) <= 2 mg/kg, free of H2S; Chlorine (Cl2) <=0.6 mg/kg.

Volute casing (102)	Grey cast iron EN-GJL-250	Shaft seal housing (441)	Grey cast iron EN-GJL-250
Pump shaft (211)	Chrome steel 1.4021+QT800	Neck ring (457.2)	Tin Bronze CC493K
Double-entry impeller (234)	GX2CRNIMOCUN25-6-3-3	Casing wear ring (502)	1.4021 (AISI 420) hardened
Bearing housing (350.1)	Duplex 1.4517	Impeller wear ring (503)	Duplex 1.4470

Shaft protecting sleeve (524.1)	1.4571 AISI 316
Spacer sleeve required (525.2)	Duplex stainl. steel 1.4462

Data sheet



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 100

Date: 19/06/2014

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Omega 300-435 A GC G F

Version no.: 1

Auxiliary connections

1M.1 Pressure gauge connection	G 1/2, Prepared for pressure gauge delivered separately	6B.1 Pumped liquid drain	G 1/2, Hand operated valve without further piping
1M.1 Pressure gauge material	1.4571	6B.1 Material	Stainless steel 1.4408
1M.1 Pressure range	-1 to +1.5 bar	6B.2 Pumped liquid drain	G 1/2, Hand operated valve with further piping to drip pan
1M.1 Damping	With damping	6B.2 Material	Stainless steel 1.4408
1M.1 Pressure gauge dial size	NG 150	6D Pumped medium - filling / venting	Rigid pipe with four way connector and venting valve with further piping to drip pan
1M.2 Pressure gauge connection	G 1/2, Prepared for pressure gauge delivered separately	6D Material	Stainless steel 1.4408
1M.2 Pressure gauge material	1.4571	6D Material sealing pipe	Stainless steel 1.4571
1M.2 Pressure range	0 - 10 bar	8A Leakage drain	G 3/4, Drilled, with further piping to drip pan
1M.2 Damping	With damping	26M.1 SPM sensor connection (driver side)	M 8, Vibration sensor and monitoring, 2 axis
1M.2 Pressure gauge dial size	NG 150	26M.2 SPM sensor connection (non-driver side)	M 8, Vibration sensor and monitoring, 3 axis
4M.1 Temperature gauge connection (Suction side)	G 1/2, Prepared for temperature gauge delivered separately		
4M.2 Temperature gauge connection (Pressure side)	G 1/2, Prepared for temperature gauge delivered separately		

Certifications

Tests acc. to QCP-Plan

Hydraulic performance test

Acceptance standard	ISO 9906 class 1U	Dimension check	
Quantity meas. points Q-H	7	Certificate	Inspection cert. 3.2 to EN 10204
Certificate	Inspection cert. 3.2 to EN 10204	Test participation	Witnessed
Test participation	Witnessed	Quantity, non-witnessed	0
Quantity, non-witnessed	3	Quantity, witnessed	4
Quantity, witnessed	1		
NPSH test	Yes		
Quantity meas. points NPSH	3		

String test

Acoustic test ISO 20361	3 speeds with job motor	Final visual and painting thickness inspection(ISO 2178)
Vibration test ISO 10816	All units with one job VSD	Certificate
Bearing temperature test	Yes	With

String test	3 speeds with job motor
Acoustic test ISO 20361	All units with one job VSD
Vibration test ISO 10816	Yes

Bearing temperature test	Yes
String test	3 speeds with job motor

Balancing test

Balancing grade ISO 1940	G 6,3	Material certificates: Pump shaft (211)
Part	Impeller	Certificate for analysis
Certificate	Inspection cert. 3.1 to EN 10204	Test report 3.1 to EN 10204
Test participation	Non- witnessed	
Quantity, non-witnessed	4	
Quantity, witnessed	0	

Hydrostatic test (room temp.)

Range	Complete pump with shaft seal	Material certificates: Casing wear ring (502)
Test pressure	11 bar.g	Certificate for analysis
Test time	30 min	Test report 3.1 to EN 10204
Certificate	Inspection cert. 3.2 to EN 10204	
Test participation	Witnessed	
Quantity, non-witnessed	3	
Quantity, witnessed	1	

Material certificates: Impeller wear ring (503)

Certificate for analysis	Test report 3.1 to EN 10204
Certificate for analysis	Test report 3.1 to EN 10204

Material certificates: Shaft sleeve (524)

Certificate for analysis	Test report 3.1 to EN 10204
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Data sheet



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 100

Date: 19/06/2014

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Omega 300-435 A GC G F

Version no.: 1

Exterior coating

KSB coating code	R1 TO AA 0080-06-01	Intermediate/ Final coating	2-pack epoxy
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Color	Ultramarine blue (RAL 5002)
Primer	2-component epoxy-zinc dust	Total film thickness approx.	KSB-blue 300 µm

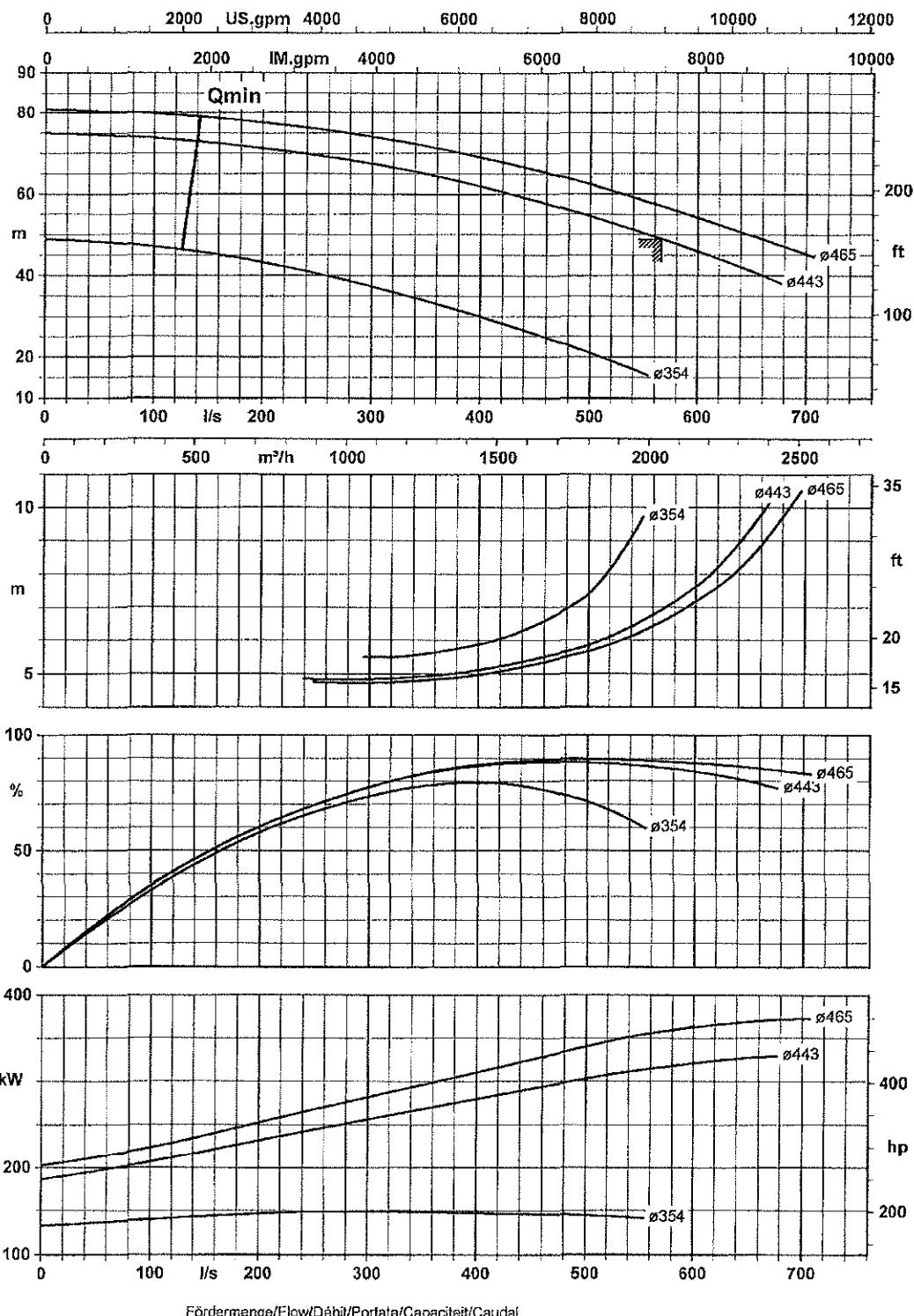
Interior coating

KSB coating code	Sika Permacor 136 TW (suitable for drinking water)	Color	KSB's choice
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Total film thickness approx.	300 µm
Intermediate / Final coating	2-component epoxy resin	Interior coatings for pumps are subjected to high loads and thus gradual, unavoidable wear, even when the plant is being operated in compliance with the specification. Signs of wear, including cracks, flaking, and similar, are to be viewed as part of the natural wear of the pump (regardless of how long it has been in operation) and do not qualify as defects. KSB shall not be held liable for wear or damage to interior coatings, including consequential damage to other pump components. Interior coatings must be checked, touched up, and repaired by the customer on a regular basis respective of the media pumped to avoid further damage to the coating and/or consequential damage to other pump components caused by corrosion and abrasion.	

Base frame

KSB coating code	R1 TO AA 0080-06-01	Final coating	2-component epoxy resin high solid
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Color	Ultramarine blue (RAL 5002)
Primer	2-component epoxy-zinc dust	Total film thickness approx.	KSB-blue 150 µm

Baureihe-Größe Type-Size Modèle	Tipo Serie Tipo	Nenndrehzahl Nom. speed Vitesse nom.	Velocità di rotazione nom. Nominal toerental Revvoluzioni nom.	Laufrad-Ø Impeller dia. Diamètre de roue	Ø girante Waaler Ø Ø rodete	
Omega 300-435A		1490 1/min				
Projekt Project Projet	Progetto Projekt Proyecto	Angebots-Nr. Quotation No. N° de l'offre	N° offerta Offerentl. N° oferta	Pos.-Nr. Item No. N° de pos.	N° pos Pos. nr. N° de art	
SS 1-A + SS 4-B		Design point		566 l/s - 49 m		KSB Aktiengesellschaft 67225 Frankenthal Johann-Klein-Straße 9 67227 Frankenthal



Leistungsbedarf

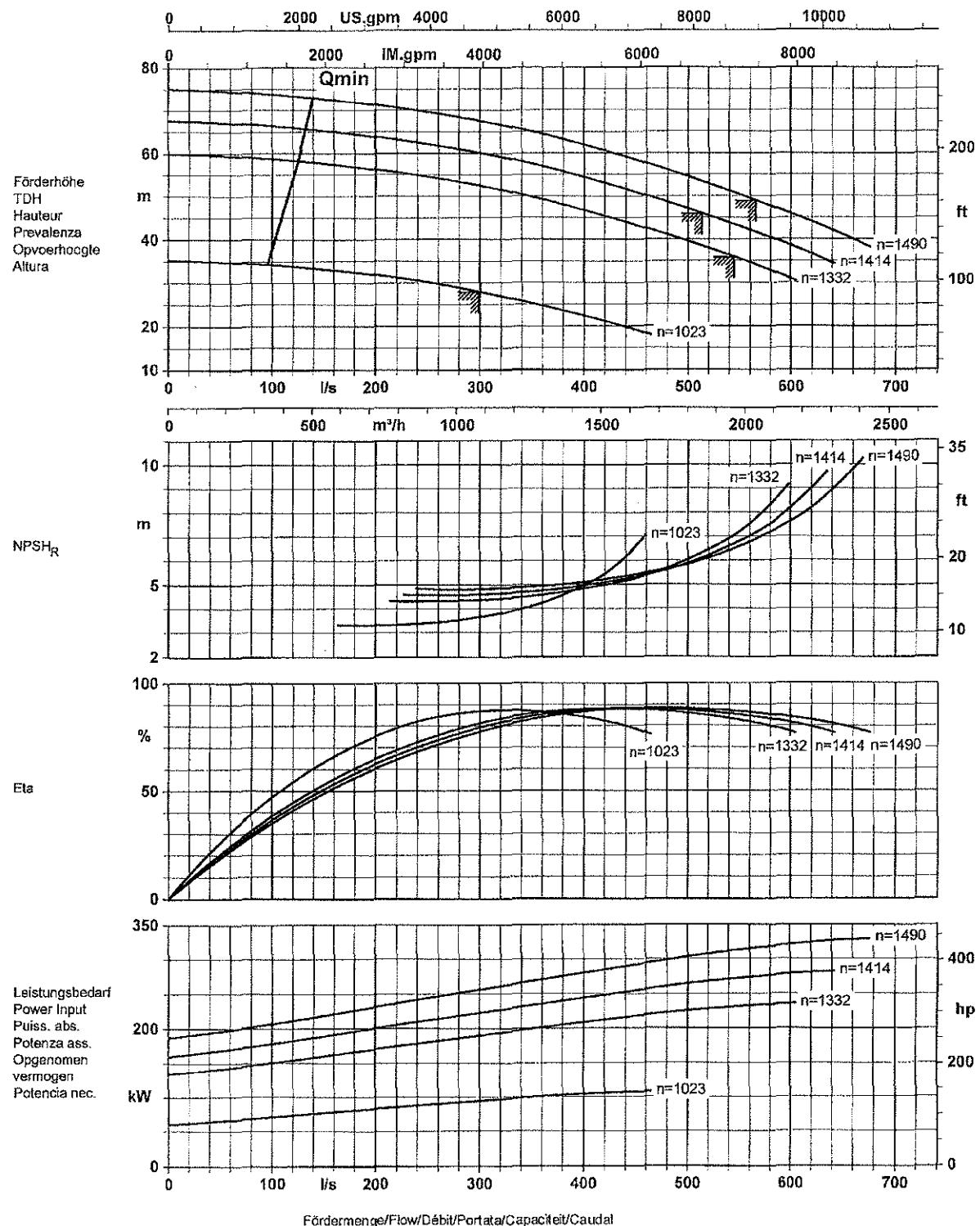
Power input
Puiss. abs.
Potenza ass.
Opgenomen
vermogen
Potencia nec.

Laufradaustrittsbreite/Impeller outlet width/Largeur à la sortie de la roue
Luce della girante/Waaler ultradebreedte/Anchura de salida rodalet
81 mm
81 mm

Aus Kurve K42798 +15/4* gerechnet
T145-Ft, Schmöller Johannes, 2014-05-23

Baureihen-Größe Type-Size Modèle	Tipo Serie Tipo	Nenndrehzahl Nom. speed Vitesses nom.	Velocità di rotazione nom. Nominaal toerental Revvoluzioni nom.	Laufrad-Ø Impeller dia. Diamètre de roue	Ø girante Waaijer ø Ø rodete	
Omega 300-435A				443 mm		KSB 
SS 1-A	Projekt Project Projet	Projetto Projekt Proyecto	Angebots-Nr. Quotation No. N° de l'offre	N° offerta Offertenr. N° oferta	Pos.-Nr. Item No. N° de pos.	N° pos Pos. nr. N° de art

Speed curves



Laufraustrittsbreite/Impeller outlet width/Largeur à la sortie de la roue 81 mm
Luce della girante/Waaijer uitstredebreedte/Anchura de salida rodete 81 mm

Aus Kurve K42798 +15/4° gerechnet
T145-Ft, Schmöller Johannes, 2014-05-23

Installation plan



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

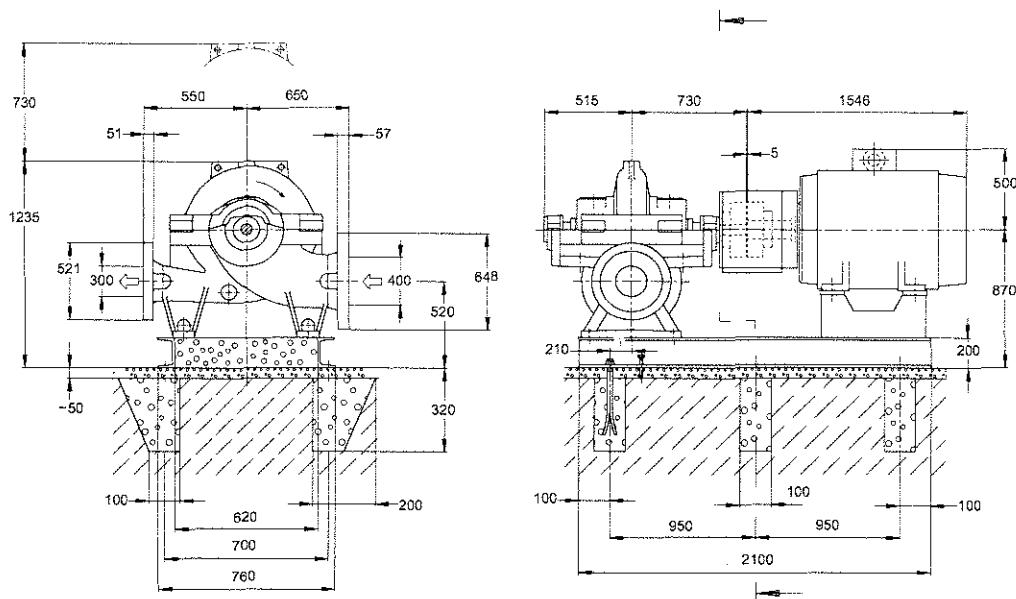
Item no.: 100

Date: 27/05/2014

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Omega 300-435 A GC G F

Version no.: 1



Drawing is not to scale

Dimensions in mm

Motor

Motor manufacturer	Siemens or equiv.
Motor size	
Motor power	460 kW
Number of poles	4
Speed of rotation	1490 rpm, speed regulated

Connections

Suction flange (AS) drilling+seal	EN 1092-2 / DN 400 / PN 10
face according to	21B / RF
Discharge flange (AD)	EN 1092-2 / DN 300 / PN 10
drilling+seal face according to	21B / RF

Base plate

Design	Pump and motor on common base frame (3E) – light execution with drip pan
Size	special
Material	S235JR
Leakage drain on	G1
drip pan (base plate)	
Foundation bolts	M20x320

Coupling

Coupling manufacturer	Siemens Flender
Coupling type	Arpex JUN
Coupling size	210-6
Spacer	280.0 mm, insulated

Weight net

Pump	905 kg
Base plate	280 kg
Coupling	22 kg
Coupling guard	8 kg
Motor	See sep. motor data sheet

For auxiliary connections see separate drawing.

Installation plan



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 100

Date: 27/05/2014

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Omega 300-435 A GC G F

Version no.: 1

Connect pipes without stress or strain!

Notes for dimensions:

Drawing is not to scale.

Admissible tolerances for shaft height: DIN 747

Dimensions without tolerance indication: ISO 2768 CK

Dimensions without tolerance indication – Welded parts: ISO 13920 – B/F

Dimensions without tolerance indication – Cast parts: ISO 8062 – CT13 – RMA(H)

General notes:

Piping must be connected free of stress. The pump must not be used as support for the piping (The pump is not an anchor point for the piping). The piping must be fixed in such a way that no forces, vibrations or the weight of the piping is transferred to the pump. Restrictions for forces and moments on suction and pressure nozzle must be considered. Connection by means of unrestrained expansion joints is not permitted!!

Connection plan



Customer item no.: 1.1.1 SS-1A

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

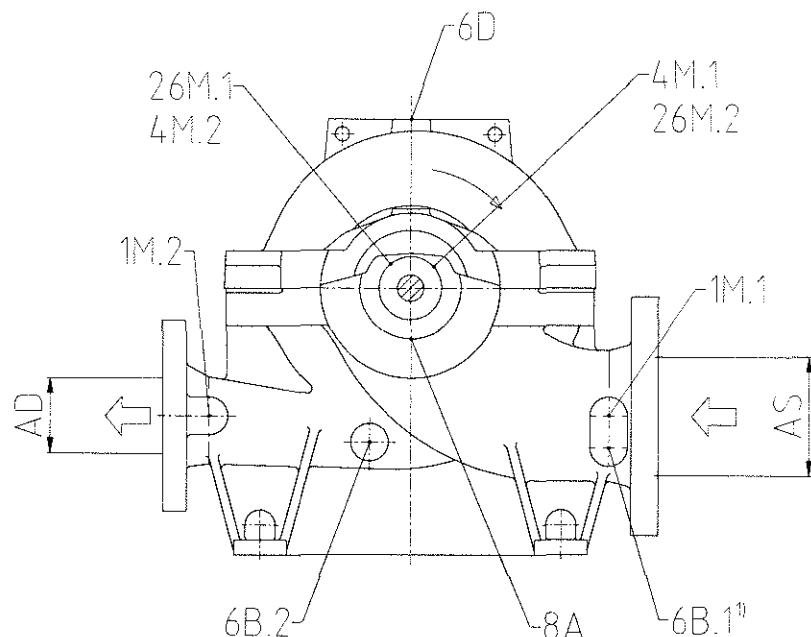
Item no.: 100

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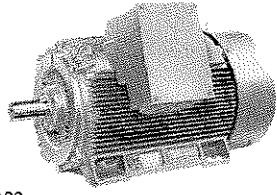
Omega 300-435 A GC G F

Version no.: 1



Connections

1M.1 Pressure gauge connection	G 1/2	Prepared for pressure gauge delivered separately
1M.2 Pressure gauge connection	G 1/2	Prepared for pressure gauge delivered separately
4M.1 Temperature gauge connection (Suction side)	G 1/2	Prepared for temperature gauge delivered separately
4M.2 Temperature gauge connection (Pressure side)	G 1/2	Prepared for temperature gauge delivered separately
6B.1 Pumped liquid drain	G 1/2	Hand operated valve without further piping
6B.2 Pumped liquid drain	G 1/2	Hand operated valve with further piping to drip pan
6D Pumped medium - filling / venting		Rigid pipe with four way connector and venting valve with further piping to drip pan
8A Leakage drain	G 3/4	Drilled and piped to drip pan
26M.1 Vibration sensor connection (driver side, 2 axis)	M 8	Drilled and plugged
26M.2 vibration sensor connection (non-driver side, 3 axis)	M 8	Drilled and plugged



Datenblatt für Drehstrommotoren

Data sheet for three-phase motors

Bestelldaten

1LA8357-4PB90-Z

Ordering data:

A12+A80+B02+B31+B32+D12+F03+F29+F83+G50+K45+L1Y+L97+M50+Q80

Kunden-Auftrags-Nr. / Client order no.:

Item-Nr. / Item no.:

Siemens-Auftrags-Nr. / Order no.:

Komm.-Nr. / Consignment no.:

Angebots-Nr. / Offer no.:

Projekt / Project:

Bemerkung / Remarks:

Elektrische Daten / Electrical data:

Allgemeine Daten / General data:

Typdaten / Type data:

Leistung P	500 kW
Motor power P	
Wärmeklasse / Ausnutzung	155(F) to 155(F) VSD only (155(F) to 130(B) DOL)
Thermal class / utilisation	
Spannung U D/Y	anormale Spannung 415 VD / - / - VY
Rated motor voltage U D/Y	
Frequenz f	50 Hz
Frequency f	
Drehzahl n	1488 1/min
Speed n	
Drehmoment M	3209 Nm
Motor torque M	
Strom I	VD
Current I	830 A

Baugröße	355
Frame size	
Kühlart	IC411 - Eigenbelüftet Oberflächengekühlte
Method of cooling	IC411 - self ventilated open-circuit cooled
Betriebsart	Umrichter ohne Filter
Duty type	Converter without filter
Baumform	IM B3
Type of construction	
Schutzaart	IP55
Degree of protection	
Gesamtgewicht	2200 kg
Total weight	
Anstrich	Normalanstrich
Coating	Standard paint finish
Farbe	RAL 7030
Color	
Zündschutzart	keine
Type of protection	none
Vorschrift/Ausführung	IEC, DIN, ISO, VDE, EN
Standards/specifications	

Bemessungsdaten / Ratings:

Bemessungsleistung P _n	460 kW
Rated motor power P _n	
Wärmeklasse / Ausnutzung	155(F) to 155(F) VSD only (155(F) to 130(B) DOL)
Thermal class / utilisation	
Servicefaktor	1.00
Service factor	
Bemessungsdrehzahl n _n	1488 1/min
Rated motor speed n _n	
Bemessungsmoment M _n	2952 Nm
Rated motor torque M _n	
Bemessungsstrom I _n	VD
Rated motor current I _n	764 A
Anzugs-/Bemessungsstrom	
Starting / rated motor current	N/A
Kipp-/Bemessungsmoment M _{Mn}	2.70
Breakdown-/rated motor torque M _{Mn}	
Anzugs-/Bemessungsmoment	
Starting / rated motor torque	N/A
IE Wirkungsgradklassif. nach IEC 60034-30	keine
IE Efficiency class in acc. to IEC 60034-30	none
Teillast P/P _n	
Partial load P/P _n	5/4
Wirkungsgrad η in % nach IEC 60034-2-1	96,0 %
Efficiency η in % in acc. to IEC 60034-2-1	96,2 %
Leistungsfaktor cos φ	0,88
Power factor cos φ	0,87

Anschlusskasten / Terminal box:

Klemmenkastentyp	1XB1 631
Type of terminal box	
Max. Leiterquerschnitt	240 mm ²
Conductor cross section, max. (IEC)	
Gewinde Kontaktschraube	M16
Contact screw thread	
Kabeldurchmesser von ... bis ...	56,0 ... 68,5
Cable diameter from ... to ...	
Kabeleinführung	4 x M80x2 + 2 x M25x1,5
Cable entry	

Sonderausführung / Special design:

A12	Motorschutz durch Kaltleiter mit 6 eingebauten Temperaturfühlern für Warnung und Abschaltung PTC thermistor motor protection using 6 integrated temperature sensors for alarm and shutdown
A80	2 Doppel-Widerstandsthermometer PT100 für 3-Leiterschaltung ab Hilfsklemmenkasten bei Wälzlagierung 2x PT100 double resistance thermometers for a 3-wire connection from the auxiliary terminal box for roller bearings
B02	Abnahmeprüfzeugnis 3.1 nach EN 10204 Acceptance test certificate 3.1 acc. to EN 10204
B31	Dokument Elektrisches Datenblatt Electrical data sheet document
B32	Dokument Auftragsmaßbild Order dimension drawing document
D12	Kühlklüfttemperatur 50 °C Cooling air temperature 50 °C
F29	Geräuschmessung im Leerlauf, ohne Geräuschanalyse, mit Abnahme Noise measurement under no-load conditions without noise analysis, with acceptance
F83	Typ-Prüfung mit Wärmelauf für horizontale Motoren, mit Abnahme Type test with heat run for horizontal motors, with acceptance
G50	Messnippel für SPM-Stoßimpulsmeßung Measuring nipple for SPM shock pulse measurement
K45	Stillstandsheizung 230V Anti-condensation heating, 230V
L1Y	anomale Spannung / anomale Wicklung L1Y:415VD 50 Hz Non-standard voltage/non-standard winding L1Y:415VD 50 Hz
L97	Hilfsanschlusskasten 1XB3 020 Auxiliary terminal box 1XB3 020
M50	Hilfsklemmenkasten 1XB9 016 (Grauguss) 1XB9 016 auxiliary terminal box (cast iron)
Q80	Verlängerung der Mängelhaftung um 12 Monate auf insgesamt 24 Monate (2 Jahre) ab Auslieferung Liability for defect period extended by 12 months up to a total of 24 months (2 years) from initial shipment

Mechanische Daten / Mechanical data:

Trägheitsmoment J _{xx}	8,6 kg·m ²
Moment of inertia J _{xx}	
Läuferwicklungsmaterial	Al
Rotor winding material	
Lagerausführung	Wälzlager
Bearing design	Roller bearing
Lagertyp AS/BS	
DE/NDE bearing design	6220 C3 / 6220 C3 *
Drehrichtung	beide
Direction of rotation	Both
Nachschrämlerfrist/-menge	3000 h / 20 g
Relubrication interval/quantity	

Umgebungsbedingungen / Environmental conditions:

Kühlmittelempfehlung K _c	50 °C
Coolant temperature K _c	
Aufstellungshöhe	1,000 m
Installation altitude	

* Standard: isoliertes Lager auf BS - VL0241
Standard: insulated bearing at NDE - VL0241

Technische Änderungen vorbehalten! Es könnte Unterschiede zwischen Datenblatt und Leistungsschild geben.
Technical data are subject to change! There may be discrepancies between calculated and rating plate values.

Data sheet



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

Item no.: 200

Date: 19/06/2014

Page: 1 / 8

RDLO 600-705 A1 SC G F

Version no.: 1

Operating data

Requested flow rate	1679 l/s	Actual flow rate	1679 l/s
Requested developed head	58 m	Actual developed head	58 m
Pumped medium	Water	Efficiency	88.2 %
	Clean water	Power absorbed	1083 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	992 rpm
Ambient air temperature	50.0 °C	NPSH required	8.4 m
Fluid temperature	20.0 °C	NPSH 3%	7.0 m
Fluid density	998 kg/m³	Discharge press.	5.68 bar.g
Fluid viscosity	1.00 mm²/s	Min. allow. flow for continuous stable operation	990 l/s
Suction pressure max.	0.00 bar.g	Shut off head	87 m
Max. power on curve	1100 kW	Max. allow. flow	2050 l/s
		Design	Single system 1 x 100 %
		Performance test	Yes

Design

Pump standard	KSB axially split volute casing pump	Impeller diameter	726.0 mm
Design	Pump and motor on common base frame (3E) with drip pan	Minimum impeller diameter	620.0 mm
Orientation	Horizontal	Full impeller diameter	770.0 mm
Suction flange (AS) according to	EN 1092-2 / DN 700 / PN 10 21B / RF	Direction of rotation from drive	Clockwise
Discharge flange (AD) according to	EN 1092-2 / DN 600 / PN 10 21B / RF	Bearing seal driver side	V ring
Shaft seal	Single acting mechanical seal	Bearing type driver side	Anti-friction bearings
Manufacturer	Burgmann	Lubrication type driver side	Grease
Type	H75S2	Bearing sealing end side	V ring
Mechanical Seal Form	Balanced	Bearing type end side	Anti-friction bearings
Material code	BQ1EGG	Bearing lubrication end side	Grease
Sealing plan	E Single acting mechanical (external circulation with cyclone separator)	Temperature measurement tapping	with
Clean water operation:	Pumped liquid with max. 100 mg/l solids.	Temperature indicator, local pump/non-drive side	with
Wear ring	Casing/impeller wear ring	Temperature indicator, local motor side	with
Wear ring type	Standard design	Temperature signal processing without Vibration measurement tapping with	
		Vibration measurement accessory	Vibration sensor and monitoring driver and end sides

Data sheet



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

Item no.: 200

Date: 19/06/2014

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RDLO 600-705 A1 SC G F

Version no.: 1

Driver, accessories

Coupling manufacturer	KTR	Base plate size	special
Coupling type	Radex-N	Motor side drill	with
Nominal size	138 NANA 3,	Scope of mounting parts :	Base frame for pump set incl.
Spacer length	300 mm, insulated	foundation bolts	
Coupling guard type	Heavy duty (ZN3230) Solid sheet 1.5 mm	Driver type	Electric motor, suitable for speed regulation
Guard size	SA 6	Drive standard mech.	IEC
Guard material	C-steel	Model (make)	Siemens or equiv.
Base plate type	Pump and motor on common base frame (3E) – light execution with drip pan	Drive supplied by	Motor supplied by KSB
		Motor const. type	B3
		Motor speed	992-732 rpm
		Frequency	50 - 37 Hz
		Rated voltage	3300 V
		Rated power P2	1300 kW
		Number of poles	6
		Starting mode	by variabel speed drive
		Motor cooling method	Surface cooling
		Motor material	Grey cast iron GG/CAST IRON

Materials SC

Notes

Ammonium (NH_4^+) $\leq 2 \text{ mg/kg}$, free of H_2S ; Chlorine (Cl_2) $\leq 0.6 \text{ mg/kg}$.

general criteria for a water analysis: pH-value ≥ 7 ; chloride content (Cl^-) $\leq 250 \text{ mg/kg}$, chlorine (Cl_2) $\leq 0.6 \text{ mg/kg}$.

Volute casing (102)	Ductile cast iron EN-GJS-400-15	Bearing housing (350.1) Bearing housing (350.2)	Grey cast iron EN-GJL-250 Grey cast iron EN-GJL-250
Pump shaft (211)	Chrome steel 1.4021+QT800	Shaft seal housing (441)	Grey cast iron EN-GJL-250
Double-entry impeller (234)	Duplex 1.4517	Casing wear ring (502) Impeller wear ring (503)	1.4021 (AISI420) hardened Duplex 1.4470
		Shaft protecting sleeve (524.2)	1.4571 (AISI 316)

Data sheet



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

Item no.: 200

Date: 19/06/2014

Page: 3 / 8

RDLO 600-705 A1 SC G F

Version no.: 1

Auxiliary connections

1M.1 Pressure gauge connection	G 1/2, Prepared for pressure gauge delivered separately	6B.1 Pumped liquid drain	G 1, Hand operated valve without further piping
1M.1 Pressure gauge material	1.4571	6B.1 Material	Stainless steel 1.4408
1M.1 Pressure range	-1 to +1.5 bar	6B.2 Pumped liquid drain	G 1, Hand operated valve with further piping to drip pan
1M.1 Damping	With damping	6B.2 Material	Stainless steel 1.4408
1M.1 Pressure gauge dial size	NG 150	6D Pumped medium - filling / venting	Rigid pipe with four way connector and venting valve with further piping to drip pan
1M.2 Pressure gauge connection	G 1/2, Prepared for pressure gauge delivered separately	6D Material	Stainless steel 1.4408
1M.2 Pressure gauge material	1.4571	6D Material sealing pipe	Stainless steel 1.4571
1M.2 Pressure range	0 - 16 bar	8A Leakage drain	G 3/4, Drilled, with further piping to drip pan
1M.2 Damping	With damping	26M.1 SPM sensor connection (driver side)	M 8, Vibration sensor and monitoring, 2 axis
1M.2 Pressure gauge dial size	NG 150	26M.2 SPM sensor connection (non-driver side)	M 8, Vibration sensor and monitoring, 3 axis
4M.1 Temperature gauge connection (Suction side)	G 1/2, Prepared for temperature gauge delivered separately		
4M.2 Temperature gauge connection (Pressure side)	G 1/2, Prepared for temperature gauge delivered separately		

Certifications

Tests acc. to QCP-Plan

Hydraulic performance test

Acceptance standard	ISO 9906 class 1U
Quantity meas. points Q-H	7
Certificate	Inspection cert. 3.2 to EN 10204
Test participation	Witnessed
Quantity, non-witnessed	4
Quantity, witnessed	1
NPSH test	Yes
Quantity meas. points NPSH	3

Hydrostatic test (room temp.)

Range	Complete pump with shaft seal
Test pressure	13 bar.g
Test time	30.0 min
Certificate	Inspection cert. 3.2 to EN 10204
Test participation	Witnessed
Quantity, non-witnessed	4
Quantity, witnessed	1
Final visual inspection	
Certificate	Report
Test participation	Witnessed
Quantity, non-witnessed	0
Quantity, witnessed	5

String test

Acoustic test ISO 20361	3 speeds with job motor one unit with one job VSD
Vibration test ISO 10816	Yes
Bearing temperature test	Yes
Quantity, witnessed	1

Material certificates: Volute casing (102)

Certificate for analysis + NDT Inspection cert. 3.1 to EN 10204

Balancing test

Balancing grade	G 6,3
Part	Impeller
Certificate	Inspection cert. 3.1 to EN 10204
Test participation	Non-Witnessed
Quantity, non-witnessed	4
Quantity, witnessed	1

Material certificates: Double-entry impeller (234)

Certificate for analysis + NDT Inspection cert. 3.1 to EN 10204

Material certificates: Pump shaft (211)

Certificate for analysis Inspection cert. 3.1 to EN 10204

Material certificates: Casing wear ring (502)

Certificate for analysis Inspection cert. 3.1 to EN 10204

Material certificates: Impeller wear ring (503)

Certificate for analysis Inspection cert. 3.1 to EN 10204

Material certificates: Shaft sleeve (524)

Certificate for analysis Inspection cert. 3.1 to EN10204

Data sheet



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

Item no.: 200

Date: 19/06/2014

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RDLO 600-705 A1 SC G F

Version no.: 1

Coating

Exterior coating

KSB coating code	R1 TO AA 0080-06-01	Intermediate/Final coating	2-pack epoxy
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Color	Ultramarine blue (RAL 5002) KSB-blue
Primer	2-component epoxy-zinc dust	Total film thickness approx.	300 µm

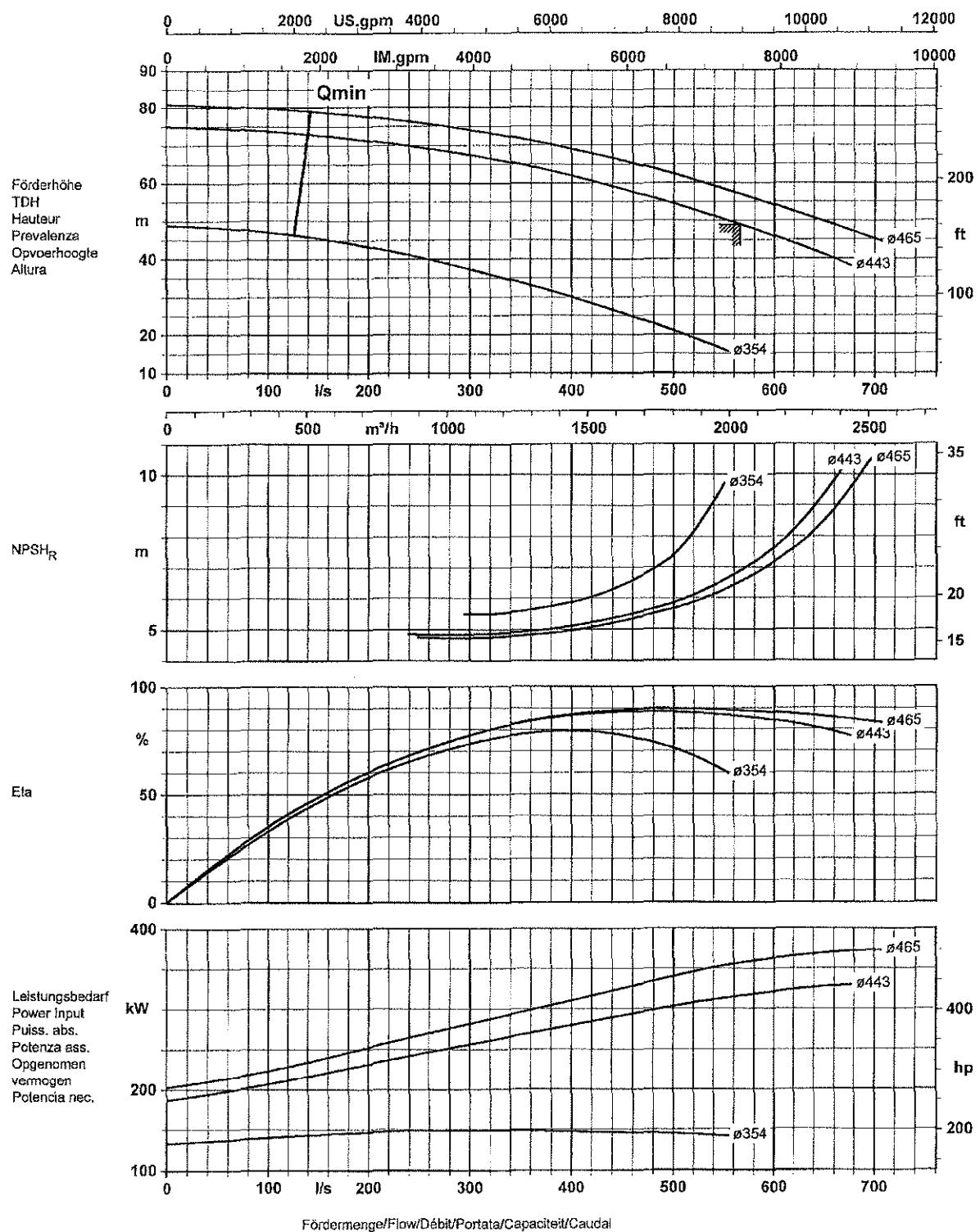
Interior coating

KSB coating code	Sika Permacor 136 TW (suitable for drinking water)	Color	KSB's choice
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Total film thickness approx.	300 µm
Intermediate/Final coating	2-component epoxy resin	Interior coatings for pumps are subjected to high loads and thus gradual, unavoidable wear, even when the plant is being operated in compliance with the specification. Signs of wear, including cracks, flaking, and similar, are to be viewed as part of the natural wear of the pump (regardless of how long it has been in operation) and do not qualify as defects. KSB shall not be held liable for wear or damage to interior coatings, including consequential damage to other pump components. Interior coatings must be checked, touched up, and repaired by the customer on a regular basis respective of the media pumped to avoid further damage to the coating and/or consequential damage to other pump components caused by corrosion and abrasion.	

Base frame

KSB coating code	R1 TO AA 0080-06-01	Final coating	2-component epoxy resin high solid
Surface preparation	Blasting, surface treatment quality SA 2 1/2	Color	Ultramarine blue (RAL 5002) KSB-blue
Primer	2-component epoxy-zinc dust	Total film thickness approx.	150 µm

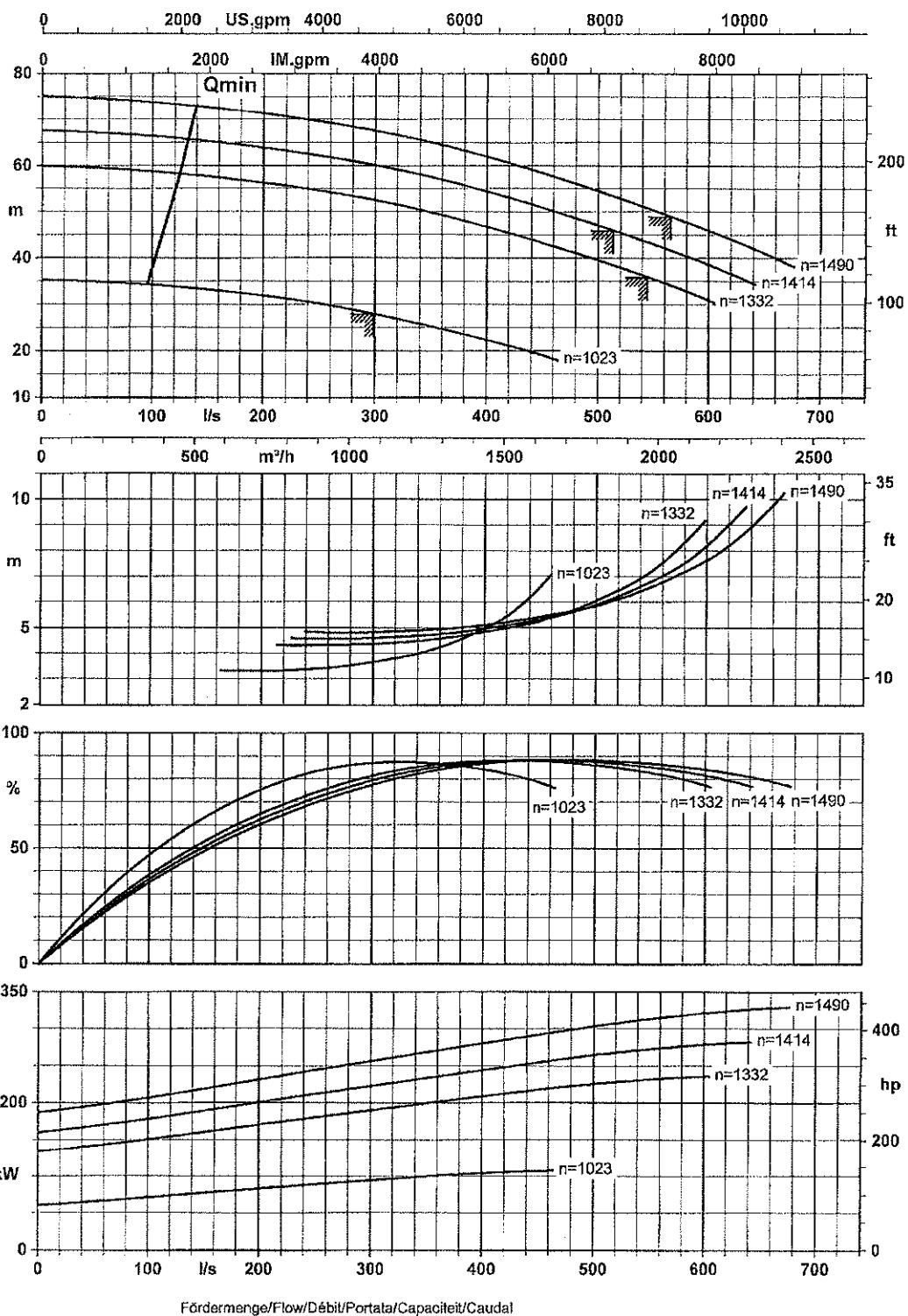
Baureihe-Größe Type-Size Modèle	Tipo Serie Tipo	Nenndrehzahl Nom. speed Vitesse nom.	Velocità di rotazione nom. Nominaal toerental Revvoluzioni nom.	Laufrad-Ø Impeller dia. Diamètre de roue	Ø girante Waaler Ø Ø rodete	
Omega 300-435A		1490 1/min				KSB 
Projekt Project Projet	Progetto Projekt Proyecto	Angebots-Nr. Quotation No. N° de l'offre	N° offerta Offerant. N° offre	Pos.-Nr. Item No. N° de pos.	N° pos Pos. nr. N° de art	KSB Aktiengesellschaft 67225 Frankenthal Johann-Klein-Straße 9 67227 Frankenthal
SS 1-A + SS 4-B		Design point		566 l/s - 49 m		



Laufrauadaustrittsbreite/Impeller outlet width/Largeur à la sortie de la roue 81 mm
Luce della girante/Waaler uitstroedepte/Anchura de salida rodete 81 mm

Aus Kurve K42798 +15/4° gerechnet
T145-F1, Schmöller Johannes, 2014-05-23

Baureihe-Größe Type-Size Modèle	Tipo Serie Tipo	Nenndrehzahl Nom. speed Vitesse nom.	Velocità di rotazione nom. Nominaal toerental Revvoluzioni nom.	Laufrad-Ø Impeller dia. Diamètre de roue	Ø girante Waaijer ø Ø rodete	
Omega 300-435A				443 mm		
SS 1-A	Speed curves					KSB b



Laufrauadaustrittsbreite/Impeller outlet width/Largeur à la sortie de la roue
Luce della girante/Waaijer uitbreedte/Anchura de salida rodete 81 mm
81 mm

Aus Kurve K42798 + 16/4* gerechnet
T145-Ft, Schmidziger Johannes, 2014-05-23

Installation plan



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

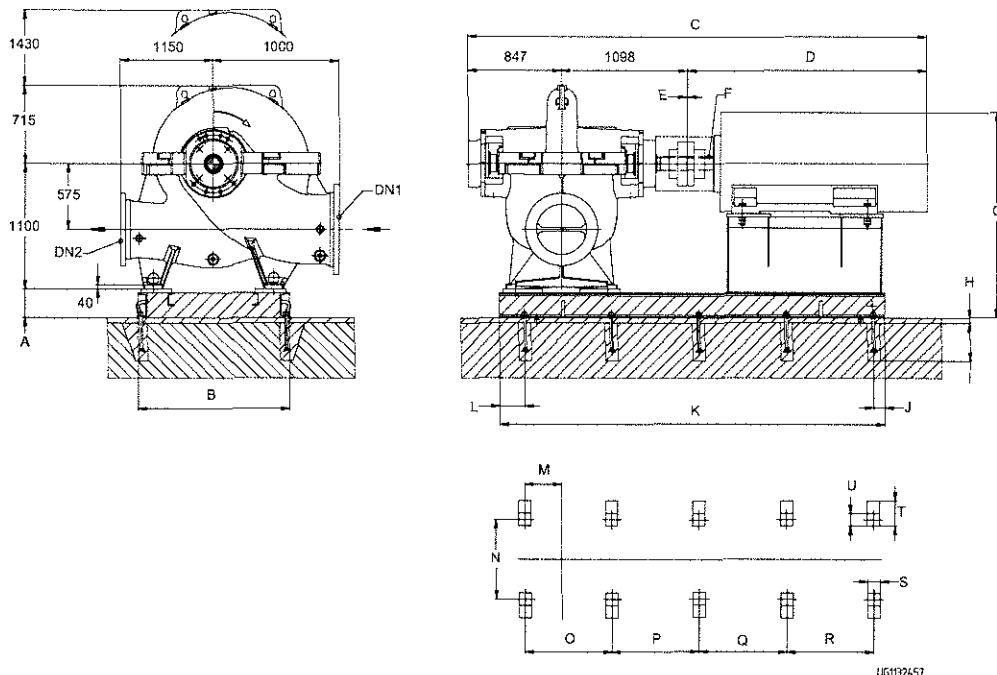
Item no.: 200

Date: 19/06/2014

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RDLO 600-705 A1 SC G F

Version no.: 1



Drawing is not to scale

Dimensions in mm

Motor

Motor manufacturer	Siemens or equiv.
Motor size	
Motor power	1300 kW
Number of poles	6
Speed of rotation	992 rpm, speed regulated

Connections

Suction flange (AS) according to	EN 1092-2 / DN 700 / PN 10 21B / RF
Discharge flange (AD) according to	EN 1092-2 / DN 600 / PN 10 21B / RF

Baseplate

Design	Pump and motor on common base frame (3E) – light execution with drip pan
Size	
Material	Welded Steel ST
Leakage drain (8B) on drip pan (base plate)	G1
Foundation bolts	M24x320

Coupling

Coupling manufacturer	KTR
Coupling type	Radex N
Coupling size	138 NANA 3
Spacer	300 mm

Weight net

Pump	5150 kg
Base plate	1000 kg
Coupling	115 kg
Coupling guard	10 kg
Motor	See sep. motor data sheet

For auxiliary connections see separate drawing.

Installation plan



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

Item no.: 200

Date: 19/06/2014

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RDLO 600-705 A1 SC G F

Version no.: 1

Connect pipes without stress or strain!

Notes for dimensions:

Drawing is not to scale and only exemplary. Weights and dimensions shown are not binding. Binding arrangement drawing only on request and with submittal of binding motor dimension sheet.

Admissible tolerances for shaft height: DIN 747

Dimensions without tolerance indication: ISO 2768 CK

Dimensions without tolerance indication – Welded parts: ISO 13920 – B/F

Dimensions without tolerance indication – Cast parts: ISO 8062 – CT13 – RMA(H)

General notes:

Piping must be connected free of stress. The pump must not be used as support for the piping (The pump is not an anchor point for the piping). The piping must be fixed in such a way that no forces, vibrations or the weight of the piping is transferred to the pump. Restrictions for forces and moments on suction and pressure nozzle must be considered. Connection by means of unrestrained expansion joints is not permitted!!

Connection plan



Customer item no.: 1.1.2 SS 1-B

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 5

Number: 4002140658

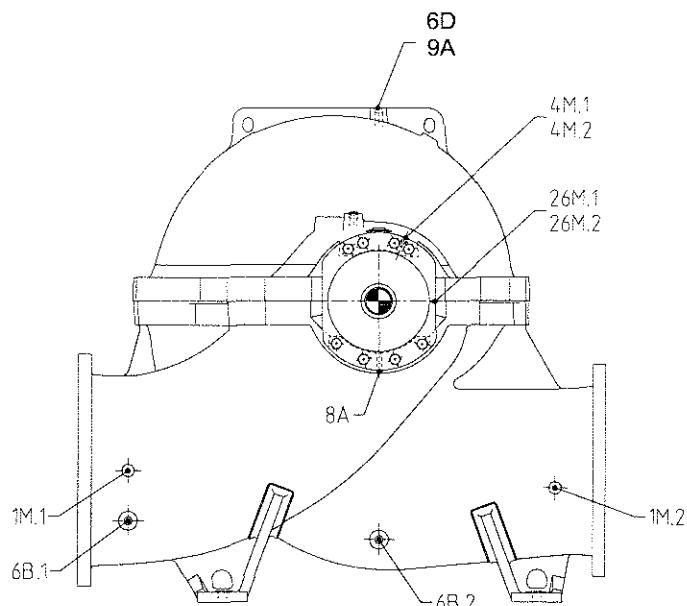
Item no.: 200

Date: 19/06/2014

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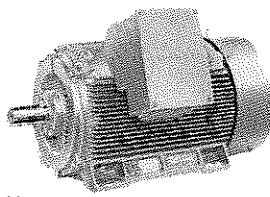
RDLO 600-705 A1 SC G F

Version no.: 1



Connections

1M.1 Pressure gauge connection	G 1/2	Prepared for pressure gauge delivered separately.
1M.2 Pressure gauge connection	G 1/2	Prepared for pressure gauge delivered separately.
6B.1 Pumped liquid drain	G 1	Hand operated valve without further piping.
6B.2 Pumped liquid drain	G 1	Hand operated valve with further piping to drip pan.
6D Pumped liquid vent	G 1	Hand operated valve with further piping to drip pan.
8A Leakage drain	G 3/4	Drilled and piped to drip pan
9A Sealing liquid outlet		Rigid pipe supplied with 'four way connector' for valve connection
26M.1 SPM sensor connection M 8 (driver side, 2 axis)		Drilled and plugged.
26M.2 SPM sensor connection M 8 (non-driver side, 3 axis)		Drilled and plugged.
4M.1 Temperature gauge connection (Suction side)	G 1/2	Prepared for temperature gauge delivered separately.
4M.2 Temperature gauge connection (Pressure side)	G 1/2	Prepared for temperature gauge delivered separately.



Datenblatt für Drehstrommotoren

Data sheet for three-phase motors

Bestelldaten

1LA8357-4PB90-Z

Ordering data:

A12+A80+B02+B31+B32+D12+F03+F29+F83+G50+K45+L1Y+L97+M50+Q80

Kunden-Auftrags-Nr. / Client order no.:

Item-Nr. / Item no.:

Siemens-Auftrags-Nr. / Order no.:

Komm.-Nr. / Consignment no.:

Angebots-Nr. / Offer no.:

Projekt / Project:

Bemerkung / Remarks:

Elektrische Daten / Electrical data:				Allgemeine Daten / General data:	
Typdaten / Type data:				Baugröße	
Leistung P	500 kW			Frame size	355
Motor power P				Kühlart	IC411 - Eigenbelüftet Oberflächengekühlt
Wärme Klasse / Ausnutzung	155(F) to 155(F) VSD only			Method of cooling	IC411 - self ventilated open-circuit cooled
Thermal class / utilisation	(155(F) to 130(B) DOL)			Betriebsart	Umrichter ohne Filter
Spannung U D/Y	anomale Spannung			Duty type	Converter without filter
Rated motor voltage U D/Y	415 VD / - / VY			Bauform	IM B3
Frequenz f	50 Hz			Type of construction	
Frequency f				Schutzart	IP55
Drehzahl n	1488 1/min			Degree of protection	
Speed n				Gesamtgewicht	2200 kg
Drehmoment M	3209 Nm			Total weight	
Motor torque M				Anstrich	Normalanstrich
Strom I	VD			Coating	Standard paint finish
Current I	830 A			Farbe	RAL 7030
Bemessungsdaten / Ratings:				Zündschutzart	keine
Bemessungsleistung P _n	460 kW			Type of protection	none
Rated motor power P _n				Vorschrift/Ausführung	IEC, DIN, ISO, VDE, EN
Wärme Klasse / Ausnutzung	155(F) to 155(F) VSD only			Standards/specifications	
Thermal class / utilisation	(155(F) to 130(B) DOL)			Anschlusskasten / Terminal box:	
Servicefaktor	1.00			Klemmenkastentyp	1XB1 631
Service factor				Type of terminal box	
Bemessungsdrehzahl n _n	1488 1/min			Max. Leiterquerschnitt	240 mm ²
Rated motor speed n _n				Conductor cross section, max. (IEC)	
Bemessungsmoment M _n	2952 Nm			Gewinde Kontaktschraube	M16
Rated motor torque M _n				Contact screw thread	
Bemessungsstrom I _n	VD			Kabeldurchmesser von ... bis ...	56,0 ... 68,5
Rated motor current I _n	764 A			Cable diameter from ... to ...	
Anzugs-/Bemessungsstrom	N/A			Kabeleinführung	4 x M80x2 + 2 x M25x1,5
Starting / rated motor current				Cable entry	
Kipp-/Bemessungsmoment M/M _n	2.70			Sonderausführung / Special design:	
Breakdown-rated motor torque M _n /M _n				A12	Motorschutz durch Kältefühler mit 6 eingebauten Temperaturfühlern für Warming und Abschaltung
Anzugs-/Bemessungsmoment	N/A				PTC thermistor motor protection using 6 integrated temperature sensors for alarm and shutdown
Starting / rated motor torque				A80	2 Doppel-Widerstandsthermometer PT100 for 3-Leiterschaltung ab Hilfsklemmenkasten bei Wälzlagierung
IE Wirkungsgradklassif. nach IEC 60034-30	keine				2x PT100 double resistance thermometers for a 3-wire connection from the auxiliary terminal box for roller bearings
IE Efficiency class in acc. to IEC 60034-30	none			B02	Abnahmeprüfzeugnis 3.1 nach EN 10204
Teillast P/P _n					Acceptance test certificate 3.1 acc. to EN 10204
Partial load P/P _n	5/4	4/4	3/4	B31	Dokument Elektrisches Datenblatt
Wirkungsgrad η in % nach IEC 60034-2-1	96,0 %	96,2 %	96,3 %	B32	Dokument Auftragsmaßbild
Efficiency η in % in acc. to IEC 60034-2-1				D12	Order dimension drawing document
Leistungsfaktor cos φ	0,88	0,87	0,83		Kühllufttemperatur 50 °C
Power factor cos φ					Cooling air temperature 50 °C
Mechanische Daten / Mechanical data:					Geräuschmessung im Leerlauf, ohne Geräuschanalyse, mit Abnahme
Trägheitsmoment J _{rot}	8.5 kg*m ²				Noise measurement under no-load conditions without noise analysis, with acceptance
Moment of inertia J _{rot}				F29	
Läuferwicklungsmaterial	Al				
Rotor winding material				F83	Typ-Prüfung mit Wärmetauf für horizontale Motoren, mit Abnahme
Lagerausführung	Wälzlager				Type test with heat run for horizontal motors, with acceptance
Bearing design	Roller bearing			G50	Messnippel für SPM-Stoßimpulsmeßung
Lagertyp AS/BS				K45	Measuring nipple for SPM shock pulse measurement
DEN/DIE bearing design	6220 C3 / 6220 C3 *				Stillstandsheizung 230V
Drehrichtung	beide			L1Y	Anti-condensation heating, 230V
Direction of rotation	Both				anomale Spannung / anomale Wicklung L1Y:415VD 50 Hz
Nachschmierfrist/-menge	3000 h / 20 g			L97	Non-standard voltage/non-standard winding L1Y:415VD 50 Hz
Relubrication interval/quantity				M50	Hilfsanschlusskasten 1XB3 020
Umgebungsbedingungen / Environmental conditions:					Auxiliary terminal box 1XB3 020
Kühlmitteltemperatur K	50 °C				1XB9 016 auxiliary terminal box (cast iron)
Coolant temperature K					Verlängerung der Mängelhaftung um 12 Monate auf insgesamt 24 Monate (2 Jahre) ab Auslieferung
Aufstellungshöhe	1,000 m				Liability for defect period extended by 12 months up to a total of 24 months (2 years) from initial shipment
Installation altitude					
Technische Änderungen vorbehalten! Es könnte Unterschiede zwischen Datenblatt und Leistungsschild geben.					
Technical data are subject to change! There may be discrepancies between calculated and rating plate values.					

* Standard: isoliertes Lager auf BS - VL0241
Standard: insulated bearing at NDE - VL0241

Data sheet



Customer item no.: 5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 500

Date: 23/06/2014

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KRTK 250-401/506UG1-S

Version no.: 1

Operating data

Requested flow rate	200.000 l/s	Actual flow rate	198.012 l/s
Requested developed head	17.00 m	Actual developed head	16.66 m
Pumped medium	Water, rainwater with strainer Not containing chemical and mechanical substances which affect the materials	Efficiency	80.4 %
Ambient air temperature	20.0 °C	Power absorbed	40.04 kW
Fluid temperature	20.0 °C	Pump speed of rotation	983 rpm
Fluid density	998 kg/m³	Max. power on curve	42.79 kW
Fluid viscosity	1.00 mm²/s	Shutoff head	27.01 m
		Design	Single system 1 x 100 %

Design

Design	Close-coupled submersible	Material code	SIC/SIC/NBR
Orientation	Vertical	Impeller type	Multivane radial flow impeller (K)
Suction flange pump according to(DN1)	unmachined	Wear ring	Casing/impeller wear ring
Discharge flange pump according to(DN2)	DN 250 / PN 10 / Drilled according to EN 1092-2	Impeller diameter	408.0 mm
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Free passage size	105.0 mm
Manufacturer	KSB	Direction of rotation from drive	Clockwise
Type	MG		

Driver, accessories

Driver type	Electric motor	Number of poles	6
Model (make)	KSB	Starting mode	Direct/Star-delta possible
Motor const. type	KSB Sub. motor	Connection mode	Delta
Frequency	50 Hz	Motor cooling method	Surface cooling
Rated voltage	415 V	Motor version	U
Rated power P2	48.00 kW	Cable design	Rubber hose
Available reserve	12.17 %	Cable entry	Sealed along entire length
Rated current	94.5 A	Power cable	S1BN8-F 4G10
Starting current ratio	5.3	Number of power cables	2
Insulation class	F to IEC 34-1	Control cable	S1BN8-F 12G1.5
Motor enclosure	IP68	Number of control cables	1
Cos phi at 4/4 load	0.78	Moisture sensor	with
Motor efficiency at 4/4 load	90.3 %	Cable length	10.00 m
Temperature sensor	Bimetallic switch 2x		
Motor winding	415 / 720 V		

Materials G1

Notes	O-Ring (412)	Nitrile rubber NBR
general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg; chlorine (Cl2) <= 0.6 mg/kg.	Casing wear ring (502.1)	CrNi steel VG434
Pump casing (101)	Impeller wear ring (503)	CrNi steel VG434
Discharge cover (163)	Motor housing (811)	Grey cast iron EN-GJL-250
Shaft (210)	Motor cable (824)	Chloroprene rubber
Impeller (230)	Hexagon socket head cap screw (914)	CrNiMo steel A4

Data sheet



Customer item no.: 5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 500

Date: 23/06/2014

Page: 2 / 6

KRTK 250-401/506UG1-S

Version no.: 1

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months	Packaging for storage Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.	Indoor
Packaging for transport IPPC Standard ISPM 15	Ship Yes		

Nameplates

Nameplates language	International	Duplicate nameplate	with
---------------------	---------------	---------------------	------

Certifications

Hydraulic performance test

Acceptance standard	ISO 9906 class 1B
Quantity meas. points Q-H	5
Certificate	Inspection cert. 3.2 to EN 10204
Test participation	Witnessed
Quantity, non-witnessed	1
Quantity, witnessed	1
Vibration test	Yes

Hydrostatic test (room temp.)

Range	Complete pump with shaft seal
Test pressure	4.50 bar.g
Test time	10.0 min
Certificate	Inspection cert. 3.1 to EN 10204
Test participation	Non-witnessed

Final visual inspection

Certificate	Without
Test participation	Witnessed

Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)

Certificate Test report 2.2 to EN 10204

Tests acc. to QCP-Plan (WBP)

QCP No.

Order documentation

The following documents will be supplied with the order:

Manufacturer's or conformity declaration

General arrangement drawing

Material certificates

Operating manual

WBP (Material and product test plan)

Performance curve

Technical data sheet

Languages English

Data sheet



Customer item no.: 5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 500

Date: 23/06/2014

Page: 3 / 6

KRTK 250-401/506UG1-S

Version no.: 1

Installation parts

Installation type	stationary 2 guide rail	Type	Chain
Scope of supply	Pump with installation parts For guide rail arrangements, the guide rails are not included in KSB's scope of supply.	Material	CrNiMo steel 1.4404
		Length	5.00 m
		Max. load	1250 kg
Installation depth	4.50 m		
Material concept	G		

Duckfoot bend

Size	DN 250
Flange design	EN
Duckfoot bend size (DN2 / DN3)	DN 250 Drilled according to EN
Material	Grey cast iron EN-GJL-250
Mounting type	Composite anchor bolts
Foundation rail	Without

Claw

Design	straight
Size	DN 250

Lifting chain / -rope

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin		KSB-blue
Intermediate coating	2-component epoxy resin high solid	Total film thickness approx.	300 µm

Performance curve



Customer item no.:5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

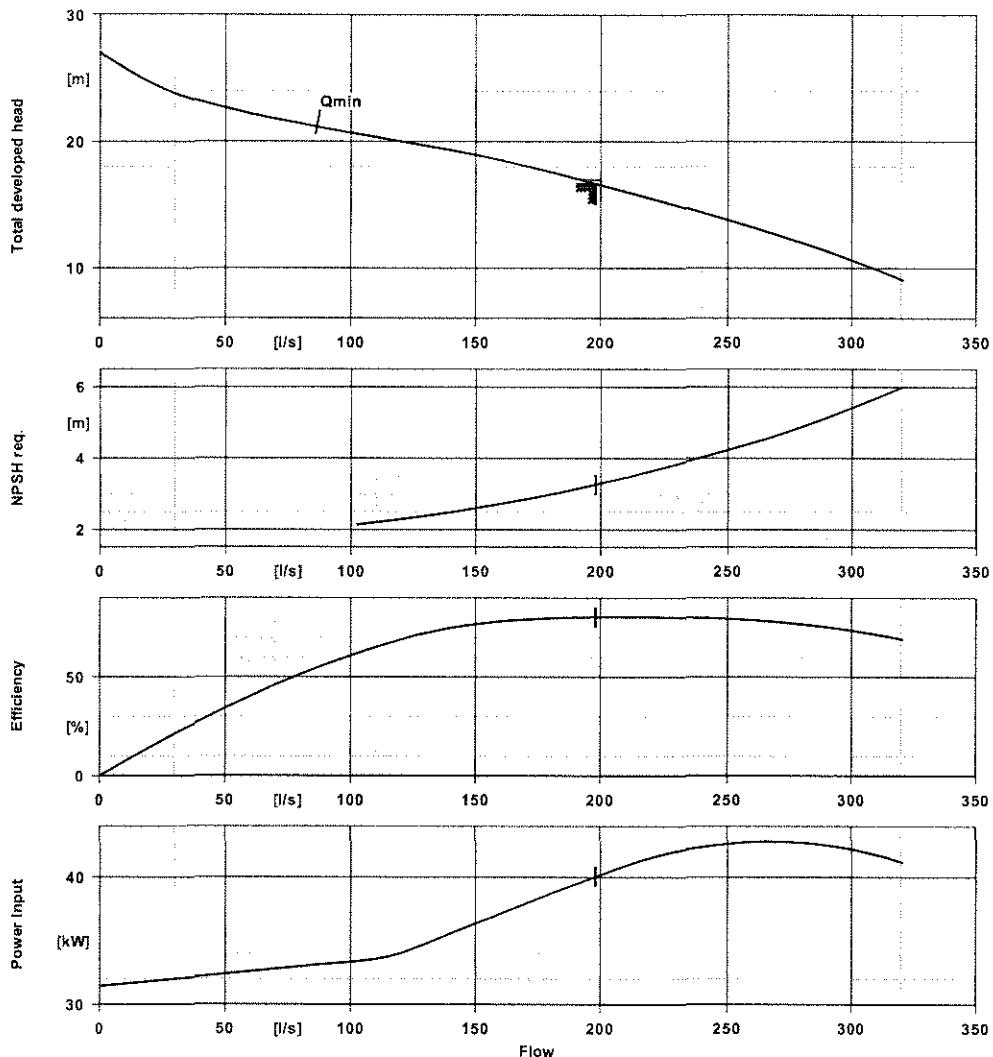
Item no.:500

Date: 23/06/2014

Page: 4 / 6

KRTK 250-401/506UG1-S

Version no.: 1



Curve data

Speed of rotation	983 rpm	Efficiency	80.4 %
Fluid density	998 kg/m ³	Power absorbed	40.04 kW
Viscosity	1.00 mm ² /s	NPSH required	3.26 m
Flow rate	198.012 l/s	Curve number	K42501s
Requested flow rate	200.000 l/s	Effective impeller diameter	408.0 mm
Total developed head	16.66 m	Acceptance standard	ISO 9906 class 1B
Requested developed head	17.00 m		

Installation plan



Customer item no.:5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

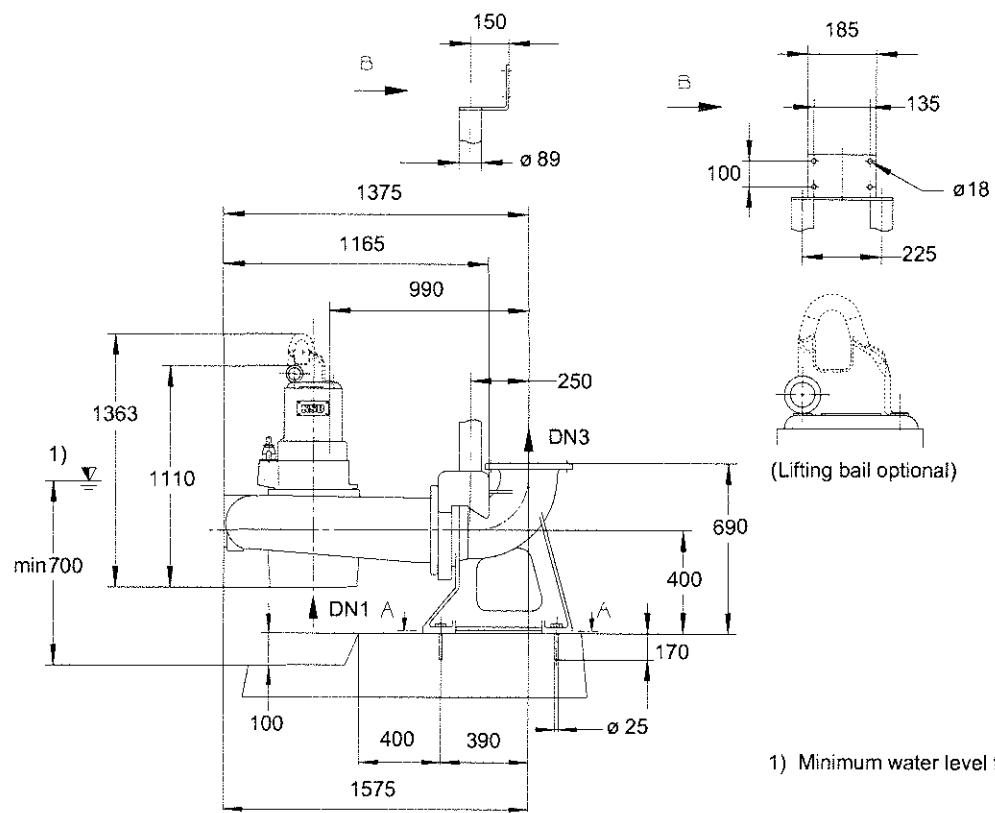
Item no.:500

Date: 23/06/2014

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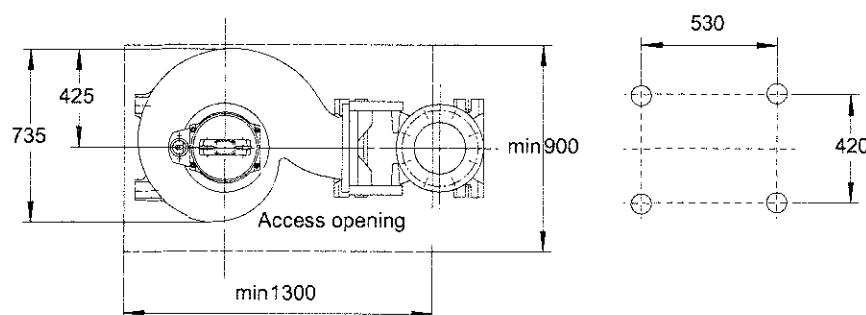
KRTK 250-401/506UG1-S

Version no.: 1



1) Minimum water level t1

A-A



Drawing is not to scale

Dimensions in mm

Installation plan



Customer item no.: 5.2.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 500

Date: 23/06/2014

Page: 6 / 6

KRTK 250-401/506UG1-S

Version no.: 1

Motor

Motor manufacturer	KSB
Motor size	50
Motor power	48.00 kW
Number of poles	6
Speed of rotation	980 rpm

Connections

Suction flange pump according unmachined
to(DN1)
Duckfoot bend size (DN2 / DN3)DN 250 Drilled according to
EN

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Dimensions without tolerances - gray cast iron parts:

Weight net

Pump, Motor, Cable	834 kg
Claw / Foot	70 kg
Total	904 kg

For auxiliary connections see
separate drawing.

DIN 747
ISO 2768-m
EN735
ISO 13920-B
ISO 8062-CT9

Data sheet



Customer item no.: 5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 700

Date: 23/06/2014

Page: 1 / 6

KRTF 80-250/74UG1-S

Version no.: 1

Operating data

Requested flow rate	9.720 l/s	Actual flow rate	10.326 l/s
Requested developed head	16.40 m	Actual developed head	18.51 m
Pumped medium	Water	Efficiency	44.9 %
	Clean water	Power absorbed	4.17 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	1468 rpm
Ambient air temperature	20.0 °C	Max. power on curve	7.07 kW
Fluid temperature	20.0 °C	Shutoff head	21.22 m
Fluid density	998 kg/m³	Design	Single system 1 x 100 %
Fluid viscosity	1.00 mm²/s	Performance test	Yes

Design

Design	Close-coupled submersible	Type	MG
Orientation	Vertical	Material code	SIC/SIC/NBR
Suction flange pump according to(DN1)	unmachined	Impeller type	Free flow (vortex) impeller (F)
Discharge flange pump according to(DN2)	DN 80 / PN 16 / Drilled according to EN 1092-2	Impeller diameter	249.0 mm
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Free passage size	76.0 mm
Manufacturer	KSB	Direction of rotation from drive	Clockwise

Driver, accessories

Driver type	Electric motor	Motor winding	415 / 720 V
Model (make)	KSB	Number of poles	4
Motor const. type	KSB Sub. motor	Starting mode	Direct/Star-delta possible
Frequency	50 Hz	Connection mode	Delta
Rated voltage	415 V	Motor cooling method	Surface cooling
Rated power P2	7.50 kW	Motor version	U
Available reserve	6.01 %	Cable design	Rubber hose
Rated current	14.7 A	Cable entry	Sealed along entire length
Starting current ratio	4.8	Power cable	S1BN8-F 12G1.5
Insulation class	F to IEC 34-1	Number of power cables	1
Motor enclosure	IP68	Moisture sensor	with
Cos phi at 4/4 load	0.85	Cable length	10.00 m
Motor efficiency at 4/4 load	83.5 %		
Temperature sensor	Bimetallic switch 2x		

Materials G1

Notes	Impeller (230)	GX2CRNIMOCUN25-6-3-3
general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg, chlorine (Cl2) <= 0.6 mg/kg.	1.4517	
Pump casing (101)	O-Ring (412)	Nitrile rubber NBR
Discharge cover (163)	Motor housing (811)	Grey cast iron EN-GJL-250
Shaft (210)	Motor cable (824)	Chloroprene rubber
	Hexagon socket head cap screw (914)	CrNiMo steel A4

Data sheet



Customer item no.: 5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 700

Date: 23/06/2014

Page: 2 / 6

KRTF 80-250/74UG1-S

Version no.: 1

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months	Packaging for storage Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.	Indoor
Packaging for transport IPPC Standard ISPM 15	Ship Yes		

Nameplates

Nameplates language	International	Duplicate nameplate	with
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Certifications

Hydraulic performance test	Acceptance standard	Certificate Test participation	Inspection cert. 3.1 to EN 10204 Non-witnessed
Quantity meas. points Q-H	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2		
Certificate	5	Range	Complete pump with shaft seal
Test participation	Inspection cert. 3.2 to EN 10204	Test pressure	3.50 bar.g
Quantity, non-witnessed	Witnessed	Test time	10.0 min
Quantity, witnessed	1	Certificate	Inspection cert. 3.1 to EN 10204
Vibration test	1	Test participation	Non-witnessed
Strip test		Final visual inspection	
Certificate	Inspection cert. 3.1 to EN 10204	Certificate	Without
Test participation	Non-witnessed	Test participation	Non-witnessed
Balancing test	Balancing grade	Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)	
Part	G 6,3 Impeller	Certificate	Test report 2.2 to EN 10204

Data sheet



Customer item no.: 5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 700

Date: 23/06/2014

Page: 3 / 6

KRTF 80-250/74UG1-S

Version no.: 1

Installation parts

Installation type	stationary 2 guide rail	Type	Chain
Scope of supply	Pump with installation parts For guide rail arrangements, the guide rails are not included in KSB's scope of supply.	Material	CrNiMo steel 1.4404
		Length	5.00 m
		Max. load	160 kg
Installation depth	4.50 m		
Material concept	G		

Duckfoot bend

Size	DN 80
Flange design	EN
Duckfoot bend size (DN2 / DN3)	DN 80 Drilled according to EN
Material	Grey cast iron EN-GJL-250
Mounting type	Composite anchor bolts
Foundation rail	Without

Claw

Design	straight
Size	DN 80

Lifting chain / -rope

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin	Total film thickness approx.	KSB-blue
Intermediate coating	2-component epoxy resin high solid		300 µm

Performance curve



Customer item no.:5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

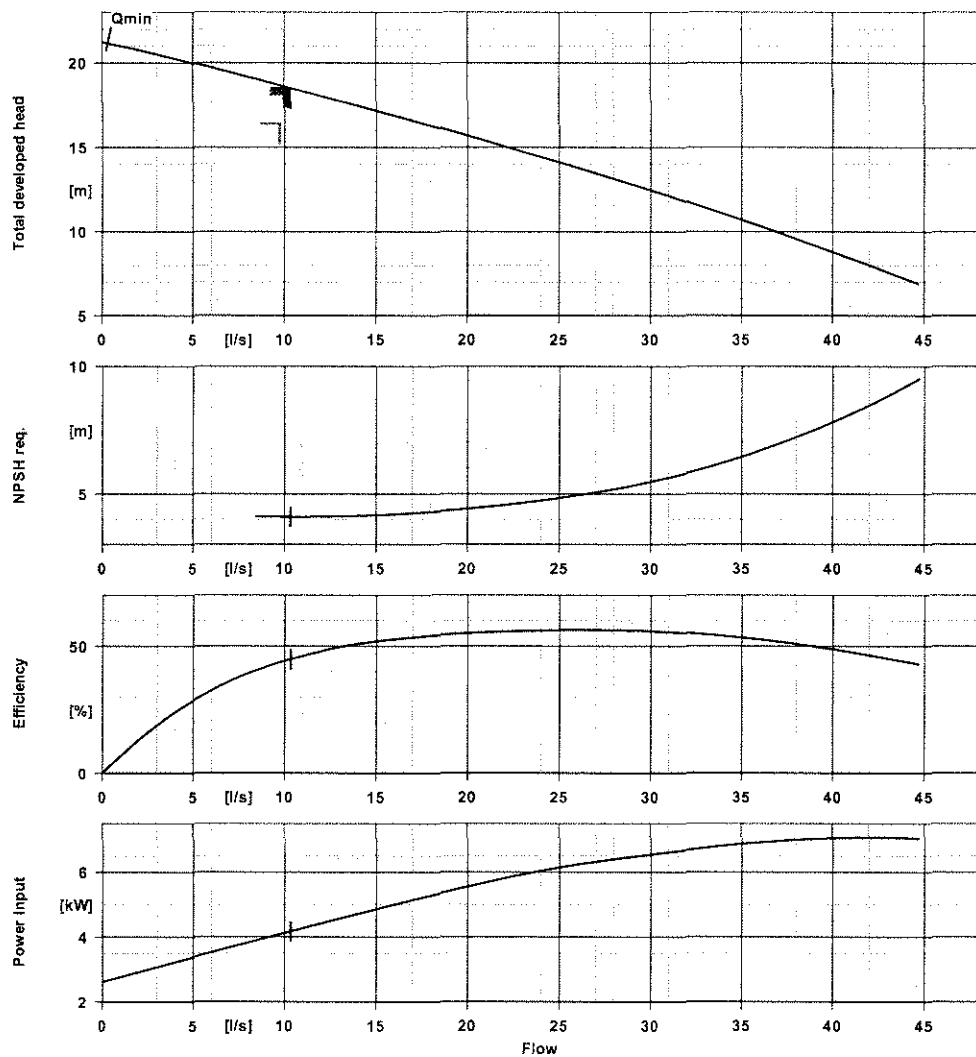
Item no.:700

Date: 23/06/2014

Page: 4 / 6

KRTF 80-250/74UG1-S

Version no.: 1



Curve data

Speed of rotation	1468 rpm	Efficiency	44.9 %
Fluid density	998 kg/m ³	Power absorbed	4.17 kW
Viscosity	1.00 mm ² /s	NPSH required	4.09 m
Flow rate	10.326 l/s	Curve number	K42873s
Requested flow rate	9.720 l/s	Effective impeller diameter	249.0 mm
Total developed head	18.51 m	Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2
Requested developed head	16.40 m		

Installation plan



Customer item no.: 5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

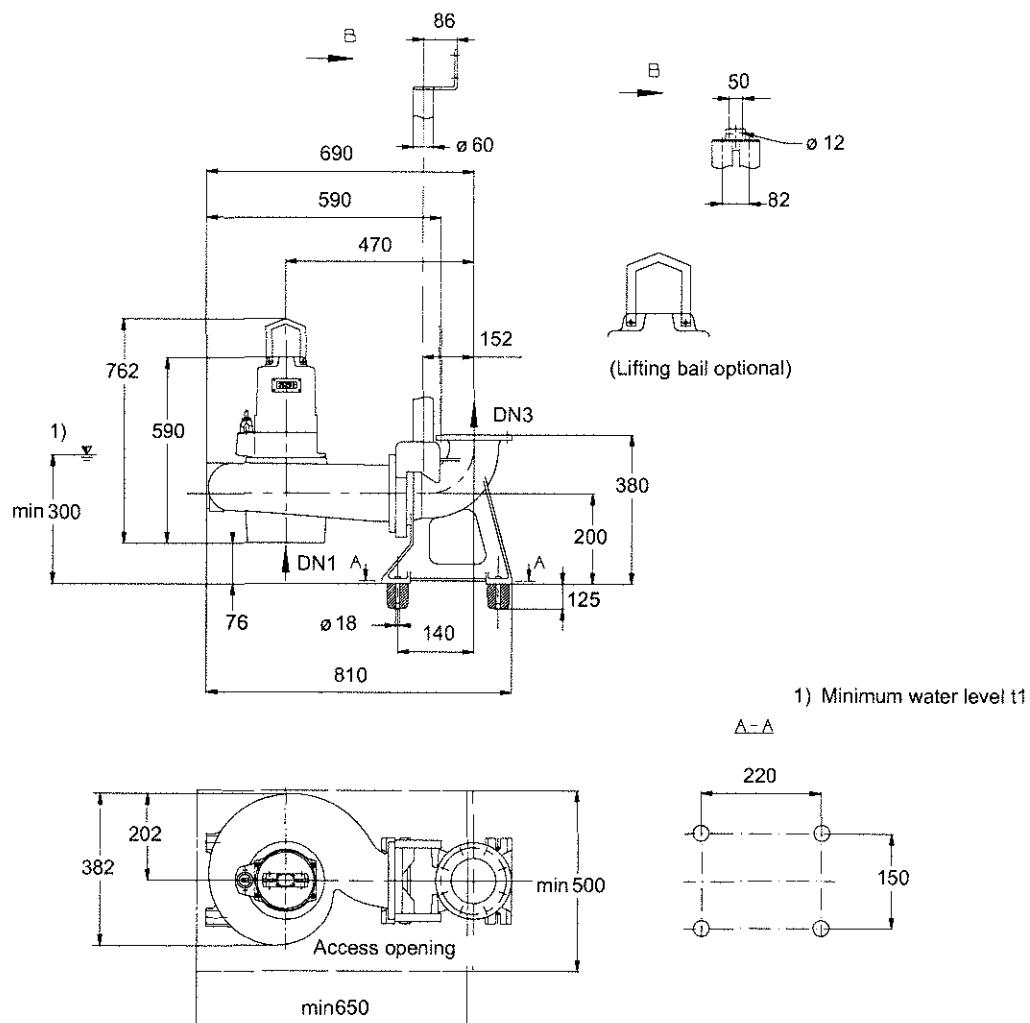
Item no.: 700

Date: 23/06/2014

Page: 5 / 6

KRTF 80-250/74UG1-S

Version no.: 1



Drawing is not to scale

Installation plan



Customer item no.: 5.2.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 700

Date: 23/06/2014

Page: 6 / 6

KRTF 80-250/74UG1-S

Version no.: 1

Motor

Motor manufacturer	KSB
Motor size	7
Motor power	7.50 kW
Number of poles	4
Speed of rotation	1441 rpm

Connections

Suction flange pump according unmachined
to(DN1)
Duckfoot bend size (DN2 / DN3)DN 80 Drilled according to EN

Weight net

Pump, Motor, Cable	147 kg
Claw / Foot	10 kg
Total	157 kg

For auxiliary connections see
separate drawing.

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Dimensions without tolerances - gray cast iron parts:

DIN 747
ISO 2768-m
EN735
ISO 13920-B
ISO 8062-CT9

Data sheet



Customer item no.: 5.3.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 800

Date: 24/06/2014

Page: 1 / 5

KRTK 700-900/19512UNG1-D

Version no.: 1

Operating data

Requested flow rate	1800.000 l/s	Actual flow rate	1800.000 l/s
Requested developed head	4.60 m	Actual developed head	4.60 m
Pumped medium	Water	Efficiency	66.7 %
	Clean water	Power absorbed	120.50 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	497 rpm
Ambient air temperature	20.0 °C	NPSH required	7.80 m
Fluid temperature	20.0 °C	Permissible operating pressure	6.00 bar.g
Fluid density	998 kg/m³	Discharge press.	0.45 bar.g
Fluid viscosity	1.00 mm²/s	Shutoff head	14.60 m
Suction pressure max.	0.00 bar.g	Design	Single system 1 x 100 %
Max. power on curve	140.59 kW	Performance test	Yes

Design

Design	Close-coupled submersible	Impeller type	Multivane radial flow impeller (K)
Orientation	Vertical	Wear ring	Casing/impeller wear ring
Suction flange pump according to(DN1)	EN 1092-2 / DN 700 / drilled DIN 2501 / ISO 7005	Impeller diameter	700.0 mm
Discharge flange pump according to(DN2)	DN 700 / PN 10 / Drilled according to EN 1092-2	Free passage size	190.0 mm
Suction nozzle drilled acc. to DIN2501 with tapped blind holes	2 mech. seals in tandem arrangement with oil reservoir	Direction of rotation from drive	Clockwise
Shaft seal	Burgmann	Temperature sensor PT100	with inboard
Manufacturer	CARTEX	Temperature sensor PT100 mtsw	with
Type	SIC/SIC/FPM	Vibration sensor	with
Material code			

Driver, accessories

Driver type	Electric motor	Motor winding	400 / 690 V
Model (make)	KSB	Number of poles	12
Motor const. type	KSB Sub. motor	Starting mode	Direct/Star-delta possible
Operating mode	S1, non submerged operation	Connection mode	Delta
Designed for operation with frequency inverter	Yes	Motor cooling method	closed-circuit jacket cooling with
Frequency	50 Hz	Motor cooling jacket	
Rated voltage	400 V	Motor version	U
Rated power P2	195.00 kW	Cable design	Shielded control cable
Available reserve	38.71 %	Cable entry	Sealed along entire length
Rated current	425.0 A	Power cable	S1BN8-F 4G50
Starting current ratio	4.9	Number of power cables	4
Insulation class	H according IEC 34-1	Control cable	S07RC4N8-F 12G1.5
Motor enclosure	IP68	Number of control cables	1
Cos phi at 4/4 load	0.72	Moisture sensor	with
Motor efficiency at 4/4 load	92.4 %	Cable length	10.00 m
Temperature sensor	PTC resistor		

Data sheet



Customer item no.: 5.3.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 800

Date: 24/06/2014

Page: 2 / 5

KRTK 700-900/19512UNG1-D

Version no.: 1

Materials G1

Notes

general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg, chlorine (Cl2) <= 0.6 mg/kg.

Pump casing (101) Grey cast iron EN-GJL-250

Discharge cover (163) Grey cast iron EN-GJL-250

Shaft (210) Chrome steel 1.4021+QT800

Impeller (230) GX2CRNIMOCUN25-6-3-3

1.4517

Bearing bracket (330) Grey cast iron EN-GJL-250

O-Ring (412) Nitrile rubber NBR

Casing wear ring (502.1)

Impeller wear ring (503)

Shaft protecting sleeve (524)

Cooling jacket (66-2)

Motor housing (811)

Motor cable (824)

Hexagon socket head cap

screw (914)

CrNi steel VG434

CrNi steel VG434

Chrome steel 1.4021+QT800

Stainless steel 1.4571

Grey cast iron EN-GJL-250

Chloroprene rubber

CrNiMo steel A4

Packaging

Packaging category

B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months

Packaging for storage Indoor

Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.

Packaging for transport IPPC Standard ISPM 15

Ship

Yes

Nameplates

Nameplates language

International

Duplicate nameplate

with

Certifications

Hydraulic performance test

Acceptance standard

ISO 9906 class 1B

Certificate
Test participation

Inspection cert. 3.1 to EN 10204
Non-witnessed

Quantity meas. points Q-H

5

Hydrostatic test (room temp.)

Certificate

Inspection cert. 3.2 to EN 10204

Range

Complete pump with shaft seal

Test participation

Witnessed

Test pressure

3.00 bar.g

Quantity, non-witnessed

3

Test time

10.0 min

Quantity, witnessed

1

Certificate

Inspection cert. 3.1 to EN 10204

NPSH test

Yes

Test participation

Non-witnessed

Quantity meas. points NPSH

1

Final visual inspection

Vibration test

Yes

Certificate

Inspection cert. 3.1 to EN 10204

Balancing test

Balancing grade

G 6,3

Part

Impeller

Test participation

Witnessed

Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)

Certificate

Test report 2.2 to EN 10204

Installation parts

Installation type

Dry installation

Foundation rails

Yes

Scope of supply

Pump with installation parts

Inlet elbow size / DN0

DN 700 / 900

Installation variant

Dry

Lifting Bail

with

G

Material concept

Coating

KSB coating code

S2 to AA-0080-06-01 / 2

Final coating

2-component epoxy resin high solid

Surface preparation

Free from dirt, grease, rust

Color

Ultramarine blue (RAL 5002)

Primer

Zinc phosphate synthetic resin

Total film thickness approx.

KSB-blue

Intermediate coating

2-component epoxy resin high solid

300 µm

Performance curve



Customer item no.:5.3.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

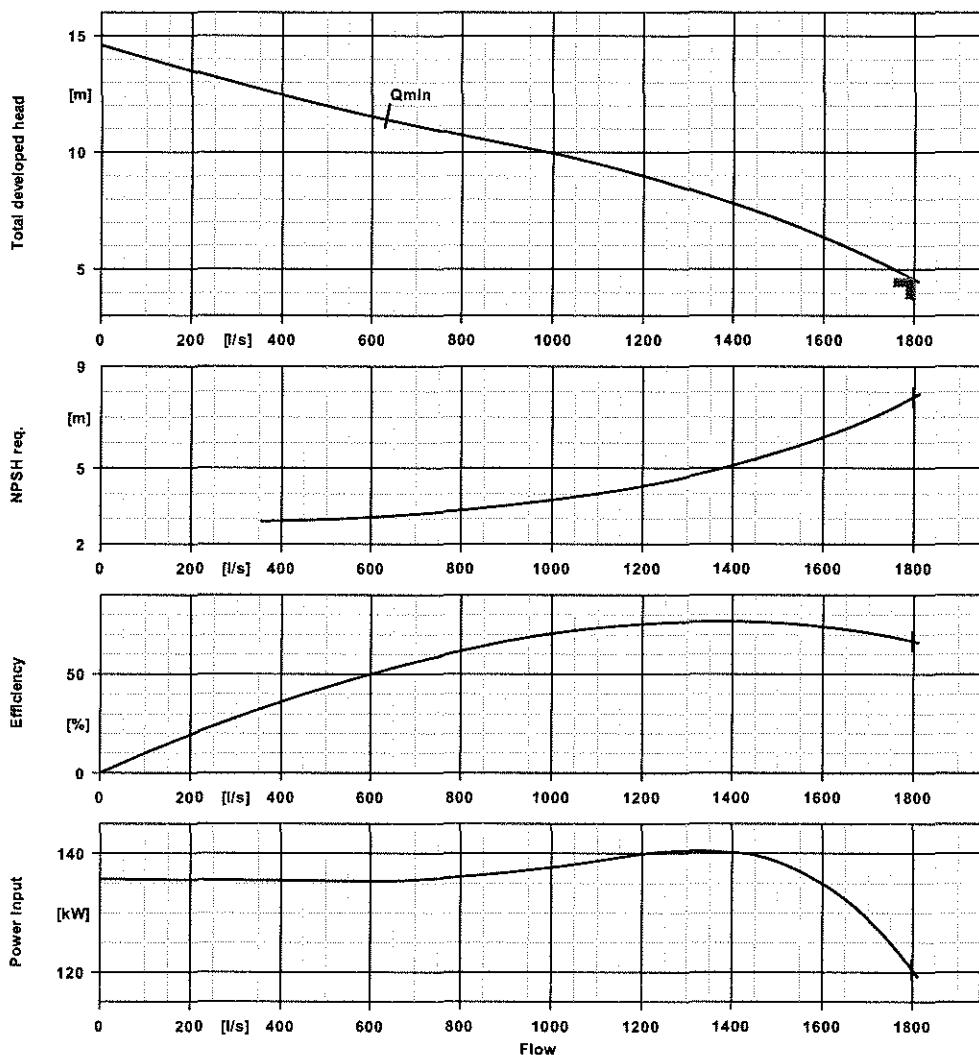
Item no.:800

Date: 24/06/2014

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KRTK 700-900/19512UNG1-D

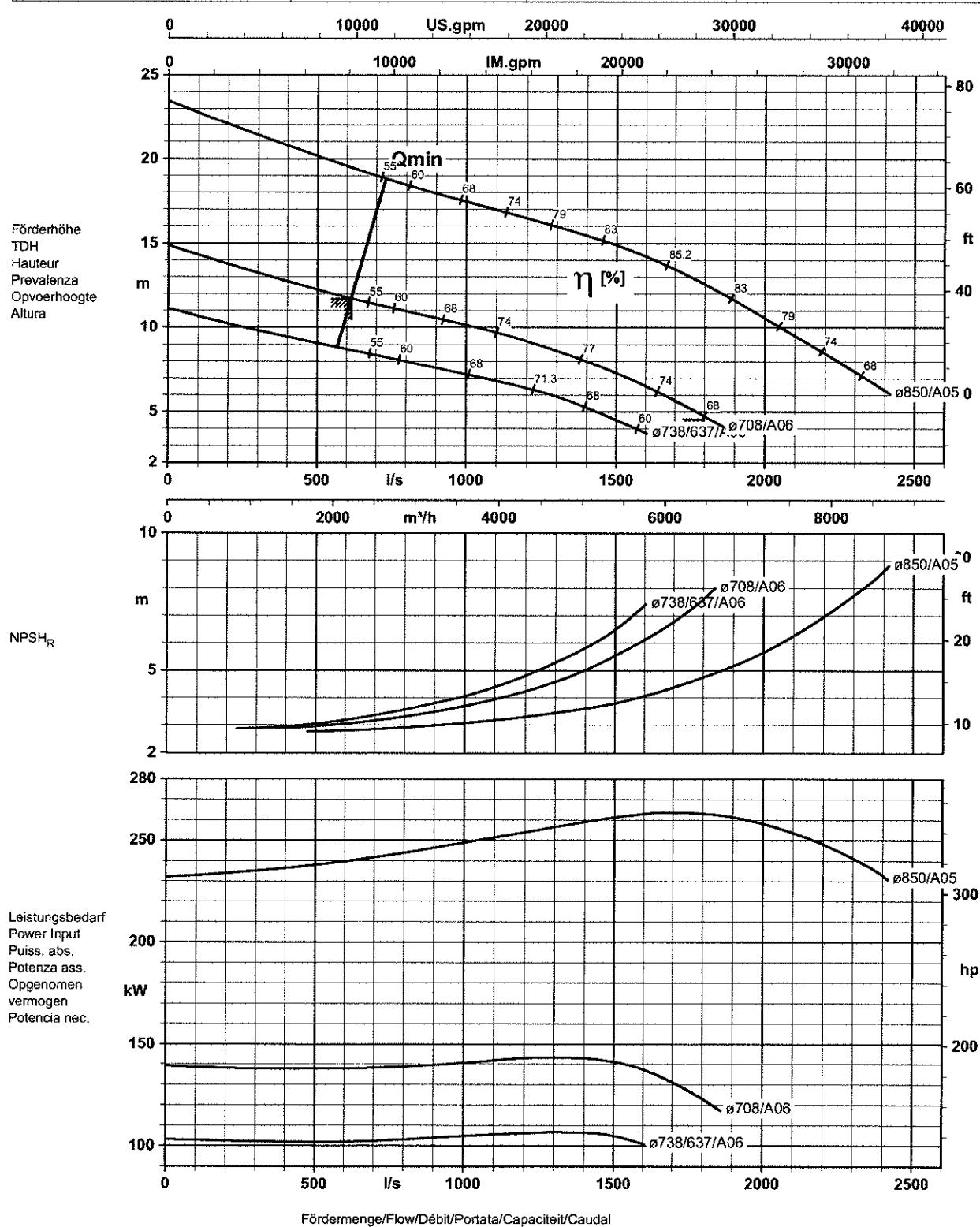
Version no.: 1



Curve data

Speed of rotation	497 rpm	Efficiency	66.7 %
Fluid density	998 kg/m ³	Power absorbed	120.50 kW
Viscosity	1.00 mm ² /s	NPSH required	7.80 m
Flow rate	1800.000 l/s	Curve number	K42884s
Requested flow rate	1800.000 l/s	Effective impeller diameter	700.0 mm
Total developed head	4.60 m	Acceptance standard	ISO 9906 class 1B
Requested developed head	4.60 m		

Baureihe-Größe Type-Size Modèle	Tipo Serie Tipo	Nenndrehzahl Nom. speed Vitesse nom.	Velocità di rotazione nom. Nominaal toerental Revvoluzioni nom.	Laufrad-Ø Impeller dia. Diamètre de roue	Ø girante Waaijer Ø Ø rodete	
Amarex KRT 700-900K	480 1/min					
Projekt Project Projet	Progetto Projekt Proyecto	Angebots-Nr. Quotation No. N° de l'offre	N° offerta Offertenr. N° de oferta	Pos.-Nr. Item No. N° de pos.	N° pos Pos. nr. N° de art	KSB-Verkaufshaus Halle Rudolf-Breitscheid-Str. 10 06110 Halle



Leistungsbedarf
Power Input
Puiss. abs.
Potenza ass.
Opgenomen
vermogen
Potencia nec.

Laufradaustrittsbreite/Impeller outlet width/Largeur à la sortie de la roue
Luce della girante/Waaijer uitredebreedte/Anchura de salida rodete 212 mm 212 mm

Aus Kurve K42884/1 gerechnet
T1572-Ha, Otto Michael, 2014-06-24

Installation plan



Customer item no.:5.3.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

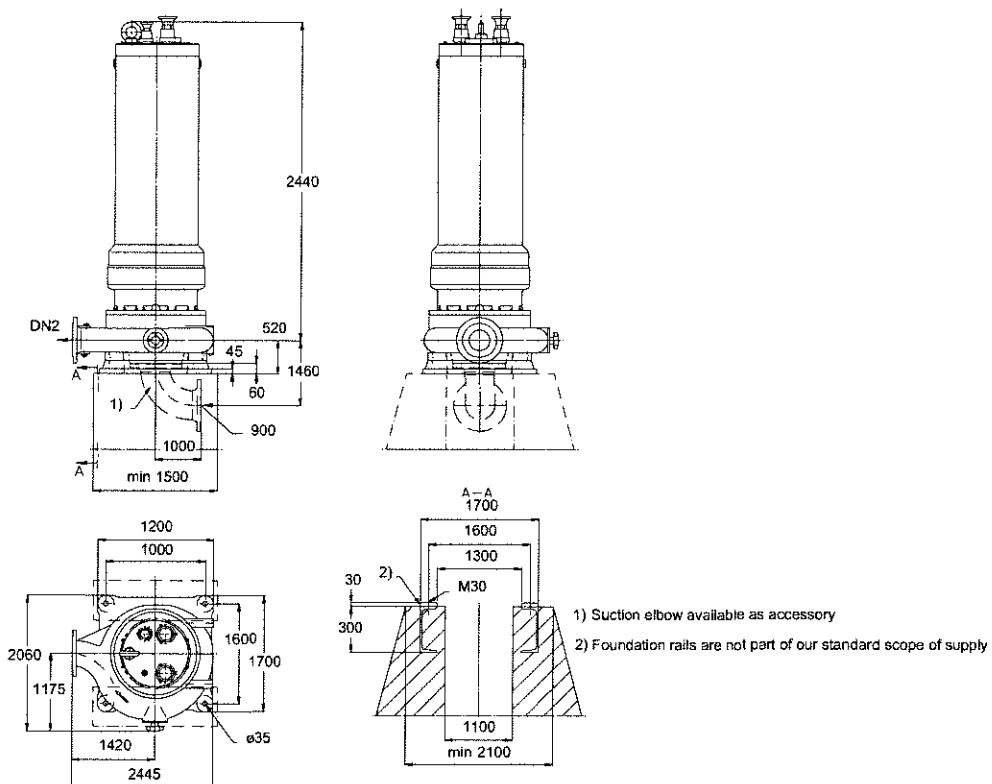
Item no.:800

Date: 24/06/2014

Page: 4 / 5

KRTK 700-900/19512UNG1-D

Version no.: 1



Drawing is not to scale

Dimensions in mm

Motor

Motor manufacturer	KSB
Motor size	195N
Motor power	195.00 kW
Number of poles	12
Speed of rotation	494 rpm

Connections

Inlet elbow size / DN0	DIN 700 / 900
Suction flange pump according to(DN1)	EN 1092-2 / DIN 700 / drilled DIN 2501 / ISO 7005
Discharge flange pump according to(DN2)	DIN 700 / PN 10 / Drilled according to EN 1092-2
Suction nozzle drilled acc. to DIN2501	with tapped blind holes

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Weight net

Pump, Motor, Cable	6604 kg
Total	6604 kg

For auxiliary connections see separate drawing.

DIN 747

ISO 2768-m

EN735

ISO 13920-B

Installation plan



Customer item no.:5.3.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 800

Date: 24/06/2014

Page: 5 / 5

KRTK 700-900/19512UNG1-D

Version no.: 1

Dimensions without tolerances - gray cast iron parts:

ISO 8062-CT9

Data sheet



Customer item no.:5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 900

Date: 24/06/2014

Page: 1 / 6

KRTK 500-630/1308UNG1-D

Version no.: 1

Operating data

Requested flow rate	750.000 l/s	Actual flow rate	750.000 l/s
Requested developed head	12.00 m	Actual developed head	12.00 m
Pumped medium	Water	Efficiency	82.5 %
	Clean water	Power absorbed	107.11 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	738 rpm
Ambient air temperature	20.0 °C	NPSH required	4.70 m
Fluid temperature	20.0 °C	Permissible operating pressure	6.00 bar.g
Fluid density	998 kg/m³	Discharge press.	1.18 bar.g
Fluid viscosity	1.00 mm²/s	Shutoff head	22.28 m
Suction pressure max.	0.00 bar.g	Design	Single system 1 x 100 %
Max. power on curve	110.92 kW	Performance test	Yes

Design

Design	Close-coupled submersible	Impeller type	Multivane radial flow impeller (K)
Orientation	Vertical	Wear ring	Casing/impeller wear ring
Suction flange pump according to(DN1)	EN 1092-2 / DN 500 / drilled DIN 2501 / ISO 7005	Impeller diameter	544.0 mm
Discharge flange pump according to(DN2)	DN 500 / PN 10 / Drilled according to EN 1092-2	Free passage size	133.0 mm
Suction nozzle drilled acc. to DIN2501 with tapped blind holes		Direction of rotation from drive	Clockwise
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Temperature sensor PT100	with
Manufacturer	KSB	inboard	
Type	MG	Temperature sensor PT100	mts with
Material code	SIC/SIC/NBR	Vibration sensor	with

Driver, accessories

Driver type	Electric motor	Number of poles	8
Model (make)	KSB	Starting mode	Direct/Star-delta possible
Motor const. type	KSB Sub. motor	Connection mode	Delta
Operating mode	S1, non submerged operation	Motor cooling method	closed-circuit jacket cooling
Frequency	50 Hz	Motor cooling jacket	with
Rated voltage	400 V	Motor version	U
Rated power P2	130.00 kW	Cable design	Shielded control cable
Available reserve	17.20 %	Cable entry	Sealed along entire length
Rated current	255.0 A	Power cable	S1BN8-F 4G50
Starting current ratio	5.3	Number of power cables	2
Insulation class	H according IEC 34-1	Control cable	S07RC4N8-F 12G1.5
Motor enclosure	IP68	Number of control cables	1
Cos phi at 4/4 load	0.80	Moisture sensor	with
Motor efficiency at 4/4 load	92.0 %	Cable length	10.00 m
Temperature sensor	PTC resistor		
Motor winding	400 / 690 V		

Data sheet



Customer item no.:5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 900

Date: 24/06/2014

Page: 2 / 6

KRTK 500-630/1308UNG1-D

Version no.: 1

Materials G1

Notes

general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <=250 mg/kg, chlorine (Cl2) <=0.6 mg/kg.

Pump casing (101)	Grey cast iron EN-GJL-250
Discharge cover (163)	Grey cast iron EN-GJL-250
Shaft (210)	Chrome steel 1.4021+QT800
Impeller (230)	GX2CRNIMOCUN25-6-3-3 1.4517
Bearing bracket (330)	Grey cast iron EN-GJL-250
O-Ring (412)	Nitrile rubber NBR

Casing wear ring (502.1)	CrNi steel VG434
Impeller wear ring (503)	CrNi steel VG434
Shaft protecting sleeve (524)	Chrome steel 1.4021+QT800
Cooling jacket (66-2)	Stainless steel 1.4571
Motor housing (811)	Grey cast iron EN-GJL-250
Motor cable (824)	Chloroprene rubber
Hexagon socket head cap screw (914)	CrNiMo steel A4

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months	Packaging for storage	Indoor
		Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.	

Nameplates

Nameplates language	International	Duplicate nameplate	with
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Certifications

Hydraulic performance test

Acceptance standard	ISO 9906 class 1B	Certificate	Inspection cert. 3.1 to EN 10204
Quantity meas. points Q-H	5	Test participation	Non-witnessed
Certificate	Inspection cert. 3.2 to EN 10204		
Test participation	Witnessed		
Quantity, non-witnessed	1		
Quantity, witnessed	1		
NPSH test	Yes		
Quantity meas. points NPSH	1		
Vibration test	Yes		

Hydrostatic test (room temp.)

Range	Complete pump with shaft seal
Test pressure	3.00 bar.g
Test time	10.0 min
Certificate	Inspection cert. 3.1 to EN 10204

Final visual inspection

Certificate	Inspection cert. 3.1 to EN 10204
Test participation	Witnessed

Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)

Certificate	Test report 2.2 to EN 10204
-------------	-----------------------------

Installation parts

Installation type	Dry installation	Foundation rails	Yes
Scope of supply	Pump with installation parts	Inlet elbow size / DN0	DN 500 / 700
Installation variant	Dry	Lifting Bail	with
Material concept	G		

Data sheet

Customer item no.: 5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 900

Date: 24/06/2014

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KRTK 500-630/1308UNG1-D

Version no.: 1

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin	Total film thickness approx.	KSB-blue
Intermediate coating	2-component epoxy resin high solid		300 µm

Performance curve



Customer item no.:5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

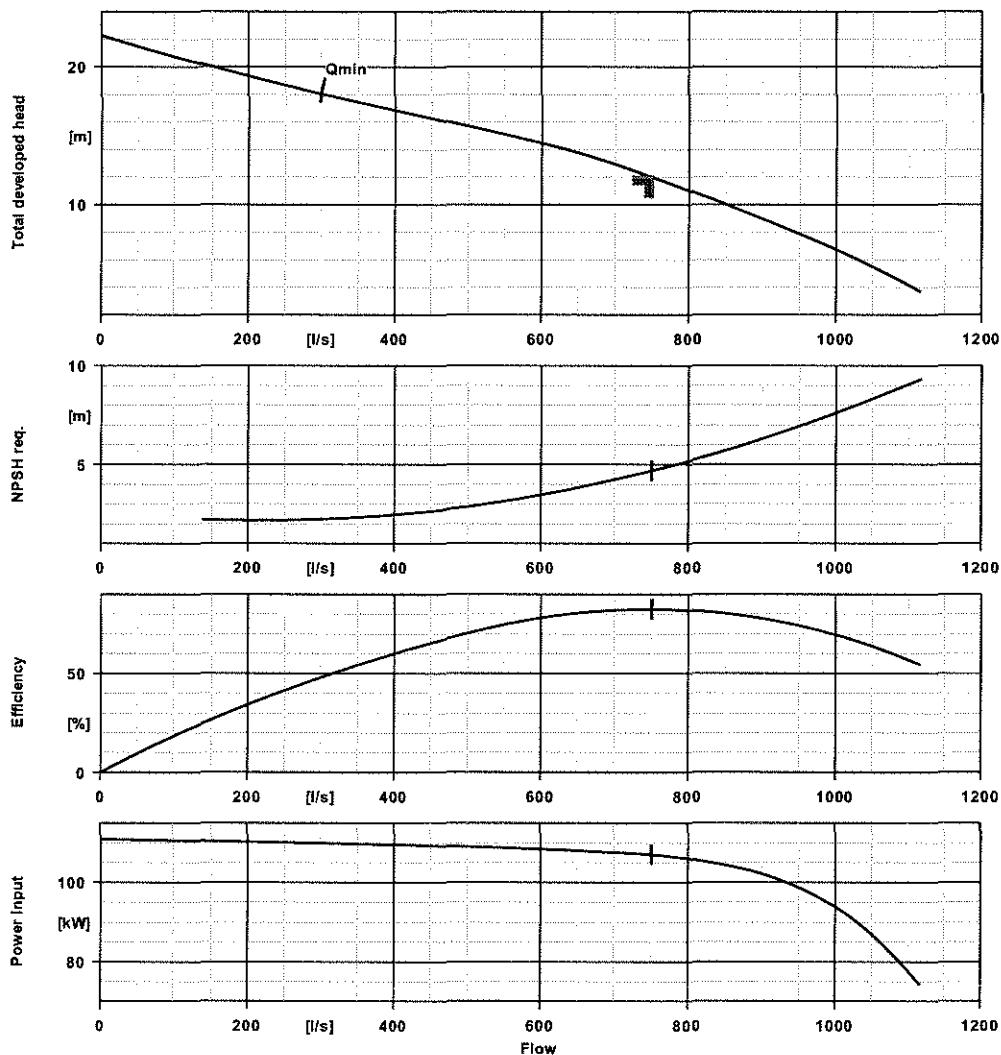
Item no.:900

Date: 24/06/2014

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KRTK 500-630/1308UNG1-D

Version no.: 1



Curve data

Speed of rotation	738 rpm	Efficiency	82.5 %
Fluid density	998 kg/m ³	Power absorbed	107.11 kW
Viscosity	1.00 mm ² /s	NPSH required	4.70 m
Flow rate	750.000 l/s	Curve number	K43080s
Requested flow rate	750.000 l/s	Effective impeller diameter	544.0 mm
Total developed head	12.00 m	Acceptance standard	ISO 9906 class 1B
Requested developed head	12.00 m		

Installation plan



Customer item no.:5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

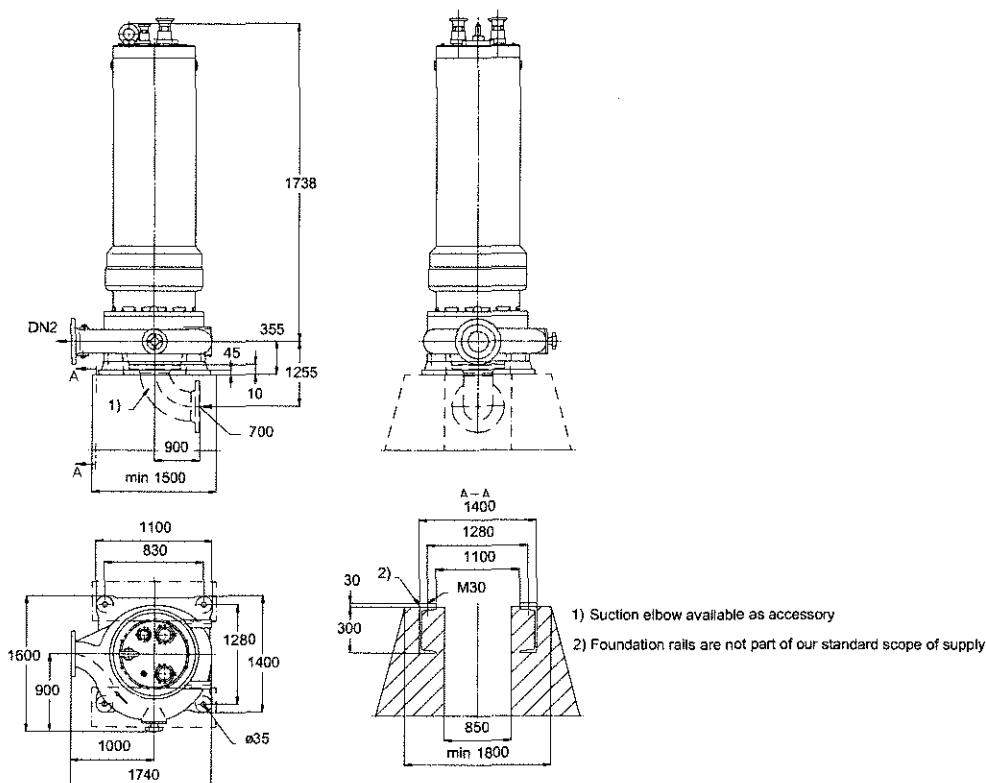
Item no.: 900

Date: 24/06/2014

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KRTK 500-630/1308UNG1-D

Version no.: 1



Drawing is not to scale

Dimensions in mm

Motor

Motor manufacturer
Motor size

KSB

130N

Motor power

130.00 kW

Number of poles

8

Speed of rotation

735 rpm

Connections

Inlet elbow size / DNO	DN 500 / 700
Suction flange pump according to(DN1)	EN 1092-2 / DN 500 / drilled DIN 2501 / ISO 7005
Discharge flange pump according to(DN2)	DN 500 / PN 10 / Drilled according to EN 1092-2
Suction nozzle drilled acc. to DIN2501 with tapped blind holes	

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Weight net

Pump, Motor, Cable
Total

2892 kg
2892 kg

For auxiliary connections see separate drawing.

DIN 747
ISO 2768-m
EN735

Installation plan



Customer item no.:5.3.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.:900

Date: 24/06/2014

Page: 6 / 6

KRTK 500-630/1308UNG1-D

Version no.: 1

Dimensions without tolerances - welded parts:

ISO 13920-B

Dimensions without tolerances - gray cast iron parts:

ISO 8062-CT9

Data sheet



Customer item no.: 5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1000

Date: 23/06/2014

Page: 1 / 7

KRTD 100-251/74UKG1-D IE3

Version no.: 1

Operating data

Requested flow rate	54.000 l/s	Actual flow rate	54.679 l/s
Requested developed head	7.00 m	Actual developed head	7.18 m
Pumped medium	Water	Efficiency	71.5 %
	Clean water	Power absorbed	5.37 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	1486 rpm
Ambient air temperature	50.0 °C	NPSH required	1.86 m
Fluid temperature	20.0 °C	Permissible operating pressure	6.00 bar.g
Fluid density	998 kg/m³	Discharge press.	0.70 bar.g
Fluid viscosity	1.00 mm²/s	Shutoff head	18.02 m
Suction pressure max.	0.00 bar.g	Design	Single system 1 x 100 %
Max. power on curve	5.57 kW	Performance test	Yes

Design

Design	Close-coupled submersible	Type	MG
Orientation	Vertical	Material code	SIC/SIC/NBR
Suction flange pump according to(DN1)	EN 1092-2 / DN 150 / drilled DIN 2501 / ISO 7005	Impeller type	Single vane mixed flow (D)
Discharge flange pump according to(DN2)	DN 100 / PN 16 / Drilled according to EN 1092-2	Wear ring	Wear plate
Suction nozzle drilled acc. to DIN2501 with tapped blind holes		Impeller diameter	234.0 mm
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Free passage size	76.0 mm
Manufacturer	KSB	Direction of rotation from drive	Clockwise

Driver, accessories

Driver type	Electric motor	Temperature sensor	PTC resistor
Model (make)	KSB	Motor winding	415 / 720 V
Motor const. type	KSB Sub. motor	Number of poles	4
Operating mode	S1, non submerged operation	Starting mode	Direct/Star-delta possible
Efficiency class	IE3 acc. to IEC 60034-30	Connection mode	Delta
Frequency	50 Hz	Motor cooling method	Surface cooling
Rated voltage	415 V	Motor version	U
Rated power P2	7.50 kW	Cable design	Rubber hose
Available reserve	39.71 %	Cable entry	Sealed along entire length
Rated current	13.8 A	Power cable	S1BN8-F 12G1.5
Starting current ratio	7.3	Number of power cables	1
Insulation class	H according IEC 34-1	Moisture sensor	with
Motor enclosure	IP68	Cable length	20.00 m
Cos phi at 4/4 load	0.84		
Motor efficiency at 4/4 load	90.4 %		

Data sheet



Customer item no.: 5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1000

Date: 23/06/2014

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KRTD 100-251/74UKG1-D IE3

Version no.: 1

Materials G1

Notes		Impeller (230)	GX2CRNIMOCUN25-6-3-3
general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <=250 mg/kg, chlorine (Cl2) <=0.6 mg/kg.		1.4517	Nitrile rubber NBR
Pump casing (101)	Grey cast iron EN-GJL-250	Motor housing (811)	Grey cast iron EN-GJL-250
Wear Plate (135)	High Chrome white iron EN-GJN-HB555(CR14)	Motor cable (824)	Chloroprene rubber
Discharge cover (163)	Grey cast iron EN-GJL-250	Hexagon socket head cap	CrNiMo steel A4
Shaft (210)	Chrome steel 1.4021+QT800	screw (914)	

Packaging

Packaging category	B2 With desiccants in PE-plastic sheeting, heat-sealed water-proof, in wooden/plywood case, outdoor storage up to 12 months	Packaging for storage	Indoor
		Outdoor storage at -40°C to +50°C, up to 12 months. Packet must be covered.	

Packaging for transport

Ship

Nameplates

Nameplates language	International	Duplicate nameplate	with
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Auxiliary connections

1M.2 Pressure gauge connection	Drilled and plugged.	6D Pumped medium - filling / venting	G 1 1/4, Drilled and plugged.
6B Pumped liquid drain	Drilled and plugged.		

Certifications

Hydraulic performance test

Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2
---------------------	--

Certificate
Test participation

Inspection cert. 3.1 to EN 10204
Non-witnessed

Quantity meas. points Q-H

Certificate

Test participation

Quantity, non-witnessed

Quantity, witnessed

NPSH test

Quantity meas. points NPSH

Vibration test

5

Inspection cert. 3.2 to EN 10204

Witnessed

1

1

Yes

3

Yes

Hydrostatic test (room temp.)

Complete pump with shaft seal

3.00 bar.g

10.0 min

Inspection cert. 3.1 to EN 10204

Non-witnessed

Final visual inspection

Inspection cert. 3.1 to EN 10204
Witnessed

Balancing test

Balancing grade

Part

G 6,3

Impeller

Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)

Certificate
Test report 2.2 to EN 10204

Order documentation

The following documents will be supplied with the order:

Manufacturer's or conformity declaration

Motor data sheet

General arrangement drawing

Operating manual

Material certificates

Performance curve

Technical data sheet

Languages

English

Data sheet



Customer item no.: 5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1000

Date: 23/06/2014

Page: 3 / 7

KRTD 100-251/74UKG1-D IE3

Version no.: 1

Installation parts

Installation type	Dry installation	Material concept	G
Scope of supply	Pump with installation parts	Inlet elbow size / DN0	DN 150 / 150
Installation variant	Dry		

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust		Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin	Color	KSB-blue
Intermediate coating	2-component epoxy resin high solid	Total film thickness approx.	300 µm

Performance curve



Customer item no.:5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

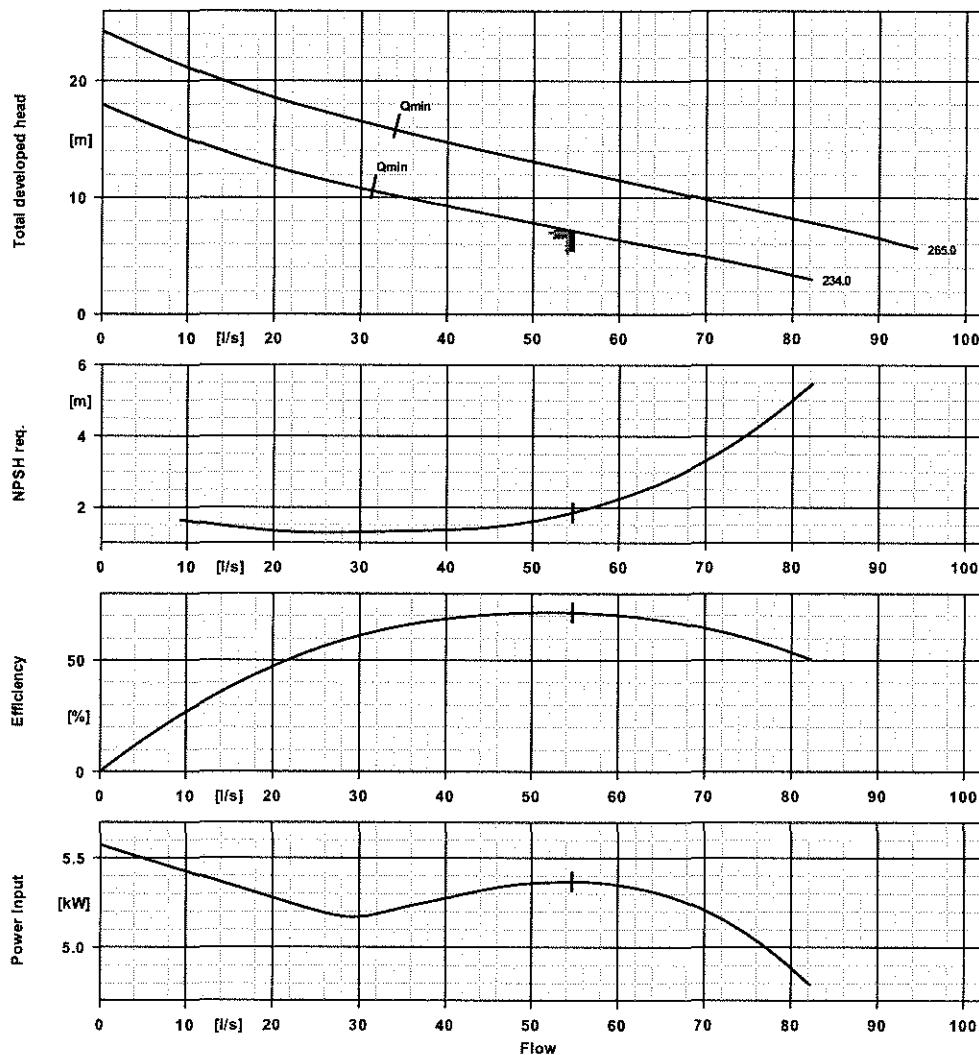
Item no.:1000

Date: 23/06/2014

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KRTD 100-251/74UKG1-D IE3

Version no.: 1



Curve data

Speed of rotation	1486 rpm	Efficiency	71.5 %
Fluid density	998 kg/m ³	Power absorbed	5.37 kW
Viscosity	1.00 mm ² /s	NPSH required	1.86 m
Flow rate	54.679 l/s	Curve number	K43118s
Requested flow rate	54.000 l/s	Effective impeller diameter	234.0 mm
Total developed head	7.18 m	Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2
Requested developed head	7.00 m		

Motor data sheet



Customer item no.:5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.:1000

Date: 23/06/2014

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KRTD 100-251/74UKG1-D IE3

Version no.: 1

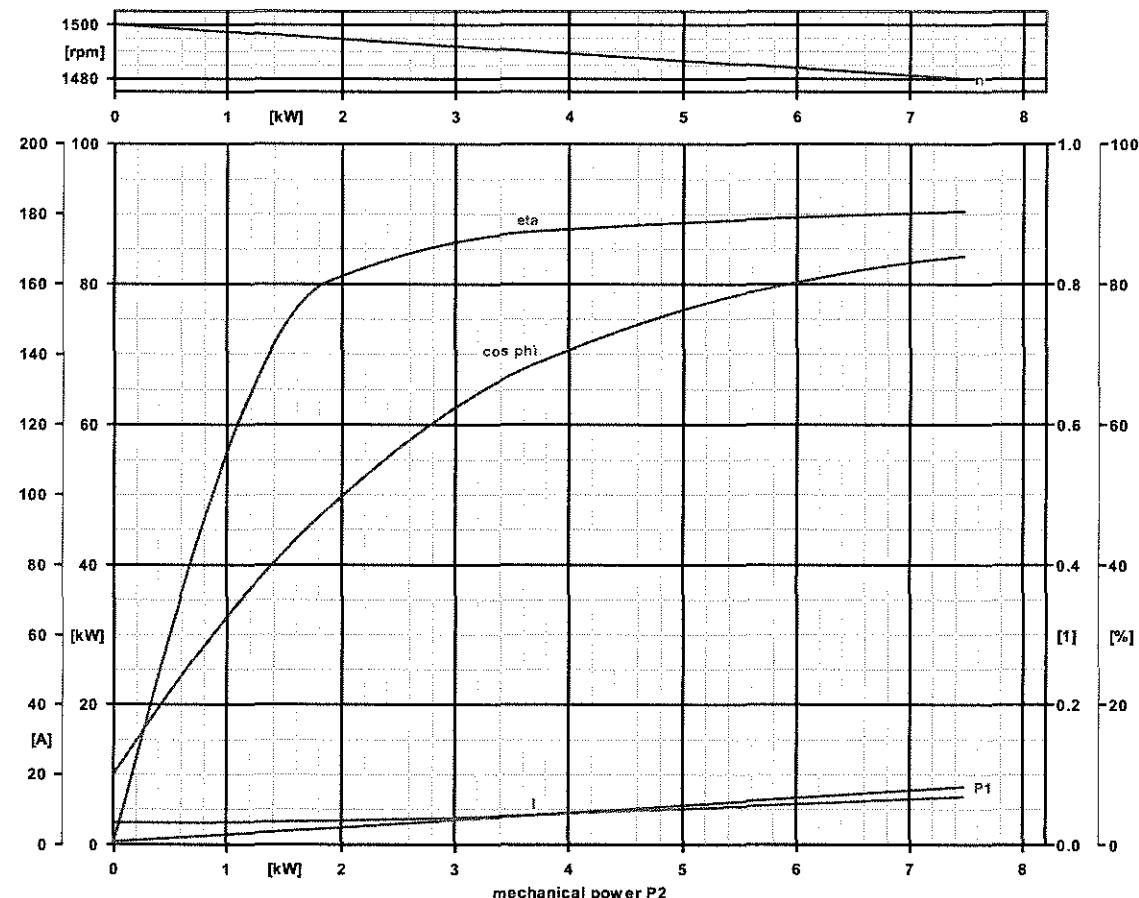
Motor data

Motor manufacturer	KSB	Rated speed	1480 rpm
Motor size	7K	Starting current ratio	7.3
Motor construction type	KSB Sub. motor	Starting mode	Direct/Star-delta possible
Motor material	Grey cast iron EN-GJL-250	Power cable	S1BN8-F 12G1.5
Efficiency class	IE3 acc. to IEC 60034-30	Number of power cables	1
Rated voltage	415 V	Power cable Ø min.	16.6 mm
Frequency	50 Hz	Power cable Ø max.	17.6 mm
Motor power	7.50 kW	Cable standard	VDE
Rated current	13.8 A	Switching frequency	30.00 1/h

Curve data

The no-load point is not a guarantee point within the meaning of IEC 60034

Load	0.0 %	25.0 %	50.0 %	75.0 %	100.0 %
P2	0.00 kW	1.88 kW	3.75 kW	5.63 kW	7.50 kW
n	1500 rpm	1495 rpm	1490 rpm	1485 rpm	1480 rpm
P1	0.45 kW	2.33 kW	4.28 kW	6.30 kW	8.30 kW
I	6.3 A	6.8 A	8.6 A	11.1 A	13.8 A
Eta	0.0 %	80.4 %	87.6 %	89.3 %	90.4 %
cos phi	0.10	0.48	0.69	0.79	0.84



Installation plan



Customer item no.:5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

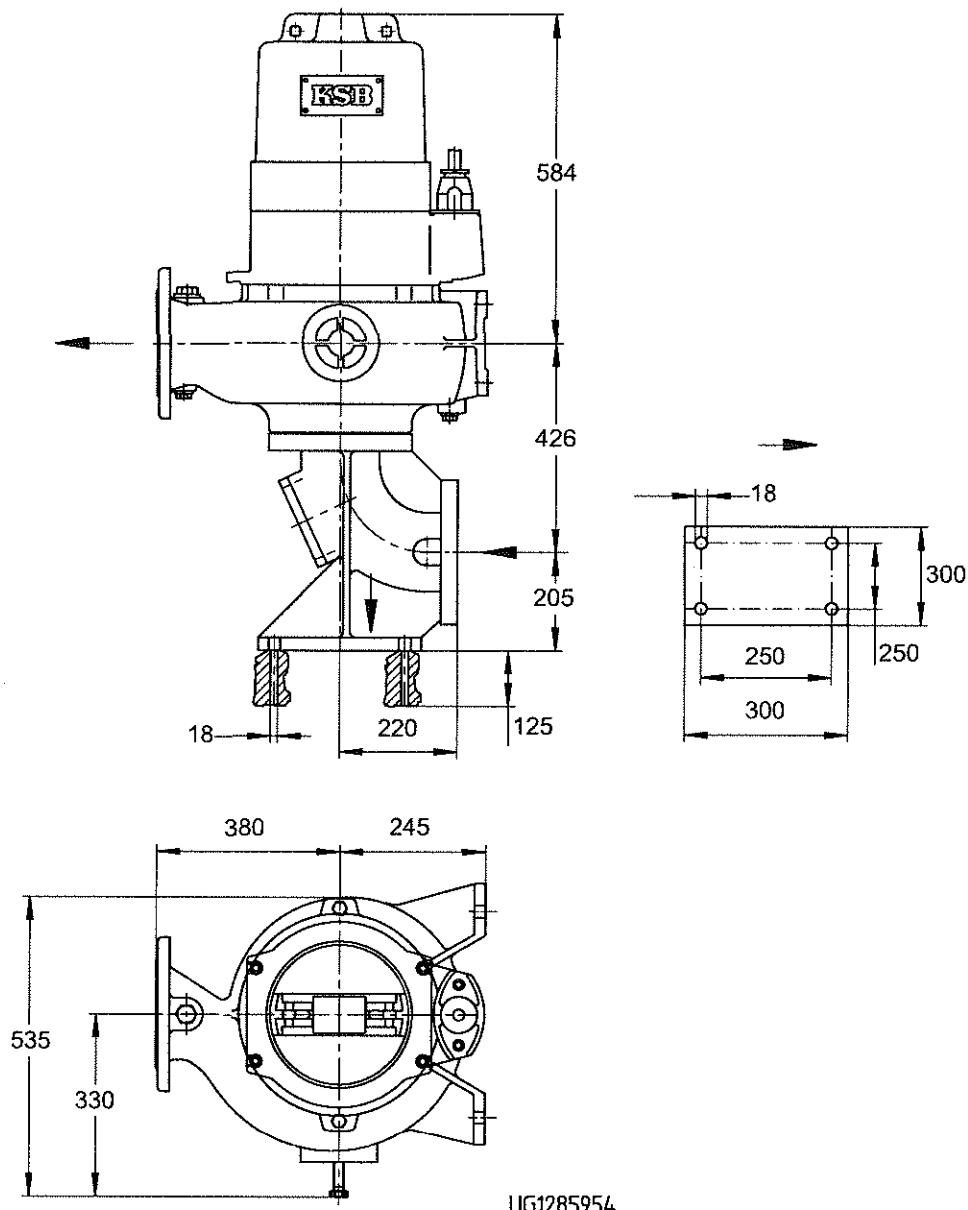
Item no.:1000

Date: 23/06/2014

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KRTD 100-251/74UKG1-D IE3

Version no.: 1



Drawing is not to scale

Dimensions in mm

Installation plan



Customer item no.:5.3.1.3

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.:1000

Date: 23/06/2014

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KRTD 100-251/74UKG1-D IE3

Version no.: 1

Motor

Motor manufacturer	KSB
Motor size	7K
Motor power	7.50 kW
Number of poles	4
Speed of rotation	1480 rpm

Connections

Inlet elbow size / DN0	DN 150 / 150
Suction flange pump according to(DN1)	EN 1092-2 / DN 150 / drilled DIN 2501 / ISO 7005
Discharge flange pump according to(DN2)	DN 100 / PN 16 / Drilled according to EN 1092-2
Suction nozzle drilled acc. to DIN2501	with tapped blind holes

Weight net

Pump, Motor, Cable	290 kg
Total	290 kg

For auxiliary connections see separate drawing.

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Dimensions without tolerances - gray cast iron parts:

DIN 747

ISO 2768-m

EN735

ISO 13920-B

ISO 8062-CT9

Data sheet



Customer item no.: 5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1100

Date: 23/06/2014

Page: 1 / 6

KRTF 80-250/54UG1-S

Version no.: 1

Operating data

Requested flow rate	10.000 l/s	Actual flow rate	10.398 l/s
Requested developed head	11.70 m	Actual developed head	12.65 m
Pumped medium	Water	Efficiency	49.1 %
	Clean water	Power absorbed	2.63 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	1468 rpm
Ambient air temperature	20.0 °C	Max. power on curve	4.24 kW
Fluid temperature	20.0 °C	Shutoff head	15.23 m
Fluid density	998 kg/m³	Design	Single system 1 x 100 %
Fluid viscosity	1.00 mm²/s	Performance test	Yes

Design

Design	Close-coupled submersible	Type	MG
Orientation	Vertical	Material code	SIC/SiC/NBR
Suction flange pump according to(DN1)	unmachined	Impeller type	Free flow (vortex) impeller (F)
Discharge flange pump according to(DN2)	DN 80 / PN 16 / Drilled according to EN 1092-2	Impeller diameter	210.0 mm
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Free passage size	76.0 mm
Manufacturer	KSB	Direction of rotation from drive	Clockwise

Driver, accessories

Driver type	Electric motor	Motor winding	415 / 720 V
Model (make)	KSB	Number of poles	4
Motor const. type	KSB Sub. motor	Starting mode	Direct/Star-delta possible
Frequency	50 Hz	Connection mode	Delta
Rated voltage	415 V	Motor cooling method	Surface cooling
Rated power P2	5.50 kW	Motor version	U
Available reserve	29.69 %	Cable design	Rubber hose
Rated current	11.4 A	Cable entry	Sealed along entire length
Starting current ratio	4.8	Power cable	S1BN8-F 12G1.5
Insulation class	F to IEC 34-1	Number of power cables	1
Motor enclosure	IP68	Moisture sensor	with
Cos phi at 4/4 load	0.82	Cable length	10.00 m
Motor efficiency at 4/4 load	82.0 %		
Temperature sensor	Bimetallic switch 2x		

Materials G1

Notes	Impeller (230)	GX2CRNIMOCUN25-6-3-3
general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg. chlorine (Cl2) <= 0.6 mg/kg.	1.4517	Nitrile rubber NBR
Pump casing (101)	O-Ring (412)	Grey cast iron EN-GJL-250
Discharge cover (163)	Motor housing (811)	Grey cast iron EN-GJL-250
Shaft (210)	Motor cable (824)	Chloroprene rubber
	Hexagon socket head cap screw (914)	CrNiMo steel A4

Data sheet



Customer item no.: 5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1100

Date: 23/06/2014

Page: 2 / 6

KRTF 80-250/54UG1-S

Version no.: 1

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months	Packaging for storage	Indoor
Packaging for transport IPPC Standard ISPM 15	Ship Yes	Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.	

Nameplates

Nameplates language	International	Duplicate nameplate	with
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Certifications

Hydraulic performance test		Test participation	Non-witnessed
Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2	Hydrostatic test (room temp.)	
Quantity meas. points Q-H	5	Range	Complete pump with shaft seal
Certificate	Inspection cert. 3.2 to EN 10204	Test pressure	2.50 bar.g
Test participation	Witnessed	Test time	10.0 min
Quantity, non-witnessed	1	Certificate	Inspection cert. 3.1 to EN 10204
Quantity, witnessed	1	Test participation	Non-witnessed
Vibration test	Yes	Final visual inspection	
Balancing test		Certificate	Inspection cert. 3.1 to EN 10204
Balancing grade	G 6.3	Test participation	Witnessed
Part	Impeller	Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)	
Certificate	Inspection cert. 3.1 to EN 10204	Certificate	Test report 2.2 to EN 10204

Installation parts

Installation type	stationary 2 guide rail	Type	Chain
Scope of supply	Pump with installation parts	Material	CrNiMo steel 1.4404
	For guide rail arrangements, the guide rails are not included in KSB's scope of supply.	Length	5.00 m
		Max. load	160 kg
Installation depth	4.50 m		
Material concept	G		

Duckfoot bend

Size	DN 80
Flange design	EN
Duckfoot bend size (DN2 / DN3)	DN 80 Drilled according to EN
Material	Grey cast iron EN-GJL-250
Mounting type	Composite anchor bolts
Foundation rail	Without

Claw

Design	straight
Size	DN 80

Lifting chain / -rope

Data sheet



Customer item no.: 5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1100

Date: 23/06/2014

Page: 3 / 6

KRTF 80-250/54UG1-S

Version no.: 1

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin	Total film thickness approx.	300 µm
Intermediate coating	2-component epoxy resin high solid		

Performance curve



Customer item no.:5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

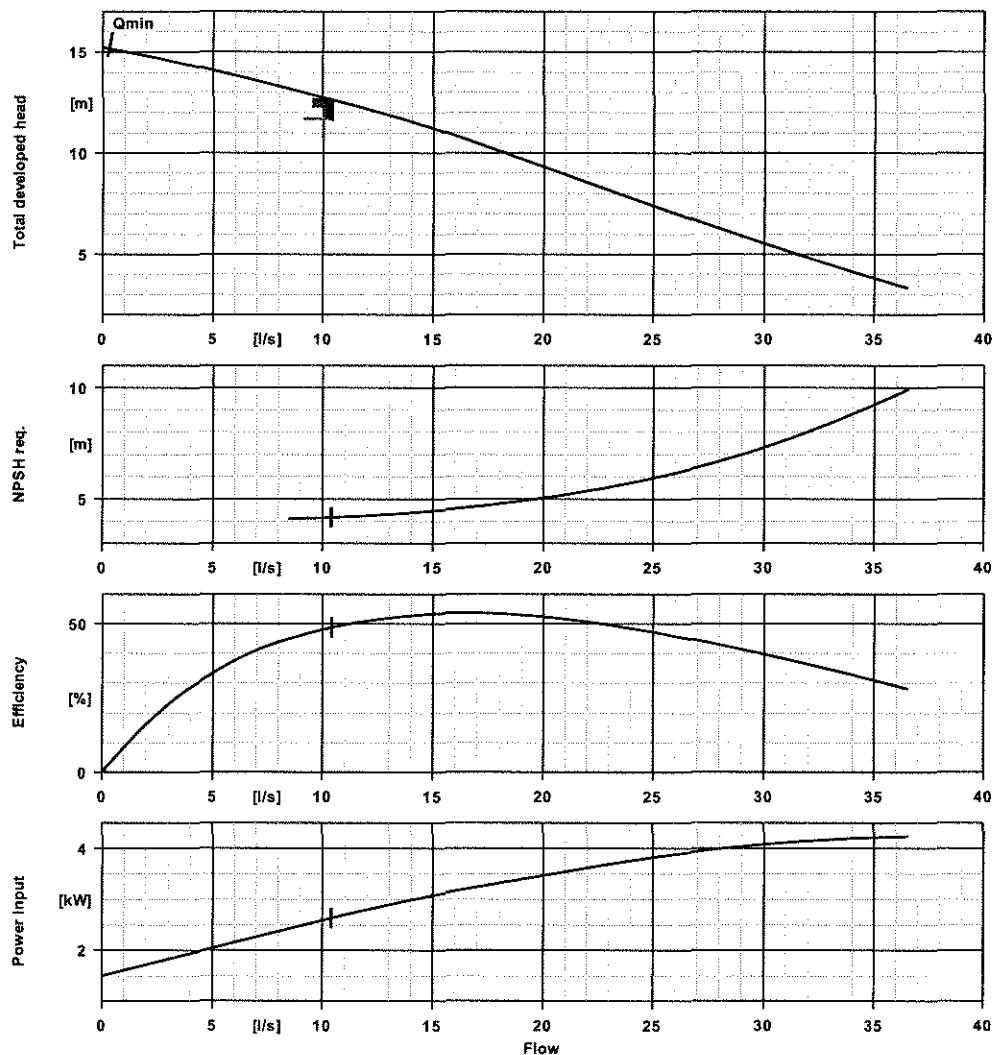
Item no.:1100

Date: 23/06/2014

Page: 4 / 6

KRTF 80-250/54UG1-S

Version no.: 1



Curve data

Speed of rotation	1468 rpm	Efficiency	49.1 %
Fluid density	998 kg/m ³	Power absorbed	2.63 kW
Viscosity	1.00 mm ² /s	NPSH required	4.18 m
Flow rate	10.398 l/s	Curve number	K42873s
Requested flow rate	10.000 l/s	Effective impeller diameter	210.0 mm
Total developed head	12.65 m	Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2
Requested developed head	11.70 m		

Installation plan



Customer item no.:5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

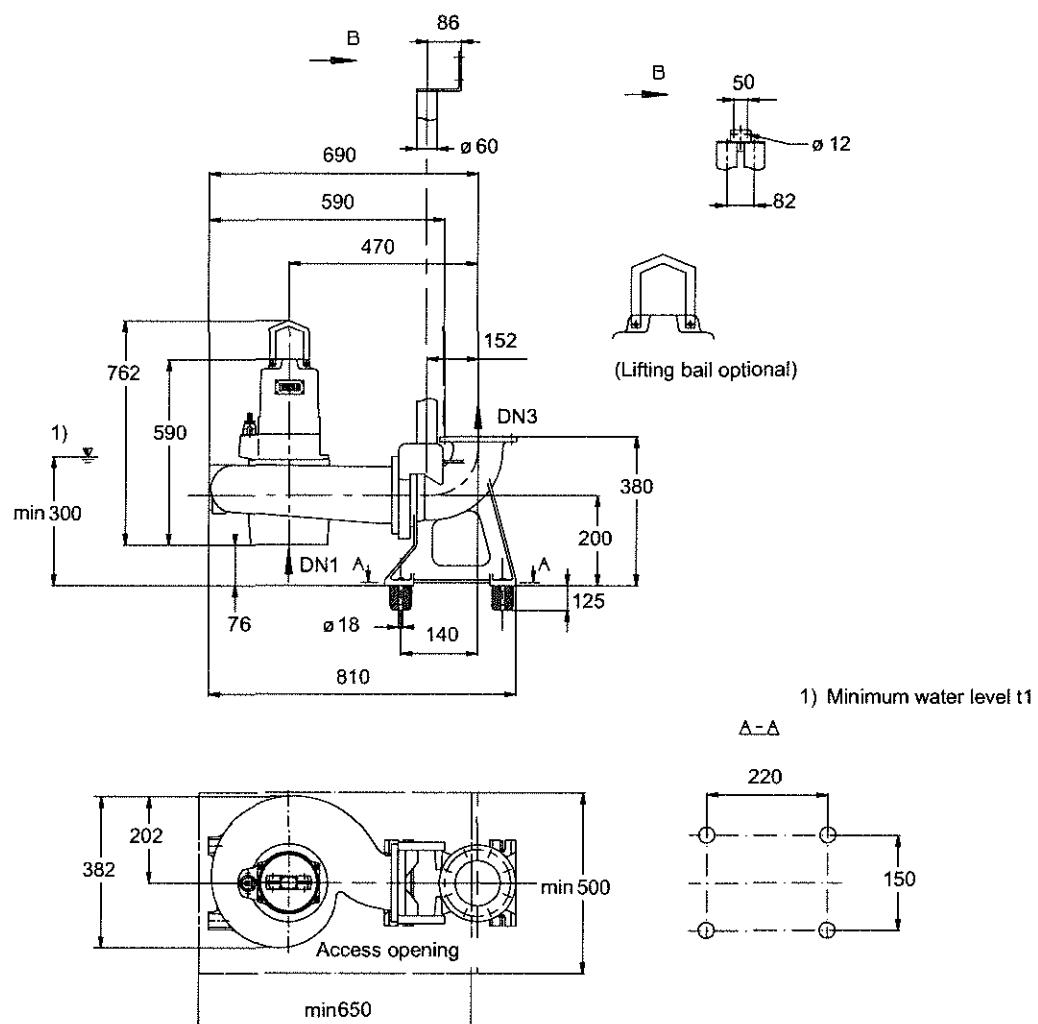
Item no.:1100

Date: 23/06/2014

Page: 5 / 6

KRTF 80-250/54UG1-S

Version no.: 1



Drawing is not to scale

Dimensions in mm

Installation plan



Customer item no.: 5.3.1.4

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1100

Date: 23/06/2014

Page: 6 / 6

KRTF 80-250/54UG1-S

Version no.: 1

Motor

Motor manufacturer	KSB
Motor size	5
Motor power	5.50 kW
Number of poles	4
Speed of rotation	1433 rpm

Connections

Suction flange pump according unmachined
to(DN1)
Duckfoot bend size (DN2 / DN3)DN 80 Drilled according to EN

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Dimensions without tolerances - gray cast iron parts:

Weight net

Pump, Motor, Cable	139 kg
Claw / Foot	10 kg
Total	149 kg

For auxiliary connections see
separate drawing.

DIN 747
ISO 2768-m
EN735
ISO 13920-B
ISO 8062-CT9

Data sheet



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 1200

Date: 23/06/2014

Page: 1 / 8

KRTK 200-401/326UNG1-D

Version no.: 1

Operating data

Requested flow rate	100.000 l/s	Actual flow rate	100.000 l/s
Requested developed head	9.96 m	Actual developed head	9.96 m
Pumped medium	Water	Efficiency	76.7 %
	Clean water	Power absorbed	12.76 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	989 rpm
Ambient air temperature	20.0 °C	NPSH required	2.01 m
Fluid temperature	20.0 °C	Permissible operating pressure	10.00 bar.g
Fluid density	998 kg/m³	Discharge press.	0.98 bar.g
Fluid viscosity	1.00 mm²/s	Shutoff head	15.69 m
Suction pressure max.	0.00 bar.g	Design	Single system 1 x 100 %
Max. power on curve	13.99 kW	Performance test	Yes

Design

Design	Close-coupled submersible	Impeller type	Multivane radial flow impeller (K)
Orientation	Vertical	Wear ring	Casing/impeller wear ring
Suction flange pump according to(DN1)	EN 1092-2 / DN 200 / drilled DIN 2501 / ISO 7005	Impeller diameter	305.0 mm
Discharge flange pump according to(DN2)	DN 200 / PN 10 / Drilled according to EN 1092-2	Free passage size	80.0 mm
Suction nozzle drilled acc. to DIN2501 with tapped blind holes		Direction of rotation from drive	Clockwise
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Temperature sensor PT100	with
Manufacturer	KSB	inboard	
Type	MG	Temperature sensor PT100 mtswith	
Material code	SIC/SIC/NBR	Vibration sensor	with

Driver, accessories

Driver type	Electric motor	Number of poles	6
Model (make)	KSB	Starting mode	Direct/Star-delta possible
Motor const. type	KSB Sub. motor	Connection mode	Delta
Operating mode	S1, non submerged operation	Motor cooling method	closed-circuit jacket cooling
Frequency	50 Hz	Motor cooling jacket	with
Rated voltage	400 V	Motor version	U
Rated power P2	24.00 kW	Cable design	Shielded control cable
Available reserve	71.61 %	Cable entry	Sealed along entire length
Rated current	49.7 A	Power cable	S1BN8-F 4G4
Starting current ratio	5.4	Number of power cables	2
Insulation class	H according IEC 34-1	Control cable	S07RC4N8-F 12G1.5
Motor enclosure	IP68	Number of control cables	1
Cos phi at 4/4 load	0.79	Moisture sensor	with
Motor efficiency at 4/4 load	88.2 %	Cable length	20.00 m
Temperature sensor	PTC resistor		
Motor winding	400 / 690 V		

Data sheet



Customer item no.: 5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 1200

Date: 23/06/2014

Page: 2 / 8

KRTK 200-401/326UNG1-D

Version no.: 1

Materials G1

Notes

general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg, chlorine (Cl2) <= 0.6 mg/kg.

Pump casing (101) Grey cast iron EN-GJL-250

Discharge cover (163) Grey cast iron EN-GJL-250

Shaft (210) Tempered steel C45+N

Impeller (230) GX2CRNIMOCUN25-6-3-3
1.4517

Bearing bracket (330) Grey cast iron EN-GJL-250

O-Ring (412) Nitrile rubber NBR

Casing wear ring (502.1)

Impeller wear ring (503)

Shaft protecting sleeve (524)

Cooling jacket (66-2)

Motor housing (811)

Motor cable (824)

Hexagon socket head cap

screw (914)

Grey cast iron EN-GJL-250

CrNi steel VG434

Chrome steel 1.4021+QT800

Stainless steel 1.4571

Grey cast iron EN-GJL-250

Chloroprene rubber

CrNiMo steel A4

Packaging

Packaging category

B1 Wooden or plywood case,
cover provided with
polypropylene cellular sheet,
outdoor storage up to 3 months

Packaging for storage Indoor

Outdoor storage at -40°C to +50°C for up to 3 months. Packet
must be covered. No corrosion protection, only transport
protection.

Packaging for transport
IPPC Standard ISPM 15

Ship
Yes

Nameplates

Nameplates language

International

Duplicate nameplate

with

Auxiliary connections

1M.2 Pressure gauge
connection

G 1/2, Drilled and plugged.

6D Pumped medium - filling / venting G 1 1/4, Drilled and plugged.

6B Pumped liquid drain

G 1, Drilled and plugged.

Certifications

Hydraulic performance test

Acceptance standard

ISO 9906 class 1B

Inspection cert. 3.1 to EN 10204
Non-witnessed

Quantity meas. points Q-H

5

Hydrostatic test (room temp.)

Certificate

Inspection cert. 3.2 to EN 10204

Complete pump with shaft seal

Test participation

Witnessed

3.00 bar.g

Quantity, non-witnessed

3

10.0 min

Quantity, witnessed

1

Inspection cert. 3.1 to EN 10204

NPSH test

Yes

Non-witnessed

Quantity meas. points NPSH

3

Final visual inspection

Vibration test

Yes

Certificate

Without

Test participation

Non-witnessed

Balancing test

Balancing grade

G 6,3

Part

Impeller

Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)

Certificate Test report 2.2 to EN 10204

Order documentation

The following documents will be supplied with the order:

Manufacturer's or conformity declaration

Material certificates

Motor data sheet

Performance curve

General arrangement drawing

Technical data sheet

Operating manual

Languages

English

Data sheet



Customer item no.: 5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 1200

Date: 23/06/2014

Page: 3 / 8

KRTK 200-401/326UNG1-D

Version no.: 1

Installation parts

Installation type	Dry installation	Foundation rails	Yes
Scope of supply	Pump with installation parts	Inlet elbow size / DN0	DN 200 / 300
Installation variant	Dry	Lifting Bail	with
Material concept	G		

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin		KSB-blue
Intermediate coating	2-component epoxy resin high solid	Total film thickness approx.	300 µm

Performance curve



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

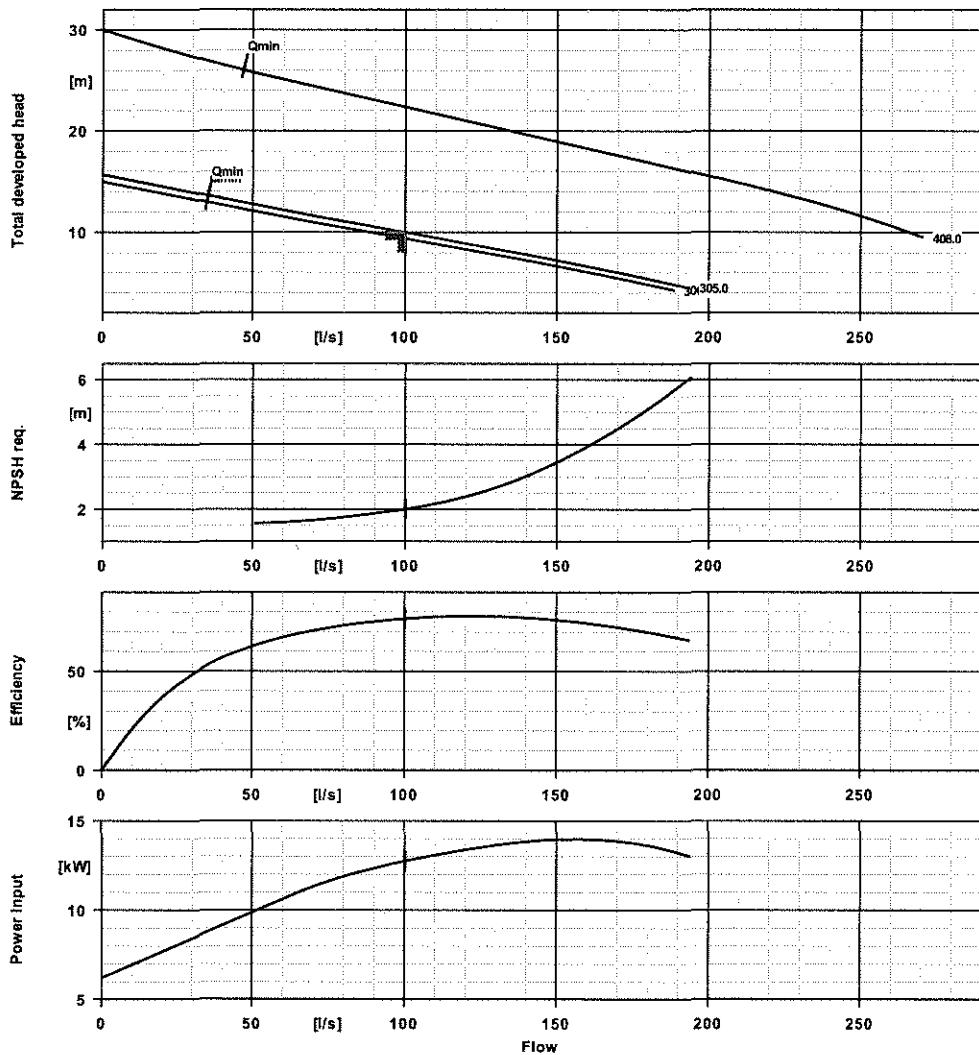
Item no.:1200

Date: 23/06/2014

Page: 4 / 8

KRTK 200-401/326UNG1-D

Version no.: 1



Curve data

Speed of rotation	989 rpm	Efficiency	76.7 %
Fluid density	998 kg/m ³	Power absorbed	12.76 kW
Viscosity	1.00 mm ² /s	NPSH required	2.01 m
Flow rate	100.000 l/s	Curve number	K43010s
Requested flow rate	100.000 l/s	Effective impeller diameter	305.0 mm
Total developed head	9.96 m	Acceptance standard	ISO 9906 class 1B
Requested developed head	9.96 m		

Motor data sheet



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.: 1200

Date: 23/06/2014

Page: 5 / 8

KRTK 200-401/326UNG1-D

Version no.: 1

Motor data

Motor manufacturer	KSB	Starting mode	Direct/Star-delta possible
Motor size	32N	Power cable	S1BN8-F 4G4
Motor construction type	KSB Sub. motor	Number of power cables	2
Motor material	Grey cast iron EN-GJL-250	Power cable Ø min.	12.4 mm
Efficiency class	not classified	Power cable Ø max.	13.4 mm
Rated voltage	400 V	Control cable	S07RC4N8-F 12G1.5
Frequency	50 Hz	Number of control cables	1
Motor power	24.00 kW	Ctrl. cable diameter, min.	19.4 mm
Rated current	49.7 A	Ctrl. cable diameter, max.	21.4 mm
Rated speed	979 rpm	Cable standard	VDE
Starting current ratio	5.4	Switching frequency	10.00 1/h

Curve data

The no-load point is not a guarantee point within the meaning of IEC 60034

Load	0.0 %	25.0 %	50.0 %	75.0 %	100.0 %
P2	0.00 kW	6.00 kW	12.00 kW	18.00 kW	24.00 kW
n	1000 rpm	995 rpm	990 rpm	984 rpm	979 rpm
P1	1.98 kW	7.74 kW	14.04 kW	20.55 kW	27.20 kW
I	22.3 A	25.4 A	31.7 A	40.1 A	49.7 A
Eta	0.0 %	77.5 %	85.5 %	87.6 %	88.2 %
cos phi	0.13	0.44	0.64	0.74	0.79

Motor data sheet



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

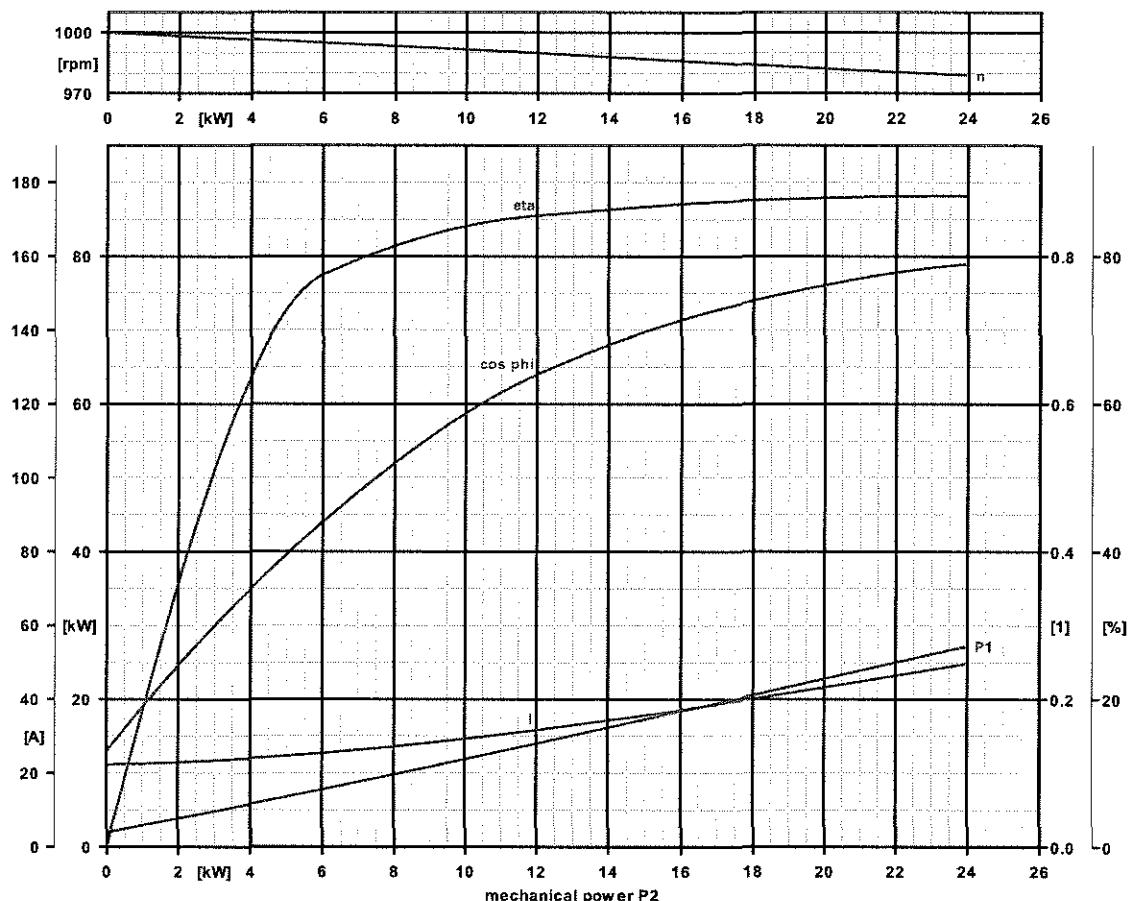
Item no.:1200

Date: 23/06/2014

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KRTK 200-401/326UNG1-D

Version no.: 1



Installation plan



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

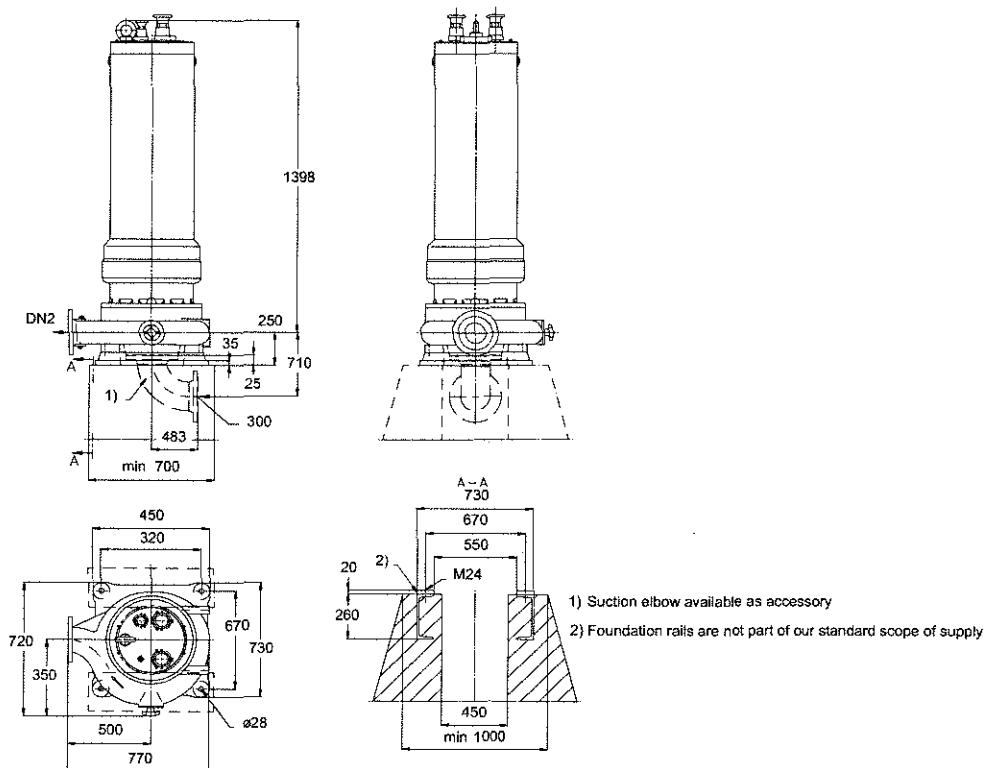
Item no.:1200

Date: 23/06/2014

Page: 7 / 8

KRTK 200-401/326UNG1-D

Version no.: 1



Drawing is not to scale

Dimensions in mm

Motor

Motor manufacturer	KSB
Motor size	32N
Motor power	24.00 kW
Number of poles	6
Speed of rotation	979 rpm

Connections

Inlet elbow size / DN0	DN 200 / 300
Suction flange pump according to(DN1)	EN 1092-2 / DN 200 / drilled DIN 2501 / ISO 7005
Discharge flange pump according to(DN2)	DN 200 / PN 10 / Drilled according to EN 1092-2
Suction nozzle drilled acc. to DIN2501	with tapped blind holes

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

Weight net

Pump, Motor, Cable
Total

1074 kg
1074 kg

For auxiliary connections see separate drawing.

DIN 747
ISO 2768-m
EN735
ISO 13920-B

Installation plan



Customer item no.:5.4.1.1

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 4

Number: 4002140658

Item no.:1200

Date: 23/06/2014

Page: 8 / 8

KRTK 200-401/326UNG1-D

Version no.: 1

Dimensions without tolerances - gray cast iron parts:

ISO 8062-CT9

Data sheet



Customer item no.: 5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1300

Date: 23/06/2014

Page: 1 / 6

KRTF 40-250/44UG1-S

Version no.: 1

Operating data

Requested flow rate	3.000 l/s	Actual flow rate	3.315 l/s
Requested developed head	12.00 m	Actual developed head	14.65 m
Pumped medium	Water	Efficiency	34.2 %
	Clean water	Power absorbed	1.39 kW
	Not containing chemical and mechanical substances which affect the materials	Pump speed of rotation	1483 rpm
Ambient air temperature	20.0 °C	Max. power on curve	2.07 kW
Fluid temperature	20.0 °C	Shutoff head	15.97 m
Fluid density	998 kg/m³	Design	Single system 1 x 100 %
Fluid viscosity	1.00 mm²/s	Performance test	Yes

Design

Design	Close-coupled submersible	Type	MG
Orientation	Vertical	Material code	SIC/SIC/NBR
Suction flange pump according to(DN1)	unmachined	Impeller type	Free flow (vortex) impeller (F)
Discharge flange pump according to(DN2)	DN 40 / PN 16 / Drilled according to EN 1092-2	Impeller diameter	200.0 mm
Shaft seal	2 mech. seals in tandem arrangement with oil reservoir	Free passage size	25.0 mm
Manufacturer	KSB	Direction of rotation from drive	Clockwise

Driver, accessories

Driver type	Electric motor	Motor winding	415 / 720 V
Model (make)	KSB	Number of poles	4
Motor const. type	KSB Sub. motor	Starting mode	Direct/Star-delta possible
Frequency	50 Hz	Connection mode	Delta
Rated voltage	415 V	Motor cooling method	Surface cooling
Rated power P2	4.00 kW	Motor version	U
Available reserve	92.82 %	Cable design	Rubber hose
Rated current	8.8 A	Cable entry	Sealed along entire length
Starting current ratio	6.3	Power cable	S1BN8-F 12G1.5
Insulation class	F to IEC 34-1	Number of power cables	1
Motor enclosure	IP68	Moisture sensor	with
Cos phi at 4/4 load	0.77	Cable length	10.00 m
Motor efficiency at 4/4 load	82.9 %		
Temperature sensor	Bimetallic switch 2x		

Materials G1

Notes	Impeller (230)	GX2CRNIMOCUN25-6-3-3
general criteria for a water analysis: pH-value >= 7; chloride content (Cl) <= 250 mg/kg. chlorine (Cl2) <= 0.6 mg/kg.	1.4517	Nitrile rubber NBR
Pump casing (101)	O-Ring (412)	Grey cast iron EN-GJL-250
Discharge cover (163)	Motor housing (811)	Chloroprene rubber
Shaft (210)	Motor cable (824)	CrNiMo steel A4
	Hexagon socket head cap screw (914)	

Data sheet



Customer item no.: 5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1300

Date: 23/06/2014

Page: 2 / 6

KRTF 40-250/44UG1-S

Version no.: 1

Packaging

Packaging category	B1 Wooden or plywood case, cover provided with polypropylene cellular sheet, outdoor storage up to 3 months	Packaging for storage Outdoor storage at -40°C to +50°C for up to 3 months. Packet must be covered. No corrosion protection, only transport protection.	Indoor
Packaging for transport IPPC Standard ISPM 15	Ship Yes		

Nameplates

Nameplates language	International	Duplicate nameplate	with
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Certifications

Hydraulic performance test		Test participation	Non-witnessed
Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2	Hydrostatic test (room temp.)	
Quantity meas. points Q-H	5	Range	Complete pump with shaft seal
Certificate	Inspection cert. 3.2 to EN 10204	Test pressure	3.00 barg
Test participation	Witnessed	Test time	10.0 min
Quantity, non-witnessed	1	Certificate	Inspection cert. 3.1 to EN 10204
Quantity, witnessed	1	Test participation	Non-witnessed
Vibration test	Yes	Final visual inspection	
		Certificate	Inspection cert. 3.1 to EN 10204
		Test participation	Witnessed
Balancing test		Material certificates: Pump casing, intermediate casing , shaft, impeller, motor housing (101, 113, 210, 230, 811)	
Balancing grade	G 6.3	Certificate	Test report 2.2 to EN 10204
Part	Impeller		
Certificate	Inspection cert. 3.1 to EN 10204		

Data sheet



Customer item no.: 5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1300

Date: 23/06/2014

Page: 3 / 6

KRTF 40-250/44UG1-S

Version no.: 1

Installation parts

Installation type	stationary 2 guide rail	Type	Chain
Scope of supply	Pump with installation parts For guide rail arrangements, the guide rails are not included in KSB's scope of supply.	Material	CrNiMo steel 1.4404
		Length	5.00 m
		Max. load	160 kg
Installation depth	4.50 m		
Material concept	G		

Duckfoot bend

Size	DN 40 / 50
Flange design	EN
Duckfoot bend size (DN2 / DN3)	DN 40 / 50 Drilled according to EN
Material	Grey cast iron EN-GJL-250
Mounting type	Composite anchor bolts
Foundation rail	Without

Claw

Design	straight
Size	DN 40 / 50

Lifting chain / -rope

Coating

KSB coating code	S2 to AA-0080-06-01 / 2	Final coating	2-component epoxy resin high solid
Surface preparation	Free from dirt, grease, rust	Color	Ultramarine blue (RAL 5002)
Primer	Zinc phosphate synthetic resin		KSB-blue
Intermediate coating	2-component epoxy resin high solid	Total film thickness approx.	300 µm

Performance curve



Customer item no.:5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

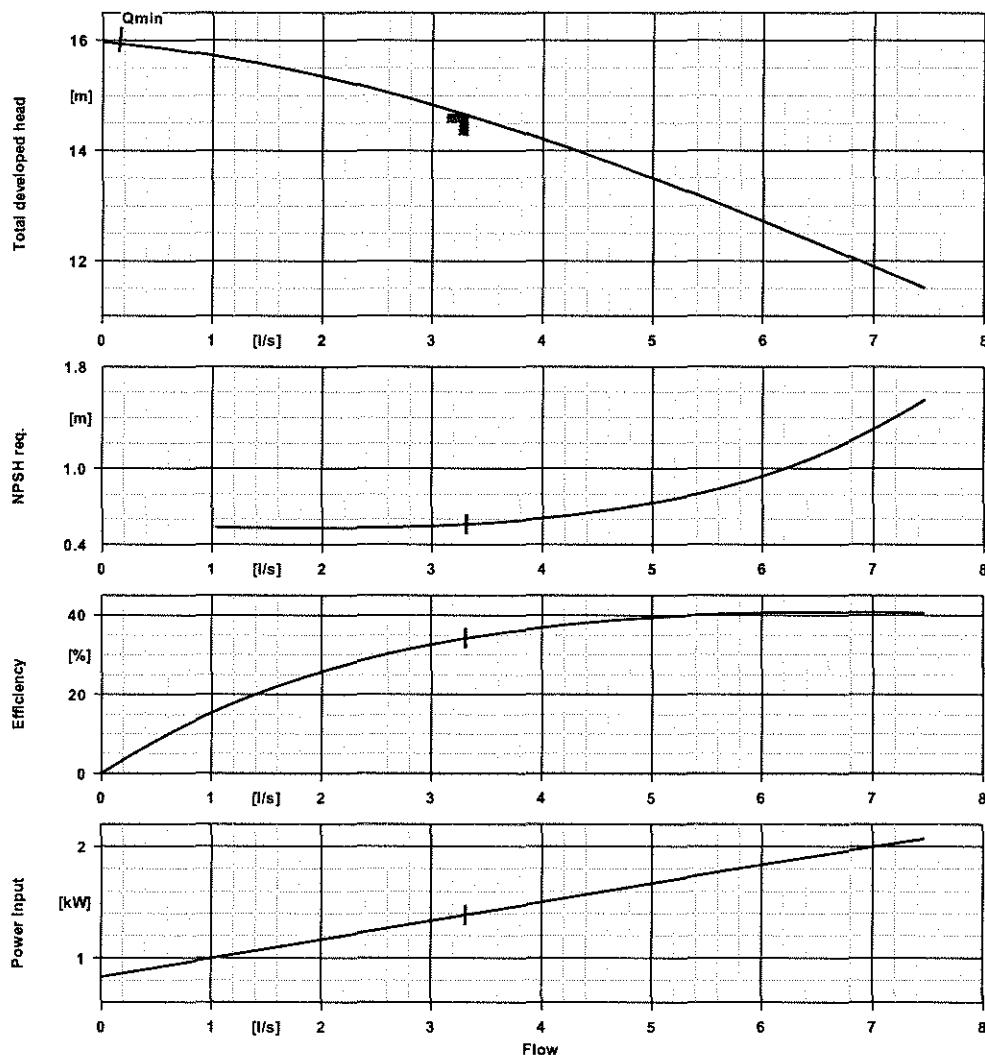
Item no.: 1300

Date: 23/06/2014

Page: 4 / 6

KRTF 40-250/44UG1-S

Version no.: 1



Curve data

Speed of rotation	1483 rpm	Efficiency	34.2 %
Fluid density	998 kg/m ³	Power absorbed	1.39 kW
Viscosity	1.00 mm ² /s	NPSH required	0.56 m
Flow rate	3.315 l/s	Curve number	K43008s
Requested flow rate	3.000 l/s	Effective impeller diameter	200.0 mm
Total developed head	14.65 m	Acceptance standard	ISO 9906 class 2B; below 10 kW acc. to paragraph 4.4.2
Requested developed head	12.00 m		

Installation plan



Customer item no.:5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

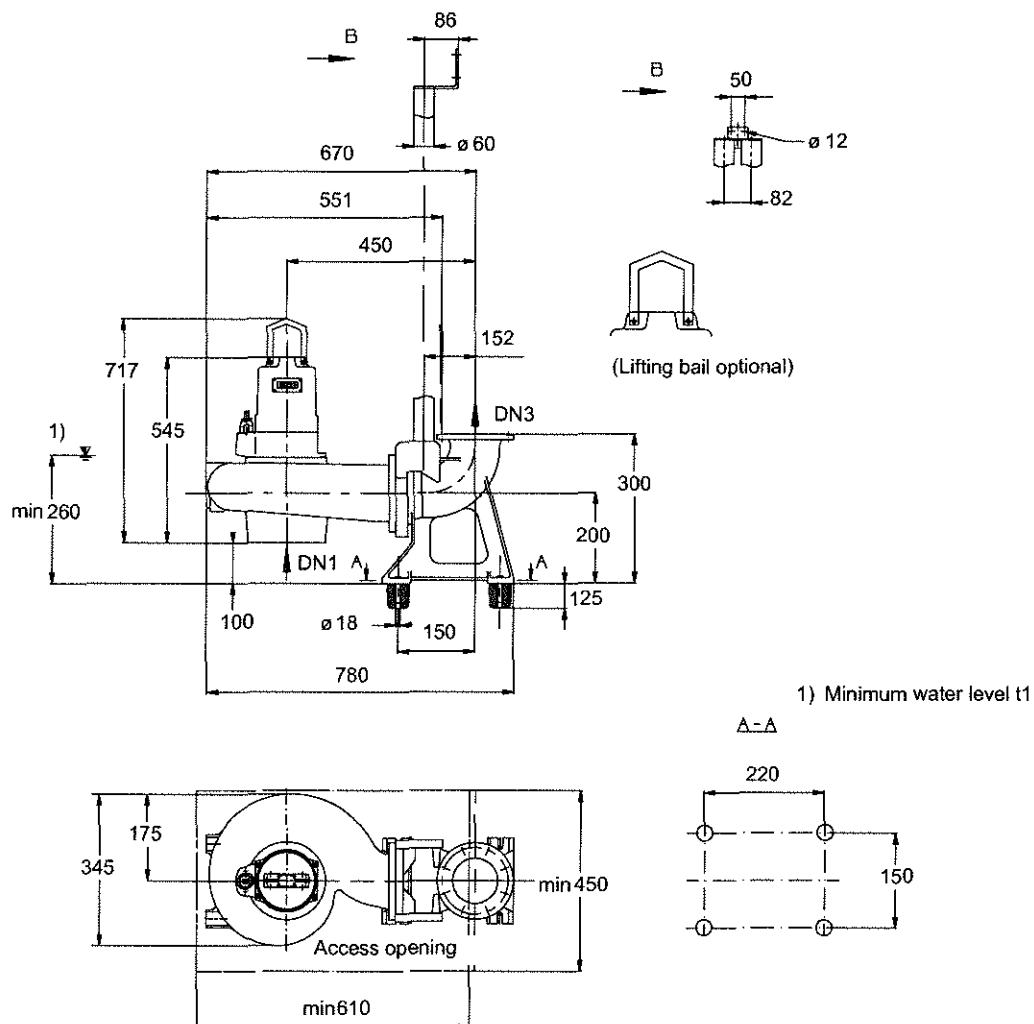
Item no.:1300

Date: 23/06/2014

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KRTF 40-250/44UG1-S

Version no.: 1



Drawing is not to scale

Dimensions in mm

Installation plan



Customer item no.: 5.4.1.2

Communication dated:

Doc. no.: Mega Reservoir - Package A

Quantity: 2

Number: 4002140658

Item no.: 1300

Date: 23/06/2014

Page: 6 / 6

KRTF 40-250/44UG1-S

Version no.: 1

Motor

Motor manufacturer	KSB
Motor size	4
Motor power	4.00 kW
Number of poles	4
Speed of rotation	1451 rpm

Connections

Suction flange pump according unmachined
to(DN1)
Duckfoot bend size (DN2 / DN3)DN 40 / 50 Drilled according
to EN

Connect pipes without stress or strain!

Dimensional tolerances for shaft axis height:

Dimensions without tolerances, middle tolerances to:

Connection dimensions for pumps:

Dimensions without tolerances - welded parts:

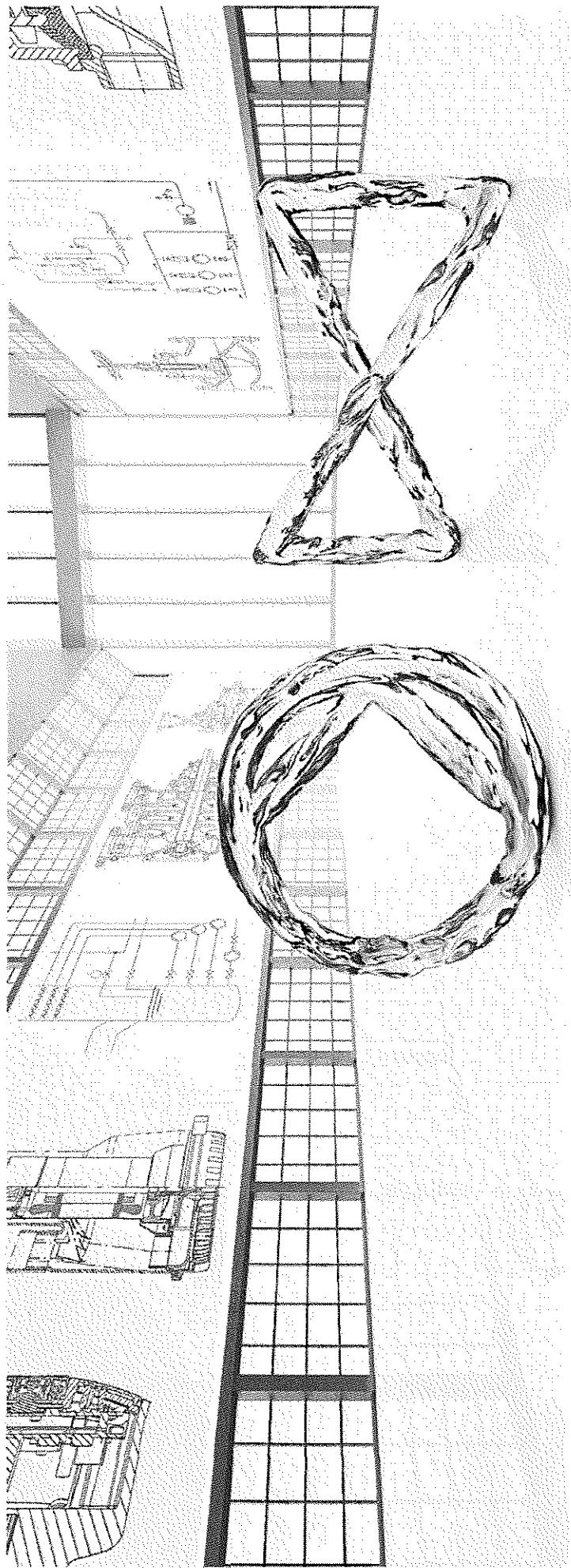
Dimensions without tolerances - gray cast iron parts:

Weight net

Pump, Motor, Cable	126 kg
Claw / Foot	9 kg
Total	135 kg

**For auxiliary connections see
separate drawing.**

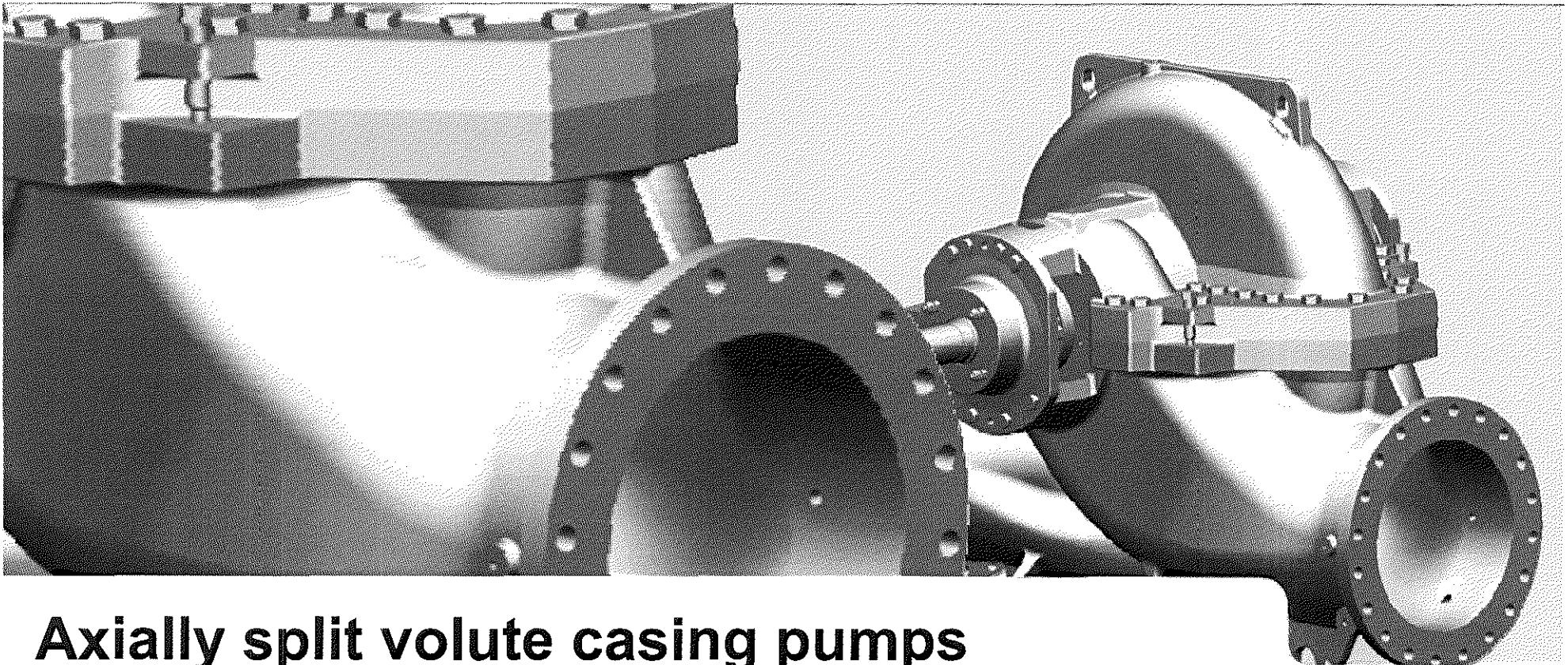
DIN 747
ISO 2768-m
EN735
ISO 13920-B
ISO 8062-CT9



Technology that makes its mark

> Our technology. Your success.
Pumps • Valves • Service

KSB b.



Axially split volute casing pumps

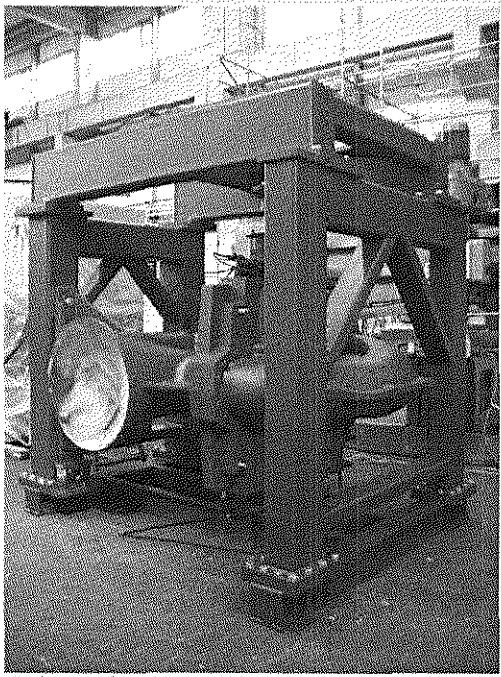
References (Extract)

Omega 300-345; 300-560

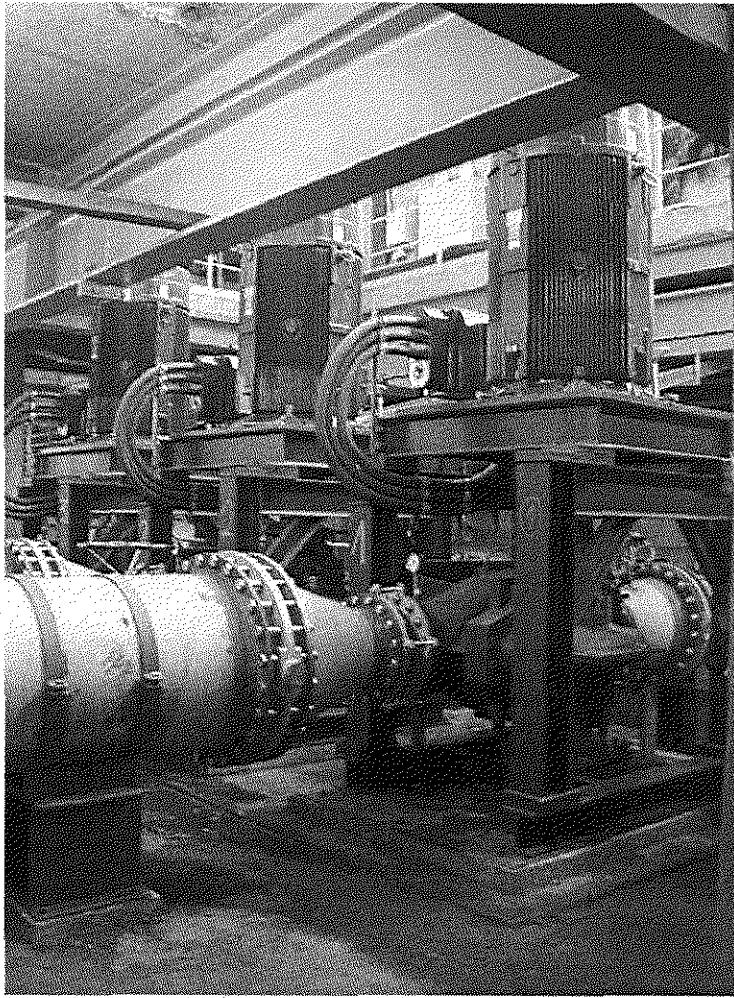
Rdlo 400-525; 600-705; 700-980

Omega / Rdlo / Rdlp Installations | C. Schaeffle
11/2013





der. 4-L73-146 583 / 9970606363 / 9971337914



**Dillingen Hütte, Germany
(Steel works cooling system)**

5 RDLOV 350-575 (VSD)

$Q = 2.250 \text{ m}^3/\text{h}$ (9.907 US.gpm)

$H = 95 \text{ m}$ (312 ft)

$n = 1.485 \text{ 1/min}$

$P = 649 \text{ kW}$

1 RDLOV 700-980 (VSD)

$Q = 6.500 \text{ m}^3/\text{h}$ (28.619 US.gpm)

$H = 80 \text{ m}$ (262 ft)

$n = 832 \text{ 1/min}$

$P = 1.630 \text{ kW}$

3 RDLOV 700-980

$Q = 6.500 \text{ m}^3/\text{h}$ (28.619 US.gpm)

$H = 60 \text{ m}$ (197 ft)

$n = 744 \text{ 1/min}$

$P = 1.630 \text{ kW}$

Omega / Rdlo / Rdip Installations | C. Schaezle
3 11/2013



Methanex, Chile (Methanol plant cooling system)

2 RDLO_Q 800-855

Driven by steam turbine

$Q = 10,000 \text{ m}^3/\text{h}$ (44,029 US.gpm)

$H = 42 \text{ m}$ (138 ft)

$n = 700 \text{ 1/min}$

$P = 1,220 \text{ kW}$

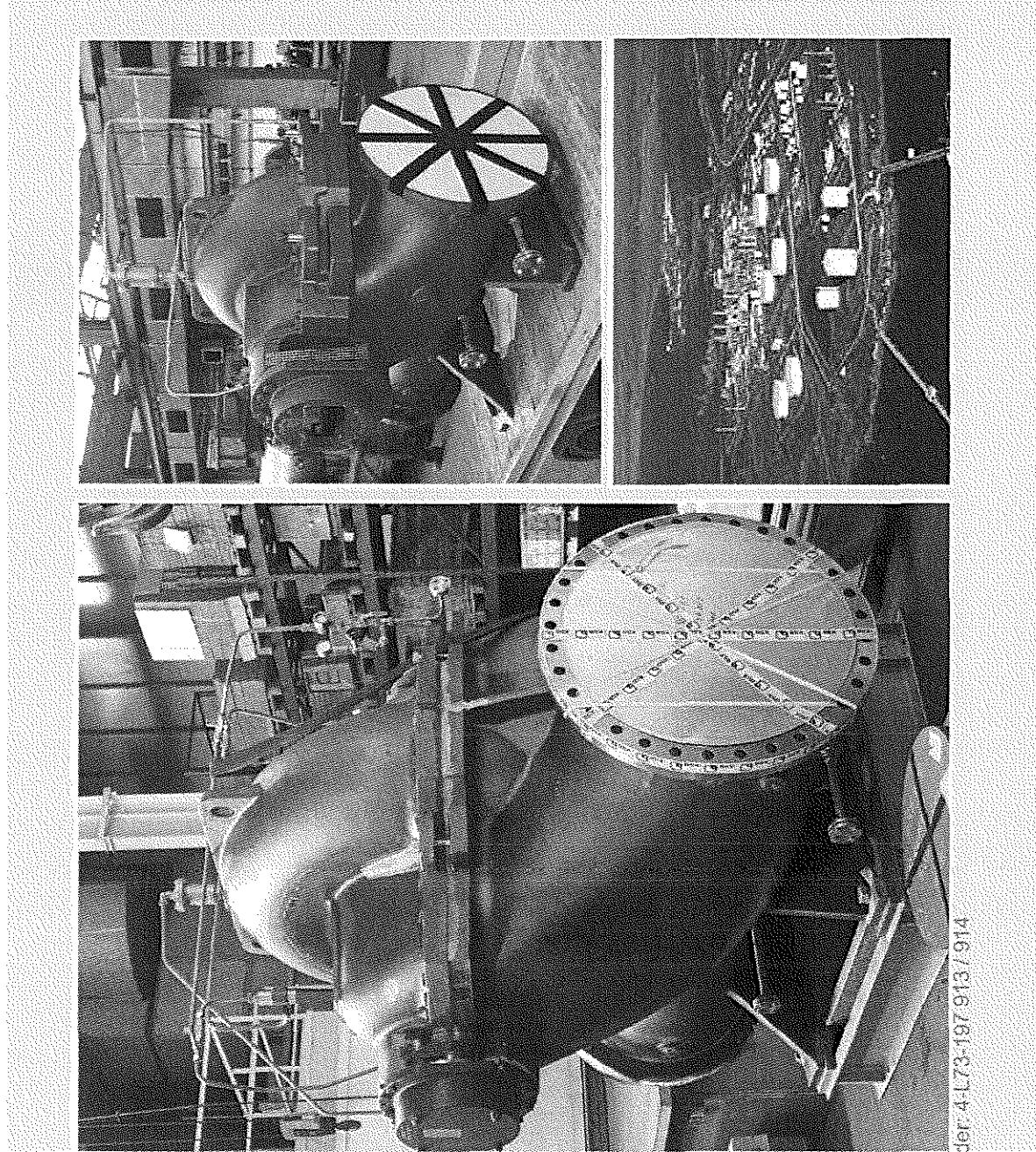
2 RDLO 400-525

$Q = 3,200 \text{ m}^3/\text{h}$ (14,089 US.gpm)

$H = 47 \text{ m}$ (154 ft)

$n = 1,280 \text{ 1/min}$

$P = 470 \text{ kW}$

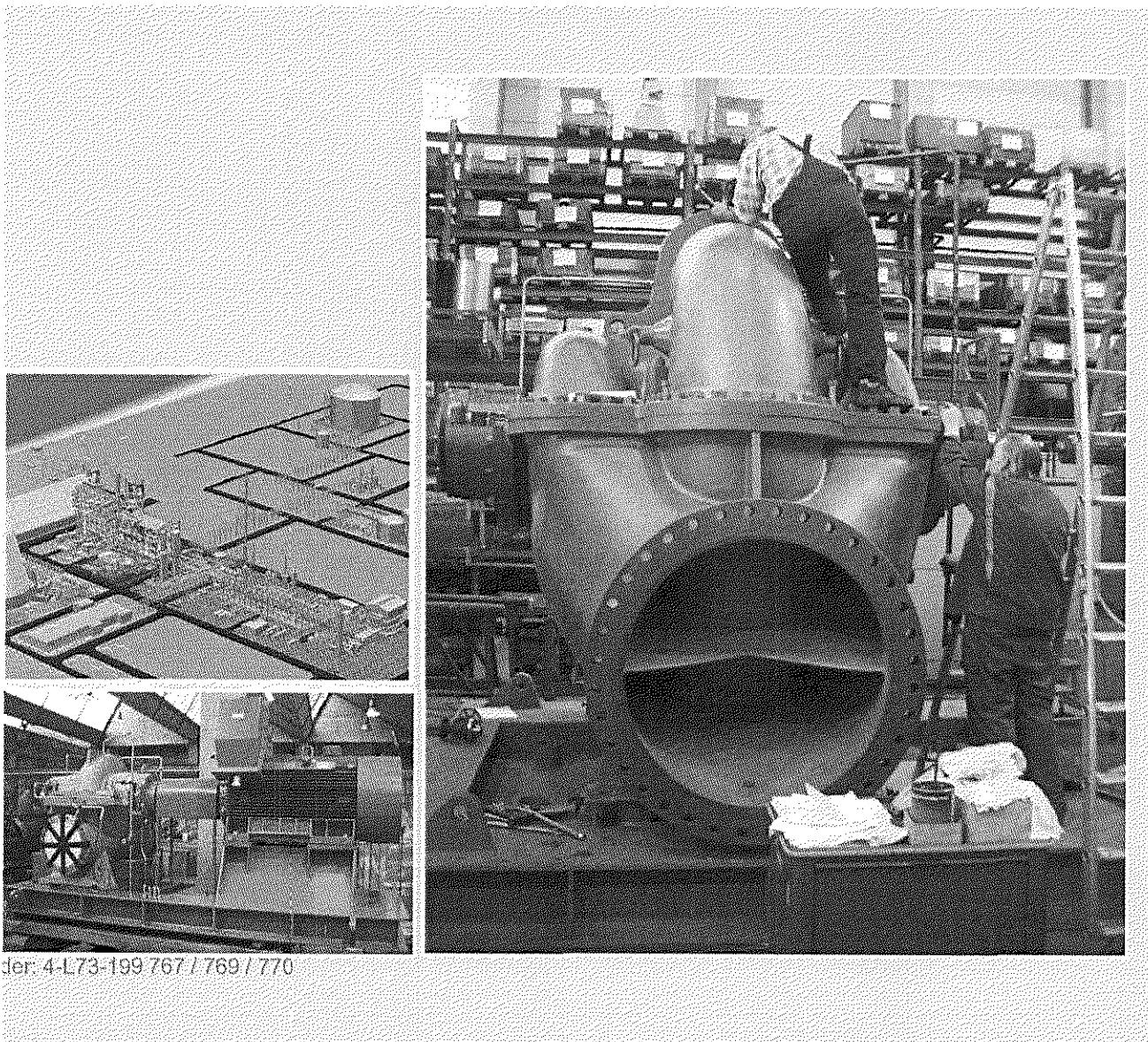


der 4-L73197913 / 914

4 11/2013

Omega / Rdlo / Rdlo Instalations | C. Schaeffle

KSB



der. 4-L73-199-767 / 769 / 770

SAFCO, Saudi Arabia (Ammonia plant cooling system)

3 RDL 900-1050

$Q = 15,000 \text{ m}^3/\text{h}$ (66.044 US.gpm)

$H = 31 \text{ m}$ (102 ft)

$n = 590 \text{ 1/min}$

$P = 1480 \text{ kW}$

2 RDLO 600-600

$Q = 4,000 \text{ m}^3/\text{h}$ (16.611 US.gpm)

$H = 9,6 \text{ m}$ (31 ft)

$n = 590 \text{ 1/min}$

$P = 132 \text{ kW}$

3 RDLO 400-525

$Q = 2,500 \text{ (11.007 US.gpm)}$

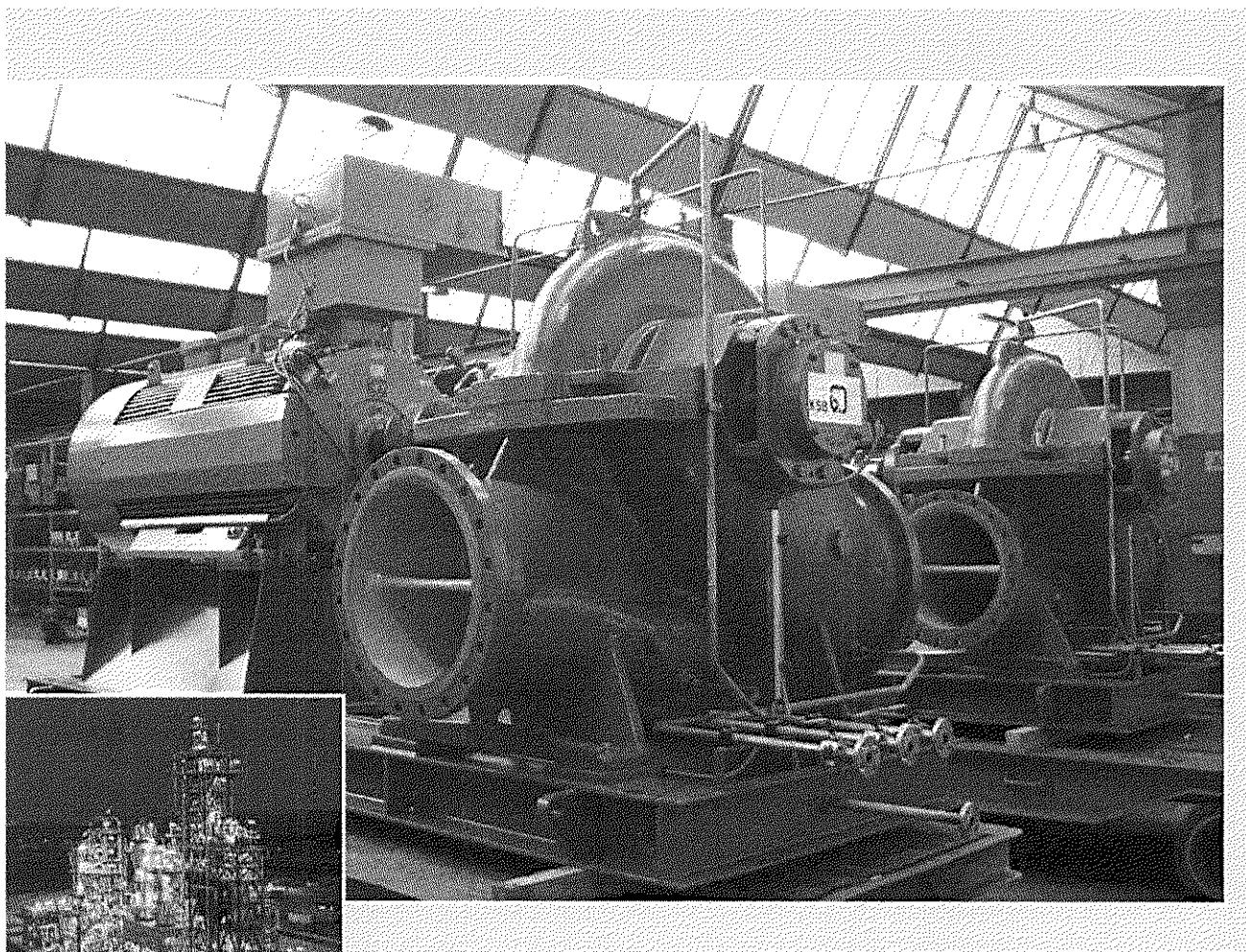
$H = 24 \text{ (79 ft)}$

$n = 895 \text{ 1/min}$

$P = 197 \text{ kW}$

Omega / Rdlo / Rdlp Installations | C. Schaetze
5 11/2013





der: 4-L73-200 679

**Borealis, Austria
(Polyethylene Plant cooling
system)**

3 RDLO 600-705

$Q = 4,700 \text{ m}^3/\text{h}$ (20,694 US.gpm)
 $H = 43 \text{ m}$ (141 ft)
 $n = 985 \text{ 1/min}$
 $P = 669 \text{ kW}$

Al Gardabiya - Assdada, Libya
(Water transport pipeline)

9 RDLO 600-705

$Q = 5.832 \text{ m}^3/\text{h}$ (25.678 US.gpm)

$H = 56 \text{ m}$ (184 ft)

$n = 990 \text{ 1/min}$

$P = 982 \text{ kW}$

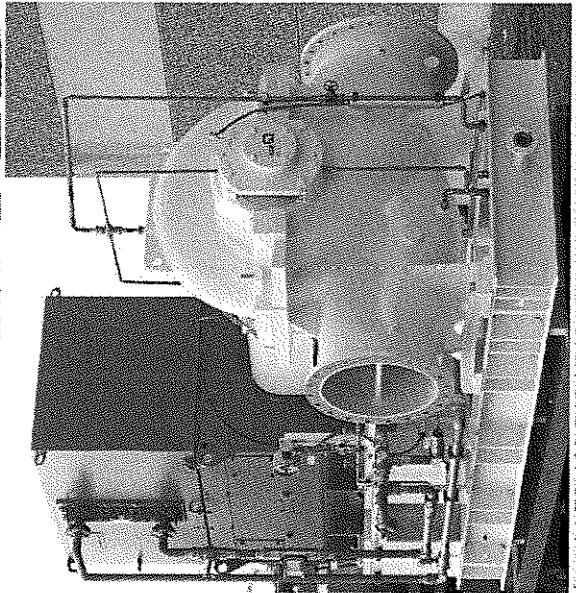
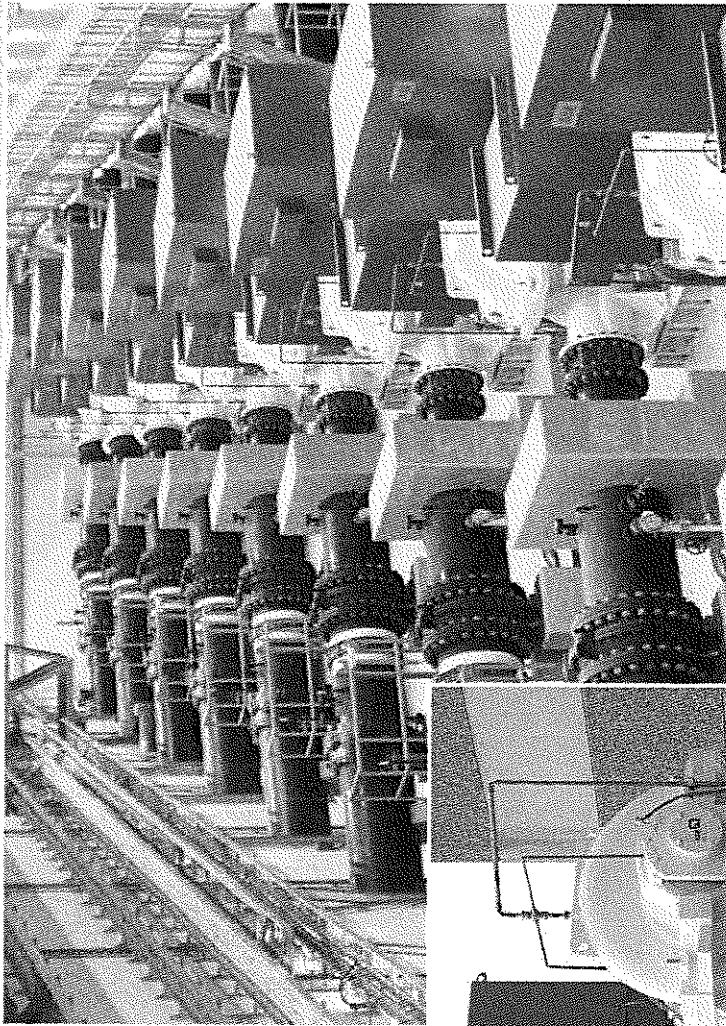
11 RDLO 500-835

$Q = 4.536 \text{ m}^3/\text{h}$ (19.972 US.gpm)

$H = 182 \text{ m}$ (597 ft)

$n = 1490 \text{ 1/min}$

$P = 2.566 \text{ kW}$

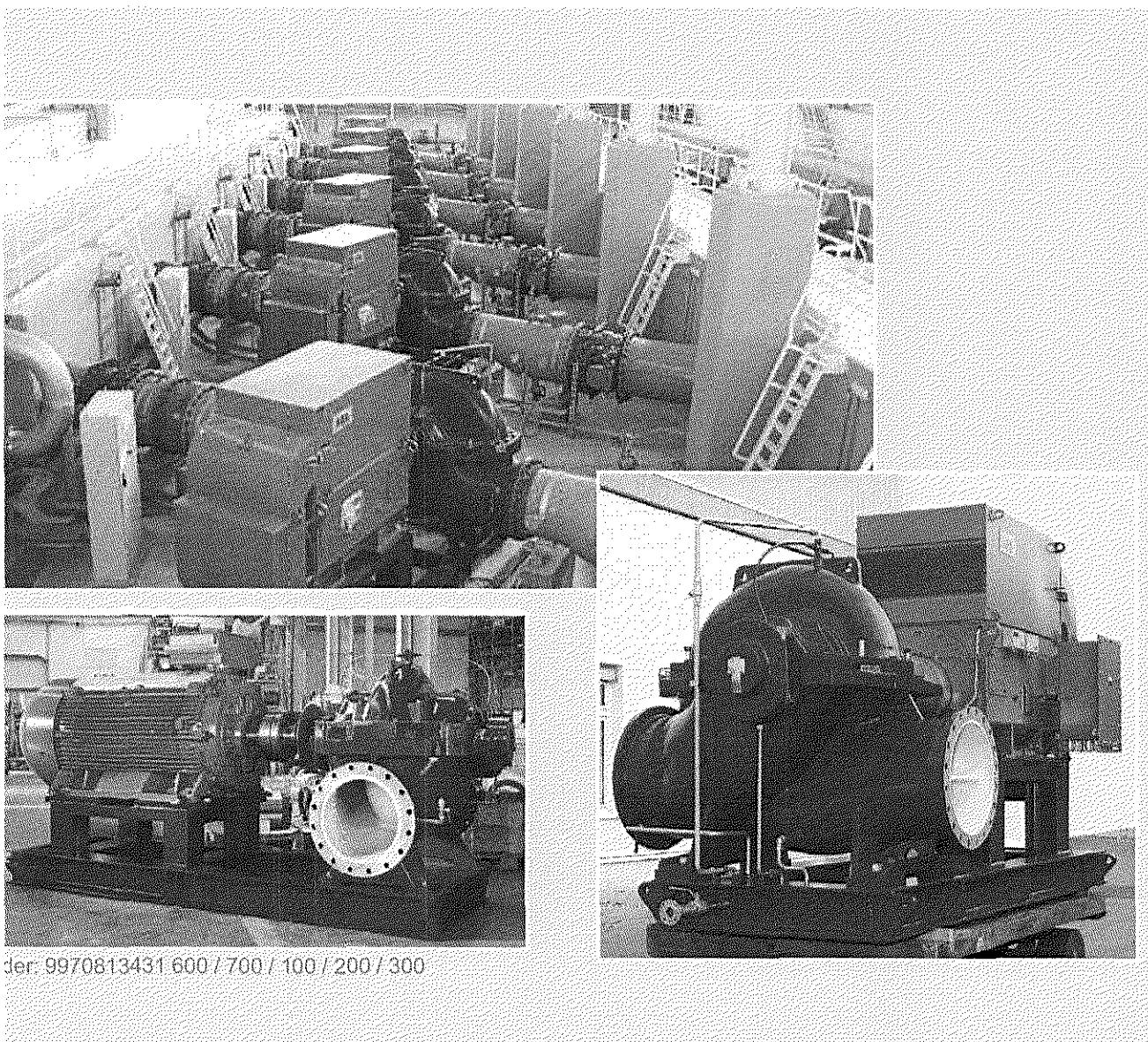


Ter 4 LT 3-199745 / 746

7 11/2013

Omega / Rölo / Rölo Installationen | G. Schatzle





der. 9970813431 600 / 700 / 100 / 200 / 300

Sirt B / Large Farms, Libya (Water transport pipeline)

6 RDLO 600-705

$Q = 4.608 \text{ m}^3/\text{h}$ (20.289 US.gpm)
 $H = 62 \text{ m}$ (203 ft)
 $n = 993 \text{ 1/min}$
 $P = 881 \text{ kW}$

12 Omega 200-520

$Q = 749 / 842 \text{ m}^3/\text{h}$ (3.297 / 3.709 US.gpm)
 $H = 67 / 65 \text{ m}$ (220 / 213 ft)
 $n = 1492 \text{ 1/min}$
 $P = 167 / 184 \text{ kW}$

6 Omega 350-510

$Q = 2.578 \text{ m}^3/\text{h}$ (11.349 US.gpm)
 $H = 57 \text{ (187 ft)}$
 $n = 1492 \text{ 1/min}$
 $P = 463 \text{ kW}$

Omega / Rdlo / Rdlp Installations | C. Schaezle
8 11/2013



Taksebt / Algeria (Water transport pipeline)

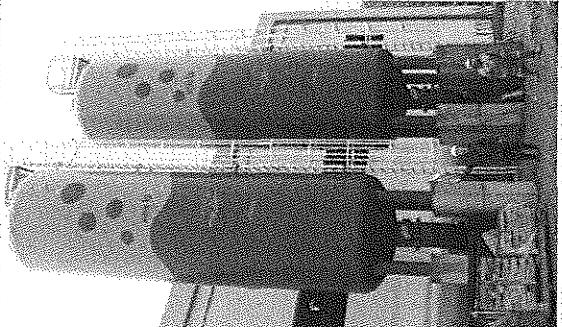
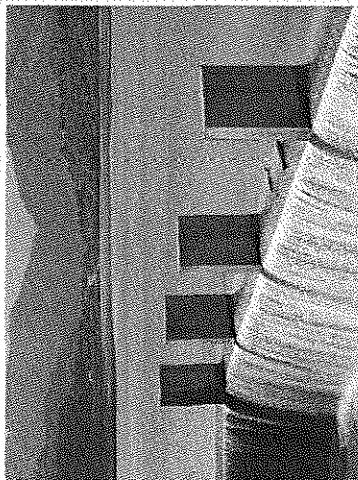
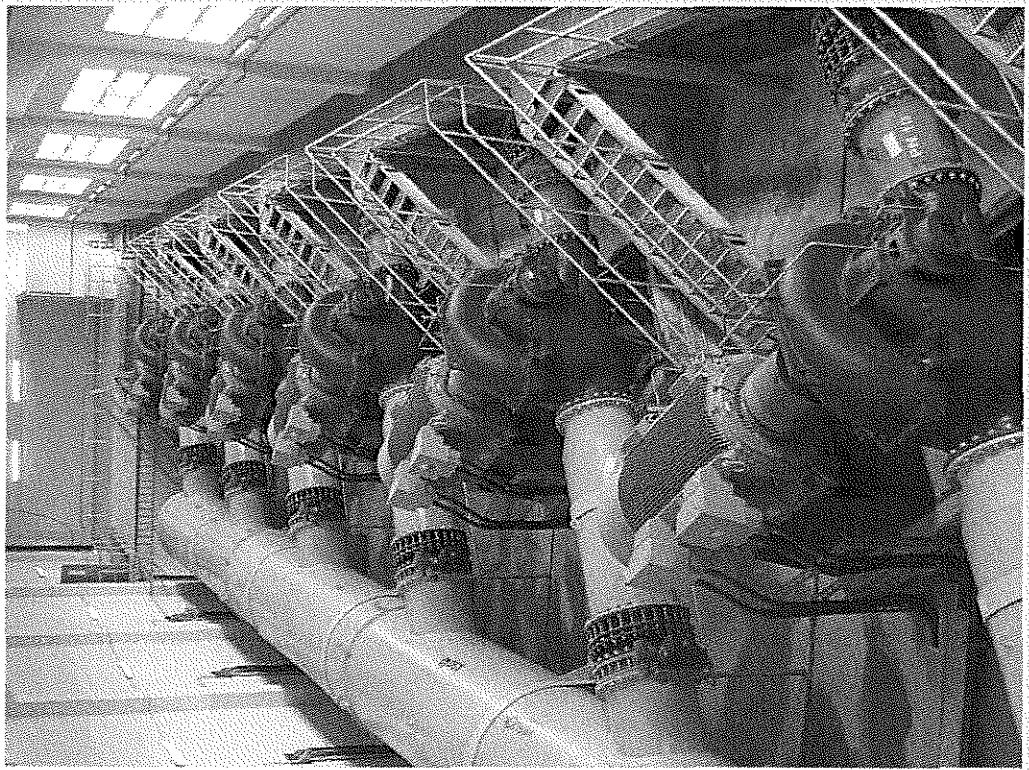
6 RDLO 700-980 (VSD)

$Q = 5.112 \text{ m}^3/\text{h}$ (22.508 US.gpm)

$H = 59 \text{ m}$ (194 ft)

$n = 744 \text{ 1/min}$

$P = 949 \text{ kW}$



Ter 9970782662

9 14/2013

Orasga / Reflo / Rdip Installations | C. Schaeffle

KSB

Bundamba / Australia
(Water transport pipeline)

2 RDLO 700-980 (VSD)

$Q = 7.142 \text{ m}^3/\text{h}$ (31.446 US.gpm)

$H = 84 \text{ m}$ (276 ft)

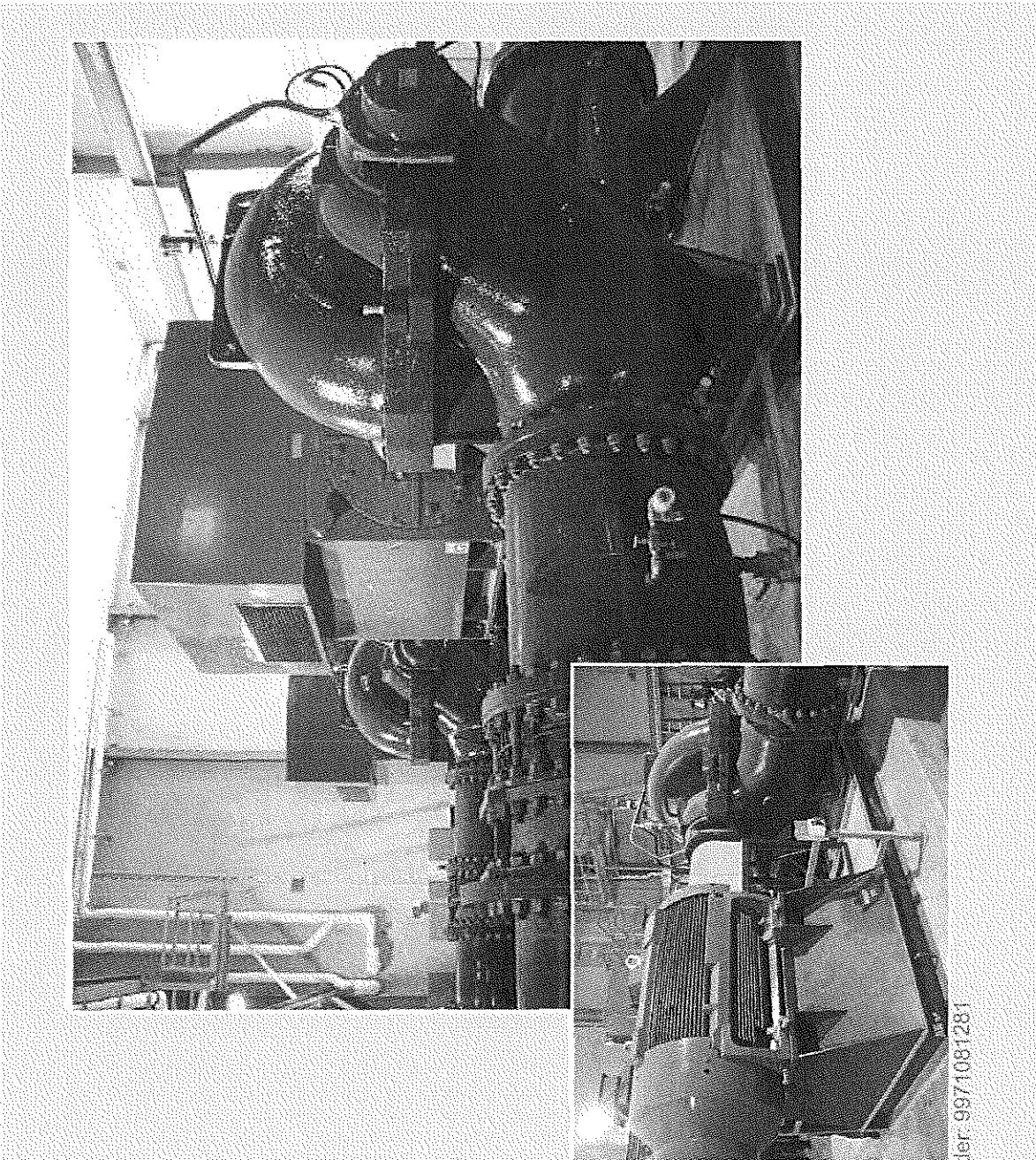
$n = 993 \text{ 1/min}$

1 RDLO 600-703 (VSD)

$Q = 3.240 \text{ m}^3/\text{h}$ (14.266 US.gpm)

$H = 29 \text{ m}$ (95 ft)

$n = 741 \text{ 1/min}$



der 9971081281

10.11.2013

Omega / Rödo / Rödp installations | C. Schaezle

KSB

Abadan III / Iran (Refinery cooling System)

7 RDLO 700-980

$Q = 6,000 \text{ m}^3/\text{h}$ (26,417 US.gpm)

$H = 93,6 \text{ m}$ (307 ft)

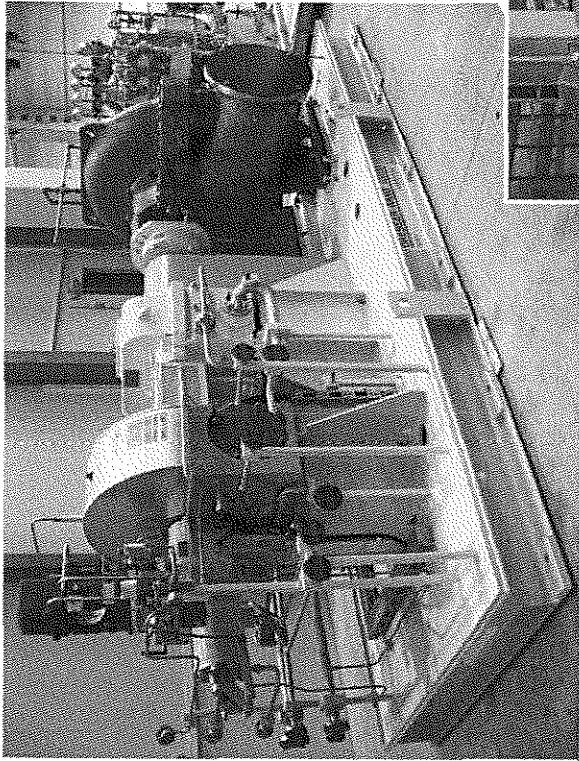
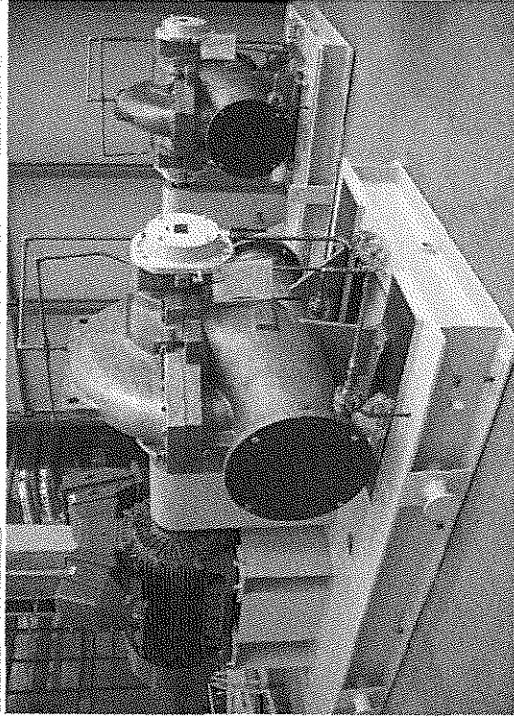
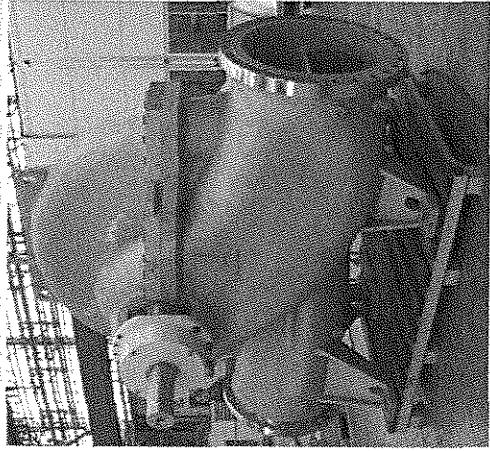
$n = 744 \text{ 1/min}$

2 RDLO 400-665

$Q = \text{m}^3/\text{h}$ (US.gpm)

$H = \text{m}$ (95 ft)

$n = 1/\text{min}$



der. 9971199928.200

11.11.2013

Omega / Rdlo / Rdip Installations | G. Schaezle

KSB

Mosenergo / Russia
(Power plant cooling System)

6 RDLO 600-705

$Q = 5,000 \text{ m}^3/\text{h}$ (22,014 US.gpm)

$H = 70 \text{ m}$ (229.65 ft)

$n = 996 \text{ 1/min}$

$P = \text{kW}$



der 9971097107

12.11.2013

Omega / Rdlo / Rdip installations | C. Schaeffle

KSB

Year	SAP Order Nr.	Type	Size	Head [m]	Flow [m³/h]	Speed [min⁻¹]	Purchaser (Client)	Enduser (Country)
2002	0211100014	RDLO	0400-0525	14	2160	740		
2002	0211100017	RDLO	0400-0525	16,1	2660	986		
2003	9970446537	RDLO	0400-0525	28,1	2.700	989	MAB Anlagenbau Austria GmbH & Co KG	Ostereich
2004	9970453856	RDLO	0400-0525	47,0	3.200	1280		
2004	9970589223	RDLO	0400-0525	50,0	3.000	1488	KSB Szivattyú és Amatura Kft.	Ungarn
2005	9970567595	RDLO	0400-0525	24,0	2.500	894		
2007	9971132897 001700	RDLO	0400-0525	#	#	1493	RWE Power AG	Deutschland
2008	9971146710 000100	RDLO	0400-0525	57,5	3.333	1492	SSAB EMEA AB	Schweden
2008	9971146036 000100	RDLO	0400-0525	#	#	1493	RWE Power AG	Deutschland
2008	9971247576 000200	RDLO	0400-0525	15,0	2.000	750	ANTWERPSE WATERWERKEN	Belgien
2008	9971275775 000100	RDLO	0400-0525	15,0	2.000	745	KSB BELGIUM S.A./N.V.	Belgien
2008	9971275775 000200	RDLO	0400-0525	15,0	2.000	745	KSB BELGIUM S.A./N.V.	Belgien
2009	9971474498 000100	RDLO	0400-0525	27,0	2.700	988	Linde AG - Geschäftsbereich	Deutschland
2009	9971445934 000100	RDLO	0400-0525	30,0	2.780	994	KSB OOO	Russland
2010	9971584702 001200	RDLO	0400-0525	20,4	2.695	988	Zolal International	VAE
2010	9971393502 000300	RDLO	0400-0525	70,0	3.000	1488	Vattenfall Europe Generation AG	Deutschland
2010	9971755797 000100	RDLO	0400-0525	15,4	2.100	988	K+S Kali GmbH Werk Werra	Deutschland
2011	9971816055 000400	RDLO	0400-0525	32,0	2.180	1180	KSB PUMPS Arabia LTD.	Saudi Arabien
2011	9971818519 000400	RDLO	0400-0525	28,0	2.100	989	KEPPEL SEGHERS BELGIUM NV	Belgien
2011	9971903685 000100	RDLO	0400-0525	#	#	995	Evonik Degussa GmbH	Deutschland
2011	9971903685 000300	RDLO	0400-0525	#	#	995	Evonik Degussa GmbH	Deutschland
2012	9972036177 000400	RDLO	0400-0525	30,0	2.780	993	KSB OOO	Russland
2013	9972225523 000600	RDLO	0400-0525	16,9	1.667	738	KSS Australia Pty Ltd	Australien
2013	9972261211 000100	RDLO	0400-0525	35,0	2.566	1188	KSB Pumps Arabia Ltd.	Saudi-Arabien
2013	9972261211 000800	RDLO	0400-0525	35,0	2.566	1188	KSB Pumps Arabia Ltd.	Saudi-Arabien
2013	9972274434 000100	RDLO	0400-0525	28,0	2.088	989	KSB Shanghai Pump Co., Ltd.	China
2013	9972298708 000100	RDLO	0400-0525	27,2	2.160	927	KSB Australia Pty Ltd	Australien
2013	9972298708 000200	RDLO	0400-0525	23,0	2.160	927	KSB Australia Pty Ltd	Australien

Sales record (extract) Rdlo 400-525

Year	SAP Order Nr.	Type	Size	Head [m]	Flow [m³/h]	Speed [min-1]	Purchaser (Client)	Enduser (Country)
2002	9211100005	RDLO	0600-0705	62,0	5.040	994		
2003	0211100011	RDLO	0600-0705	63,0	4.439	970		
2004	9970509597	RDLO	0600-0705	60,0	5.300	993	Mittal Steel Galati S.A.	Rumänien
2005	9970566475	RDLO	0600-0705	56,0	5.832	995	Vinci Construction Grande Projets	Frankreich
2004	9970609100	RDLO	0600-0705	43,0	4.700	985	DTG	Deutschland
2005	9970811772	RDLO	0600-0705	60,0	4.860	993	COMET CO. FOR TRADING &	Ägypten
2005	9970813431	RDLO	0600-0705	62,0	4.608	993	ABB Utilities GmbH	Deutschland
2006	9970930962	RDLO	0600-0705	96,0	4.572	992	ProStream Group Ltd.	Bulgarien
2008	9971250137_000300	RDLO	0600-0705	56,0	5.040	993	Horse Engineering Works	Ägypten
2008	9971250137_000400	RDLO	0600-0705	56,0	5.040	993	Horse Engineering Works	Ägypten
2008	9971198929_000100	RDLO	0600-0705	43,5	5.100	988	KSB ITALIA S.P.A.	Italien
2008	9971198929_000200	RDLO	0600-0705	43,5	5.100	988	KSB ITALIA S.P.A.	Italien
2008	9971296023_000100	RDLO	0600-0705	52,0	4.500	994	Basell Polyolefins GmbH	Deutschland
2008	9971301864_000200	RDLO	0600-0705	70,0	5.000	994	KSB OOO	Russland
2009	9971436721_000100	RDLO	0600-0705	60,0	5.350	993	Passavant Rödiger GmbH	Deutschland
2009	9971436721_000200	RDLO	0600-0705	60,0	5.350	993	Passavant Rödiger GmbH	Deutschland
2009	9971505743_000100	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971505743_000400	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971505743_000200	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971505743_000500	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971505743_000300	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971505743_000600	RDLO	0600-0705	75,0	4.320	993	COMET CO. FOR TRADING &	Ägypten
2009	9971469313_000100	RDLO	0600-0705	68,5	5.472	994	Rosado Transitários	Portugal
2009	9971511616_000100	RDLO	0600-0705	68,5	5.472	995	Rosado Transitários	Portugal
2009	9971444793_000100	RDLO	0600-0705	60,0	5.300	993	S.C. MULTIGAMA TECH S.R.L	Rumänien
2009	9971489531_000100	RDLO	0600-0705	39,1	5.843	991	Uhde GmbH	Deutschland
2010	9971677027_000100	RDLO	0600-0705	54,0	4.734	993	KSB ITALIA S.P.A	Italien
2010	9971705100_000200	RDLO	0600-0705	56,0	5.040	995	The Construction Authority for	Ägypten
2010	9971720149_000100	RDLO	0600-0705	72,5	4.583	993	Bamag Middle East and North Africa	Ägypten
2010	9971720149_000200	RDLO	0600-0705	72,5	4.583	993	Bamag Middle East and North Africa	Ägypten
2010	9971720149_000300	RDLO	0600-0705	72,5	4583	993	Bamag Middle East and North Africa	Ägypten
2010	9971720149_000400	RDLO	0600-0705	72,5	4583	993	Bamag Middle East and North Africa	Ägypten
2010	9971720149_000500	RDLO	0600-0705	72,5	4583	993	Bamag Middle East and North Africa	Ägypten
2010	9971720149_000600	RDLO	0600-0705	72,5	4583	993	Bamag Middle East and North Africa	Ägypten
2011	9971589333_000100	RDLO	0600-0705	63	4460	993	Faravand Kav	Iran
2012	9971973825_000200	RDLO	0600-0705	56,5	4800	991	OASIS TECHNICAL CORPOR.	Tunesien
2012	9972096844_000100	RDLO	0600-0705	43,5	5.100	988	KSB Italia S.p.A.	Italien
2013	9972298708_000300	RDLO	0600-0705	28,0	5.040	721	KSB Australia Pty Ltd	Australien
2013	9972293716_000200	RDLO	0600-0705	56,0	5.040	995	The Construction Authority for	Ägypten

Sales record (extract) Rdlo 600-705

Year	Delivery date	Type	Size	Head [m]	Flow [m³/h]	Speed [min-1]	Purchaser (Client)	Enduser (Country)
2002	9211100030	RDLO	0700-0980	67,5	6.192	744		Algerien
2004	9970606363	RDLO	0700-0980	80,0	6.500	832	Dillinger Hütte	Deutschland
2005	9970782862	RDLO	0700-0980	59,4	5.112	744		Algerien
2007	9971081261 000300	RDLO	0700-0980	84,1	7.142	1000	KSB AUSTRALIA PTY LTD	Australien
2008	9971199928 000200	RDLO	0700-0980	63,6	6.000	746	Petrochemicals Industries	Iran
2008	9971199928 000300	RDLO	0700-0980	63,6	6.000	774	Petrochemicals Industries	Iran
2009	9971337914 000100	RDLO	0700-0980	60,0	6.500	748	GTS INDUSTRIES	Frankreich
2009	9971337914 000200	RDLO	0700-0980	60,0	6.500	748	GTS INDUSTRIES	Frankreich
2010	9971518590 000100	RDLO	0700-0980	43,0	5.150	594	Linde Engineering	VAE
2010	9971518590 000200	RDLO	0700-0980	43,0	5.150	594	Linde Engineering	VAE
2011	9971717405 000400	RDLO	0700-0980	35,0	7.100	594	KSB OOO	Russland
2011	9971767590 000200	RDLO	0700-0980	52,0	6.000	746	KSB OOO	Russland
2011	9971717405 000500	RDLO	0700-0980	35,0	7.100	594	KSB OOO	Russland
2011	9971767590 000100	RDLO	0700-0980	52,0	6.000	746	KSB OOO	Russland
2011	9971767590 000300	RDLO	0700-0980	52,0	8.000	746	KSB OOO	Russland
2012	9971965615 000100	RDLO	0700-0980	62,3	7.000	748	HAMON THERMAL EUROPE	Frankreich
2012	9972020739 000100	ROLO	0700-0980	73,7	7.499	746	KSB - Bombas e Válvulas, S.A.	Portugal
2013	9972238262 000100	RDLO	0700-0980	135,0	6.750	993	OOO "KSB"	Russland
2013	9972262717 000200	RDLO	0700-0980	63,0	7.615	1438	Vattenfall Europe Wärme AG	Deutschland
2013	9972262717 000400	RDLO	0700-0980	123,0	5.364	882	Vattenfall Europe Wärme AG	Deutschland

Sales record (extract) Rdlo 700-980

Year	SAP Order Nr.	Pump Typ	Size	Head	Flow	Speed	Purchaser (Client)	Enduser (Country)
				[m]	[m³/h]	[min-1]		
2007	9971052438 000100	OMEGA	0300-0435	#	#	1489	Vattenfall Europe Generation AG	Deutschland
2007	9971105994 000100	OMEGA	0300-0435	#	#	1489	X Norddeutsche Affinerie AG	Deutschland
2007	9971121407 000100	OMEGA	0300-0435	19,0	655	1485	KSB Mörck AB	Schweden
2007	9971099863 000100	OMEGA	0300-0435	46,0	1.700	1375	DUFERCO CLABECQ S.A.	Belgien
2007	9971190987 000100	OMEGA	0300-0435	53,0	471	1450	KSB New Zealand Ltd	Neuseeland
2007	9971190700 000200	OMEGA	0300-0435	60,0	1.360	1488	KSB SZIVATTYU ES ARMATURA	Ungarn
2007	9971190700 000300	OMEGA	0300-0435	60,0	1.360	1488	KSB SZIVATTYU ES ARMATURA	Ungarn
2007	9971190700 000100	OMEGA	0300-0435	60,0	1.360	1489	KSB SZIVATTYU ES ARMATURA	Ungarn
2007	9971190700 000400	OMEGA	0300-0435	60,0	1.360	1488	KSB SZIVATTYU ES ARMATURA	Ungarn
2007	9971246415 000100	OMEGA	0300-0435	55,0	1.500	1460	KSB TESMA AG	Griechenland
2007	9971217004 000100	OMEGA	0300-0435	40,0	1.215	1485	JSC "Mittal Steel Temirtau"	Kasachstan
2007	9971232878 000100	OMEGA	0300-0435	45,0	1.485	1489	Messer Group GmbH	Deutschland
2007	9971234903 000100	OMEGA	0300-0435	38,0	1.600	1488	KSB CERPADLA A ARMATURY	Slowak. Rep.
2007	9971234903 000200	OMEGA	0300-0435	38,0	1.600	1488	KSB CERPADLA A ARMATURY	Slowak. Rep.
2007	9971250065 000100	OMEGA	0300-0435	50,0	350	1488	KSB ITALIA S.P.A.	Italien
2007	9971255142 000100	OMEGA	0300-0435	40,0	389	1488	KSB New Zealand Ltd	Neuseeland
2008	9971268139 000100	OMEGA	0300-0435	45,0	1.500	1488	Berliner Wasserbetriebe	Deutschland
2008	9971296639 000200	OMEGA	0300-0435	39,0	1.332	1485	Rosado Transitários	Portugal
2008	9971296639 000400	OMEGA	0300-0435	39,0	1.332	1485	Rosado Transitários	Portugal
2008	9971338923 000100	OMEGA	0300-0435	26,0	1.412	1450	KSB ITALIA S.P.A.	Italien
2008	9971358227 000100	OMEGA	0300-0435	53,0	1.698	1488	KSB New Zealand Ltd	Neuseeland
2008	9971285518 000300	OMEGA	0300-0435	52,3	1.700	1488	KSB iTUR Spain S.A.	Spanien
2008	9971291530 000100	OMEGA	0300-0435	52,0	1.620	1489	PROJEKTOMONTAZA A.D.	Serben
2008	9971291530 000200	OMEGA	0300-0435	52,0	1.620	1488	PROJEKTOMONTAZA A.D.	Serben
2008	9971307984 000100	OMEGA	0300-0435	61,5	308	1450	KSB New Zealand Ltd	Neuseeland
2008	9971307024 000200	OMEGA	0300-0435	46,0	1.295	1480	KSB Alcene Eurl	Algerien
2008	9971355958 000300	OMEGA	0300-0435	80,0	1.875	1785	KSB TAIWAN CO., LTD.	Taiwan
2008	9971406182 000500	OMEGA	0300-0435	20,0	720	985	KSB Zurich AG	Schweiz
2008	9971318673 000700	OMEGA	0300-0435	#	#	1488	Vattenfall Europe Generation AG	Deutschland
2008	0005268199 008000	OMEGA	0300-0435	35,0	1.800	1488	KSB ITALIA S.P.A.	Italien
2009	9971443301 000200	OMEGA	0300-0435	40	1440	1488	KSB Zurich AG	Schweiz
2009	9971331213 000200	OMEGA	0300-0435	32	1400	1488	CARAMONDANI DESALINATION	Zypern
2009	9971428046 000100	OMEGA	0300-0435	45	1400	1488	KSB-POMPA ARMATUER	Turkei
2009	9971468003 002700	OMEGA	0300-0435	60	1910	1780	KSB ITALIA S.P.A.	Italien
2009	9971341047 000500	OMEGA	0300-0435	39,6	1720	1491	KSB AG U8: E	Deutschland
2009	9971341047 000550	OMEGA	0300-0435	39,6	1720	1491	KSB AG U8: E	Deutschland
2009	9971528477 000600	OMEGA	0300-0435	37,0	2.245	1488	KSB Zurich AG	Schweiz
2009	9971500438 000800	OMEGA	0300-0435	45,0	1.512	1488	Rosado Transitários	Portugal
2009	9971500438 000700	OMEGA	0300-0435	45,0	1.512	1488	Rosado Transitários	Portugal

Sales record (extract) Omega 300-435 / I

Year	SAP Order Nr.	Pump Typ	Size	Head [m]	Flow [m³/h]	Speed [min-1]	Purchaser (Client)	Enduser (Country)
2009	9971462026 000100	OMEGA	0300-0435	50	1500	1488	KSB ITALIA S.P.A.	Italien
2009	9971539212 000200	OMEGA	0300-0435	35	1500	1488	KSB ITALIA S.P.A.	Italien
2009	9971445934 000200	OMEGA	0300-0435	31,86	1350	1488	KSB OOO	Russland
2010	9971615380 000100	OMEGA	0300-0435	50	1368	1488	NASR CITY FOR TRADE	Agypten
2010	9971592008 000100	OMEGA	0300-0435	38,5	1330	1488	KSB iTUR Spain S.A.	Spanien
2010	9971397711 000300	OMEGA	0300-0435	40	1216,8	1488	Eagle Electromechanical	VAE
2010	9971397711 000400	OMEGA	0300-0435	40	1216,8	1488	Eagle Electromechanical	VAE
2010	9971612530 001500	OMEGA	0300-0435	55	1430	1488	DUFERCO CLABECQ SA	Belgien
2010	9971705539 002500	OMEGA	0300-0435	50	1650	1488	VEOLIA EAU-CIE GENERALE DES EAUX	Frankreich
2010	9971700008 000100	OMEGA	0300-0435	40,08	1500	1488	KSB Belgium S.A./N.V.	Belgien
2010	0005442359 004000	OMEGA	0300-0435	50	1590	1488	KSB ITALIA S.P.A.	Italien
2010	9971672577 000100	OMEGA	0300-0435	38,3	1575	1488	KSB Middle East FZE	VAE
2010	0005442359 003000	OMEGA	0300-0435	50	1590	1488	KSB ITALIA S.P.A.	Italien
2010	0005455580 001000	OMEGA	0300-0435	35	1800	1488	KSB OOO	Russland
2010	9971697681 000800	OMEGA	0300-0435	54,3	1573,2	1488	OASIS TECHNICAL CORPOR	Tunesien
2010	9971738450 000100	OMEGA	0300-0435	40	1400	1488	LE NICKEL SLN	Neukaledonien
2010	9971739015 000100	OMEGA	0300-0435	#	#	#	KSB iTUR Spain S.A.	Spanien
2011	9971825947 000100	OMEGA	0300-0435	45	1850	1488	Schachbau Nordhausen GmbH	Deutschland
2011	9971825947 000300	OMEGA	0300-0435	45	1350	1488	Schachbau Nordhausen GmbH	Deutschland
2011	9971815379 000300	OMEGA	0300-0435	32,99	1700	1500	China State Construction Second	China
2011	0005535200 010000	OMEGA	0300-0435	30	1500	1188	KSB Italia SpA	Italien
2011	0005535200 011000	OMEGA	0300-0435	30	1500	1188	KSB Italia SpA	Italien
2011	0005535200 012000	OMEGA	0300-0435	30	1500	1188	KSB Italia SpA	Italien
2011	9972015139 000100	OMEGA	0300-0435	58,76	1600	1488	Bulden Consult	Grossbritannien
2012	9972022077 000300	OMEGA	0300-0435	50	1400	1488	Leading Heating & Air	Jordanien
2012	0005529404 001000	OMEGA	0300-0435	60	1400	1488	KSB-POMPA ARMATUER	Türkei
2012	9972036177 000100	OMEGA	0300-0435	32,03	1350	1490	KSB OOO	Russland
2012	9971863878 000200	OMEGA	0300-0435	50	1400	1488	Autotec GmbH	Deutschland
2012	9972075293 000100	OMEGA	0300-0435	48	585	1488	KSB AUSTRALIA PTY LTD	Australien
2012	9972110541 000100	OMEGA	0300-0435	64	1500	1488	Bulden Consult	Grossbritannien
2012	9972149693 000200	OMEGA	0300-0435	27,8	1000	991	VMW	Belgien
2012	9972149693 000100	OMEGA	0300-0435	27,8	1000	991	VMW	Belgien
2012	9972178511 000100	OMEGA	0300-0435	40	1500	1488	SOLVAY ELECTROLYSE FRANCE	Frankreich
2012	9972177295 000100	OMEGA	0300-0435	25	1200	991	Yera AB	Schweden
2012	9971934050 000500	OMEGA	0300-0435	47	1240	1298	CADAGUA, S.A.	Spanien
2012	9972186071 000100	OMEGA	0300-0435	50,05	1440,75	1488	KSB Middle East FZE	VAE
2012	9972221298 000100	OMEGA	0300-0435	52	1295,99	1488	KSB Australia Pty Ltd	Australien
2012	9972169630 000100	OMEGA	0300-0435	42	2100	1408	SCA Hygiene Products GmbH	Deutschland
2012	9972203334 000100	OMEGA	0300-0435	50,03	1760,56	1488	KSB Mörck AB	Schweden

Sales record (extract) Omega 300-435 / II

Year	SAP Order Nr.	Pump Typ	Size	Head (m)	Flow (m³/h)	Speed (min-1)	Purchaser (Client)	Enduser (Country)
2013	9972271941 000300	OMEGA	0300-0435	22,93	1080,7	1186	KSB Middle East FZE	VAE
2013	9972251605 000100	OMEGA	0300-0435	60,41	1773,49	1786	KSB Pumps Arabia Ltd.	Saudi Arabien
2013	9972251605 000200	OMEGA	0300-0435	60,41	1773,49	1786	KSB Pumps Arabia Ltd.	Saudi Arabien
2013	9972277674 000100	OMEGA	0300-0435	20	1199,88	988	Engineering Group for	Agypten
2013	9972333469 000100	OMEGA	0300-0435	55,54	1606,25	1488	CONTROLMATIC COMMERCE D.O.O.	Montenegro
2013	9972333469 000200	OMEGA	0300-0435	55,54	1606,25	1488	CONTROLMATIC COMMERCE D.O.O.	Montenegro
2013	9972381901 000100	OMEGA	0300-0435	46,99	1799,75	1490	KSB ITUR Spain S.A.	Spanien
2013	9972406615 000100	OMEGA	0300-0435	48,99	1749,77	1490	KSB ITUR Spain S.A.	Spanien
2013	9972406615 000200	OMEGA	0300-0435	48,99	1749,84	1490	KSB ITUR Spain S.A.	Spanien
2013	9972358835 000100	OMEGA	0300-0435	51,15	1430,3	1794	KSB Pumps Arabia Ltd.	Saudi-Arabien
2013	9972403145 000100	OMEGA	0300-0435	50,05	1750,82	1490	OOO "KSB BEL"	Rep. Belarus
2013	9972379165 000100	OMEGA	0300-0435	21,97	1199,17	989	KSB Finland Oy	Finland
2013	9972397260 000300	OMEGA	0300-0435	40,98	1899,67	1489	Infraserv GmbH&Co.	Deutschland
2013	9972442530 000100	OMEGA	0300-0435	42,84	1598,39	1490	Aurubis AG	Deutschland
2013	9972368665 001300	OMEGA	0300-0435	63,35	1487,7	1490	KSB AG - UB I	Deutschland
2013	9972397260 000100	OMEGA	0300-0435	40,99	1449,83	1491	Infraserv GmbH&Co.	Deutschland
2013	9972397260 000200	OMEGA	0300-0435	40,98	1699,57	1489	Infraserv GmbH&Co.	Deutschland
2013	9972397260 000400	OMEGA	0300-0435	40,99	1449,83	1491	Infraserv GmbH&Co.	Deutschland

Sales record (extract) Omega 300-435 / III

Sales record (extract)

Omega 300-560 / I

Year	SAP Order Nr.	Type	Size	Head [m]	Flow [m³/h]	Speed [min⁻¹]	Purchaser (Client)	Enduser (Country)
2007	9971118747 000300	OMEGA	0300-0560	80,0	1.200	1450	MUTHEC	Frankreich
2007	9971144041 000100	OMEGA	0300-0560	120,0	1.380	1450	KSB Nederland BV	Niederlande
2007	9971144041 000200	OMEGA	0300-0560	120,0	1.380	1450	KSB Nederland BV	Niederlande
2007	9971147684 000100	OMEGA	0300-0560	92,0	520	1492	Mohamed Nasser Mamdan	Syrien
2007	9971165993 000100	OMEGA	0300-0560	90,0	1.600	1488	KSB OOO	Russland
2007	9971192556 000400	OMEGA	0300-0560	70,0	1.500	1488	KSB ITALIA S.P.A.	Italien
2007	9971187797 000100	OMEGA	0300-0560	72,4	1.341	1188	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971187797 000200	OMEGA	0300-0560	72,4	1.341	1188	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971187797 000300	OMEGA	0300-0560	72,4	1.341	1188	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971187797 000400	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971187797 000500	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971187797 000600	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971171925 000100	OMEGA	0300-0560	#	#	#	KSB Mörck AB	Schweden
2007	9971231980 000100	OMEGA	0300-0560	#	#	#	X LINDFLATEN A.S.	Norwegen
2007	9971206800 002400	OMEGA	0300-0560	72,4	1.341	1188	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971206800 002500	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971206800 002600	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971206800 002700	OMEGA	0300-0560	84,7	1.341	1189	P.A.S.I. Pumpen u. Armaturen	Deutschland
2007	9971151932 000100	OMEGA	0300-0560	#	#	#	The Management and Implementation	Libyen
2007	9971238740 000100	OMEGA	0300-0560	#	#	#	KSB SZIVATTYU ES ARMATURA	Ungarn
2008	9971289275 000700	OMEGA	0300-0560	62,0	1.620	1488	KSB ITALIA S.P.A.	Italien
2008	9971289275 000800	OMEGA	0300-0560	62,0	1.622	1488	KSB ITALIA S.P.A.	Italien
2008	9971289133 000300	OMEGA	0300-0560	70,0	1.690	1488	KSB ITALIA S.P.A.	Italien
2008	9971289133 000100	OMEGA	0300-0560	82,0	1.693	1488	KSB ITALIA S.P.A.	Italien
2008	9971342900 000200	OMEGA	0300-0560	85,0	350	1485	KSB AUSTRALIA PTY LTD	Australien
2008	9971342900 000500	OMEGA	0300-0560	85,0	350	1485	KSB AUSTRALIA PTY LTD	Australien
2008	9971296876 000100	OMEGA	0300-0560	66,0	1.724	1488	KSB ITUR Spain S.A.	Spanien
2008	9971289344 000200	OMEGA	0300-0560	85,0	1.500	1488	KSB ITALIA S.P.A.	Italien
2008	9971324033 000100	OMEGA	0300-0560	135,0	1.800	1450	X LINDFLATEN A.S.	Norwegen
2008	9971344404 000100	OMEGA	0300-0560	95,0	450	1450	KSB ITALIA S.P.A.	Italien
2008	9971342900 000400	OMEGA	0300-0560	90	345	1485	KSB AUSTRALIA PTY LTD	Australien
2008	9971339806 000200	OMEGA	0300-0560	88	1364	1488	KSB ITUR Spain S.A.	Spanien
2008	9971367805 000100	OMEGA	0300-0560	77	1130,4	1488	Saudi Basic Industries	Saudi Arabien
2008	9971371890 000100	OMEGA	0300-0560	61	2000	1488	Infraserv GmbH & Co	Deutschland
2008	0005268199 002000	OMEGA	0300-0560	65	1250	1488	KSB ITALIA S.P.A.	Italien
2008	0005268199 003000	OMEGA	0300-0560	75	900	1488	KSB ITALIA S.P.A.	Italien
2008	0005274885 001000	OMEGA	0300-0560	80,0	1.750	1488	S.C. MULTIGAMA TECH S.R.L	Rumänien
2008	9971358811 000500	OMEGA	0300-0560	90,0	474	1490	KSB Middle East FZE	VAE
2008	9971358811 000600	OMEGA	0300-0560	90,0	474	1490	KSB Middle East FZE	VAE

Sales record (extract)

Omega 300-560 / II

Year	SAP Order Nr.	Pump Typ	Size	Head [m]	Flow [m³/h]	Speed [min-1]	Purchaser (Client)	Enduser (Country)
2009	9971398471 000300	OMEGA	0300-0560	91,22	1362	1488	DECKX WERKHUIZEN N.V.	Belgien
2009	9971436112 000100	OMEGA	0300-0560	70	1512	1488	KSB - POMPY I ARMATURA	Polen
2009	9971459142 000100	OMEGA	0300-0560	77	1130	1488	SAUDI Basics Industries	Saudi Arabien
2009	9971397523 000100	OMEGA	0300-0560	57	1980	1488	AJ Jaber Group	VAE
2009	9971468376 000200	OMEGA	0300-0560	94,5	1497,6	1492	Garland Transférios, Lda.	Portugal
2009	9971468003 000900	OMEGA	0300-0560	65	1980	1780	KSB ITALIA S.P.A.	Italien
2009	9971468003 001000	OMEGA	0300-0560	65	1980	1780	KSB ITALIA S.P.A.	Italien
2009	9971468003 001400	OMEGA	0300-0560	70	1750	1780	KSB ITALIA S.P.A.	Italien
2009	9971508524 000100	OMEGA	0300-0560	80	1250	1488	FELJAS ET MASSON	Frankreich
2009	9971468003 001500	OMEGA	0300-0560	70	1750	1780	KSB ITALIA S.P.A.	Italien
2009	9971468003 002200	OMEGA	0300-0560	60	1980	1780	KSB ITALIA S.P.A.	Italien
2009	9971468003 002100	OMEGA	0300-0560	60	1980	1780	KSB ITALIA S.P.A.	Italien
2009	9971522764 000100	OMEGA	0300-0560	93	1720	1492	Jos. Hansen & Sohne GmbH	Deutschland
2009	9971404844 000700	OMEGA	0300-0560	61	1471,68	1488	HNS GROUP FOR REAL ESTATE	Agypten
2009	9971469313 000200	OMEGA	0300-0560	70	1440	1489	Rosado Transférios	Portugal
2009	9971562193 000200	OMEGA	0300-0560	105	1600	1492	VN-Pumpen GmbH & Co.KG	Deutschland
2009	9971562193 000300	OMEGA	0300-0560	#	#	#	VN-Pumpen GmbH & Co.KG	Deutschland
2009	9971556950 000100	OMEGA	0300-0560	92	1332	1488	WASCO Industrieanlagen	Deutschland
2009	9971494881 000100	OMEGA	0300-0560	87,72	1750	1492	KSB ITUR Spain S.A.	Spanien
2009	9971494881 000200	OMEGA	0300-0560	87,72	1750	1492	KSB ITUR Spain S.A.	Spanien
2009	9971596144 000100	OMEGA	0300-0560	43,92	1750	1488	SAUDI Basics Industries	Saudi Arabien
2009	9971615342 000100	OMEGA	0300-0560	80	1620	1488	Horse Engineering Works	Agypten
2010	9971589333 000300	OMEGA	0300-0560	105	1400	1492	Faravand Kav	Iran
2010	9971688826 000200	OMEGA	0300-0560	80,68	1663,41	1488	KSB Lindflaten AS	Norwegen
2010	9971607185 000100	OMEGA	0300-0560	65	1800	1488	Sasol Solvents Germany GmbH	Deutschland
2010	9971607185 000200	OMEGA	0300-0560	65	1800	1488	Sasol Solvents Germany GmbH	Deutschland
2010	9971685880 000100	OMEGA	0300-0560	95	1860	1491	KSB ITALIA S.P.A.	Italien
2010	9971812830 001300	OMEGA	0300-0560	95	1750	1492	DUFERCO CLABECQ SA	Belgien
2010	9971627666 000500	OMEGA	0300-0560	#	#	#	All Pack	Belgien
2010	9971627666 000600	OMEGA	0300-0560	#	#	#	All Pack	Belgien
2010	9971627566 000700	OMEGA	0300-0560	#	#	#	All Pack	Belgien
2010	9971627666 000800	OMEGA	0300-0560	#	#	#	All Pack	Belgien
2010	9971749763 000100	OMEGA	0300-0560	#	#	#	INTERNATIONAL ENVIRONMENTAL	Agypten
2010	9971717405 000100	OMEGA	0300-0560	#	#	#	KSB OOO	Russland
2010	9971717405 000200	OMEGA	0300-0560	#	#	#	KSB OOO	Russland
2011	9971816055 000500	OMEGA	0300-0560	62,18	1296,88	1488	KSB PUMPS Arabia LTD.	Saudi Arabien
2011	9971816055 000600	OMEGA	0300-0560	62,18	1296,88	1488	KSB PUMPS Arabia LTD.	Saudi Arabien
2011	9971827294 000200	OMEGA	0300-0560	90	1000	1488	BIS INDUSTRIETECHNIK	Oesterreich
2011	9971869699 000100	OMEGA	0300-0560	87,5	2000	1491	KSB - POMPY I ARMATURA	Polen

Year	SAP Order Nr.	Pump Typ	Size	Head [m]	Flow [m³/h]	Speed [min-1]	Purchaser (Client)	Enduser (Country)
2011	9971780729 000600	OMEGA	0300-0560	91,46	1419,5	1488	KSB PUMPS Arabia LTD.	Saudi Arabien
2011	9971780729 000700	OMEGA	0300-0560	91,46	1419,5	1488	KSB PUMPS Arabia LTD.	Saudi Arabien
2011	9971901445 000100	OMEGA	0300-0560	80,68	1663,41	1488	KSB Lindflaten AS	Norwegen
2011	9971929783 000100	OMEGA	0300-0560	70	1250	1488	KSB OOO	Russland
2011	9971957489 000100	OMEGA	0300-0560	90	1500	1488	KSB OOO	Russland
2011	9971916350 000400	OMEGA	0300-0560	61,98	1500	1488	KSB AUSTRALIA PTY LTD	Australien
2011	9971916350 000800	OMEGA	0300-0560	61,98	1500	1488	KSB AUSTRALIA PTY LTD	Australien
2011	9971973978 000100	OMEGA	0300-0560	85	1693	1488	KSB Italia SpA	Italien
2011	99719938010 000100	OMEGA	0300-0560	65	1111	1249	ASTALDI SPA	Italien
2011	9971994905 000100	OMEGA	0300-0560	100	1480	1500	KSB ITUR Spain S.A.	Spanien
2011	9972008577 000100	OMEGA	0300-0560	83,1	2400	1500	KSB Nederland BV	Niederlande
2012	9971528437 001400	OMEGA	0300-0560	72,02	1525,7	1488	UTE DESALADORA	Spanien
2012	9971528437 001300	OMEGA	0300-0560	67,7	1525,7	1488	UTE DESALADORA	Spanien
2012	9972051908 000100	OMEGA	0300-0560	90	2000	1792	KSB ITUR Spain S.A.	Spanien
2012	9972104826 000600	OMEGA	0300-0560	102,88	37,5	1492	SCHUBERT ELEKTROANLAGEN GESMBH	Osterreich
2012	9972116441 000100	OMEGA	0300-0560	82	1800	1492	KSB OOO	Russland
2012	9972049989 000200	OMEGA	0300-0560	101,43	1334,7	1492	Caliqua Powertec GmbH	Deutschland
2012	9971997380 000100	OMEGA	0300-0560	75,37	1249,99	1488	Wasserwerke Westfalen	Deutschland
2012	0005656448 001000	OMEGA	0300-0560	78,2	1657,03	1488	KSB OOO	Russland
2012	9972153694 000400	OMEGA	0300-0560	75	1900,04	1492	KSB Italia SpA	Italien
2012	9972198118 000100	OMEGA	0300-0560	40	999,72	990	KSB Service GmbH ET/Ha	Deutschland
2007	9970962976 000100	OMEGA	0300-0560	#	#	1490	X Abu Dhabi Maint and VAE	
2012	9972196814 000100	OMEGA	0300-0560	48,47	838,57	988	ASCOMETAL	Frankreich
2013	9972241284 000100	OMEGA	0300-0560	86,5	1400	1353	Oberhessische Versorgungs-	Deutschland
2013	9972302623 000100	OMEGA	0300-0560	94,21	1440,09	1488	KSB ITUR Spain S.A.	Spanien
2013	9972336482 000100	OMEGA	0300-0560	80,03	1405,27	1488	OOO "KSB"	Russland
2013	9972198803 000500	OMEGA	0300-0560	60,65	2211,88	1750	Paul Wurth	Deutschland
2013	9972352751 000200	OMEGA	0300-0560	93,54	2100	1690	CHAUD FROID INDUSTRIE	Frankreich
2013	9972352751 000100	OMEGA	0300-0560	93,54	2100	1690	CHAUD FROID INDUSTRIE	Frankreich
2013	99723564085 000100	OMEGA	0300-0560	110,01	1350,07	1730	Saudi Basic Industries	Saudi-Arabien
2013	9972364085 000200	OMEGA	0300-0560	75,05	1750,6	1784	Saudi Basic Industries	Saudi-Arabien
2013	9972380391 000100	OMEGA	0300-0560	70	1400,02	1489	OOO "KSB"	Russland
2013	9972401420 000100	OMEGA	0300-0560	85	1690	1489	KSB ITALIA S.P.A.	Italien
2013	9972379165 000200	OMEGA	0300-0560	44,99	1119,82	996	KSB Finland Oy	Finnland
2013	9972439609 000100	OMEGA	0300-0560	90,02	2000,21	1492	OOO "KSB"	Russland
2013	9972262717 000500	OMEGA	0300-0560	70	1400	1236	Vattenfall Europe Wärme AG	Deutschland

Sales record (extract) Omega 300-560 / III

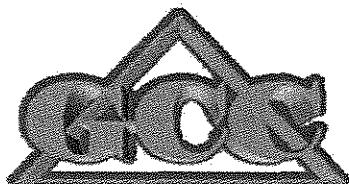
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2013 EDITION

TECHNICAL SUBMITTAL



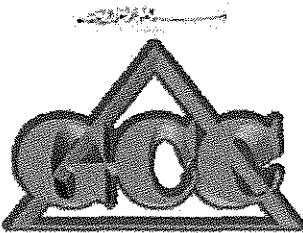
FOR WATER & WASTEWATER, FIRE PROTECTION & INDUSTRIAL APPLICATIONS



MORE
THAN
PIPE.



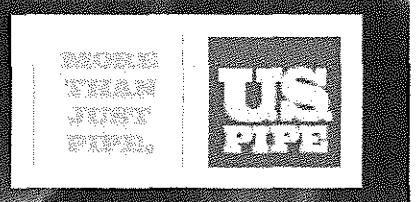
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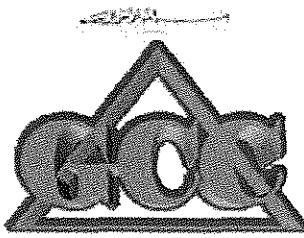
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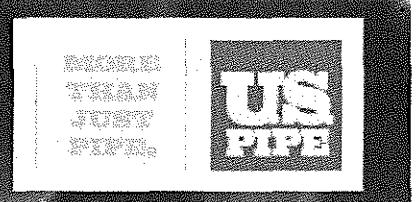


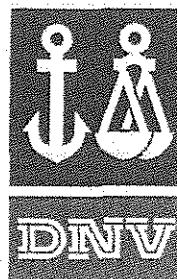
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ISO CERTIFICATE & QMS MANUAL





DNV BUSINESS ASSURANCE

MANAGEMENT SYSTEM CERTIFICATE

Certificate No. CERT-9385-2004-AQ-USA-RvA

This is to certify that

US Pipe and Foundry Company
Alabama Works

at
2023 St. Louis Avenue, Bessemer, AL 35020 USA

Additional Location:

Site Address	Site City	Site State	Site Main Activities
2101 18th Avenue	Bessemer	AL 35020	Holding Furnace, Casting, Annealing, Pipe Run, QA, Shipping, Maintenance.

has been found to conform to the Management System Standard:

ISO 9001:2008

This Certificate is valid for the following product or service ranges:

Manufacture of Ductile Iron Pipe to National and International Standards and Customer Specifications, and the Supply of Related Piping Materials Including Fittings and Valves.

Initial Certification date:

November 19, 1998

Place and date:

Houston, Texas, October 26, 2012

for the Accredited Unit:

**DNV CERTIFICATION B.V.,
THE NETHERLANDS**

This Certificate is valid until:

November 16, 2015

John Stefan

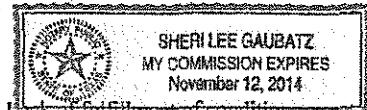
The audit has been performed under the supervision of

Len Williford

Lead Auditor

STATE OF TEXAS, COUNTY OF HARRIS

This instrument was acknowledged before me on Jan. 23 2013 by John Stefan, Management Representative of Det Norske Veritas Certification, Inc. on behalf of said corporation.



John Stefan

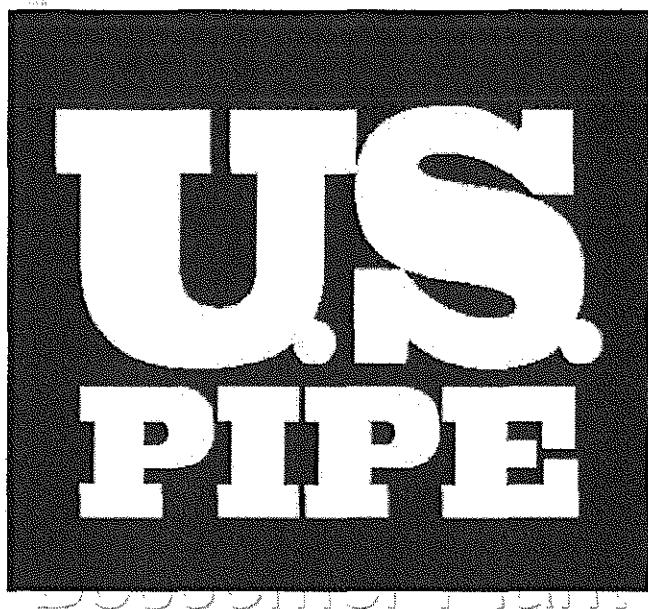
Management Representative

Sheri L. Gaubatz

Notary Public Signature

ACCREDITED UNIT: DET NORSCHE VERITAS CERTIFICATION B.V., ZWOLSEWEG 1, 2994 LB, BARENDRICHT, THE NETHERLANDS, TEL +31 (0)10 2922600 WWW.DNVBA.COM

BESSEMER PLANT



QUALITY SYSTEM MANUAL

BQSM, VOLUME 1

Date:
05/31/2006

Revision:
03

Approved By:

Bessemer Plant Manager	Bessemer Plant, Quality Assurance Manager
Tom R. Nicholson	Richard Thorp

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1.0 SCOPE

1.1 GENERAL

The scope of the United States Pipe and Foundry Company, Bessemer Plant Quality Management System is:

MANUFACTURE OF DUCTILE IRON PIPE TO NATIONAL AND INTERNATIONAL STANDARDS INCLUDING CUSTOMER SPECIFICATIONS, ALONG WITH THE SUPPLY OF RELATED PIPING MATERIALS INCLUDING FITTINGS AND VALVES.

1.2 PERMISSIBLE EXCLUSIONS

The scope of the Bessemer Plant Quality Management System (QMS) does not include design control, customer property, or service. Design control is conducted by United States Pipe and Foundry Company's Corporate Office (Technical Services and Engineering) in accordance with applicable Corporate Controlled Documents. Customer property is not received or used by the Bessemer Plant. The Bessemer Plant manufactures ductile iron pipe and does not supply a service to that product. These requirements are not applicable to the Bessemer Plant QMS.

2.0 NORMATIVE REFERENCE

The Bessemer Plant uses and maintains Corporate Controlled Documents. These documents are copied from the original document onto Bessemer Plant watermark paper or stamped "CONTROLLED" in red ink and distributed within the Bessemer Plant. An updated set of the Corporate Controlled Documents is located in the Document Control office. General Office, Technical Services, and/or Engineering of United States Pipe and Foundry Company, Incorporated, maintain the content of these documents.

Other Documents referenced by this QMS include; the ISO 9001 – Quality Management System – Requirements; ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, For Water; ANSI/AWWA C104/A21.4 - Cement-Mortar Lining For Ductile-Iron Pipe And Fittings For Water. These are the basic references used to make pipe at the Bessemer Plant. When other references are used they will be stated at the beginning of a procedure. The QMS follows the structure of the ISO 9001 standard. Pipe minimum specifications are based on the ANSI/AWWA and/or ISO standards.

3.0 TERMS AND DEFINITIONS

Bessemer Plant: The location of the United States Pipe and Foundry Company, Incorporated, which this QMS is referencing. The location of the facility is 2023 Saint Louis Avenue, Bessemer, Alabama 35020.

Continual Improvement: Recurring activity to increase the ability to fulfill requirements.

Continuous Improvement: Improvement trending in a positive direction.

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*Note: While recognizing the difference between continual and continuous improvement, Bessemer Plant will use these terms interchangeably.

Corporate: United States Pipe and Foundry Company, Incorporated is located in Birmingham, Alabama. The Vice President of Manufacturing of the company is located at the corporate office.

Corporate Controlled Document: These documents are used by United States Pipe and Foundry Company, Incorporated. These documents are used at all administrative, manufacturing, and sales locations. The manufacturing plants within have created their own documentation of their operations. The manufacturing plants have created their documentation in accordance with ISO 9001 requirements.

QMS: Quality Management System

Sales: The customer of the Bessemer Plant is United States Pipe and Foundry, Incorporated, Sales organization. This is the primary customer of the Bessemer Plant.

Technical Services: The United States Pipe and Foundry Company, Incorporated, product engineering organization, located in Bessemer, Alabama.

3.1 PRODUCT

Product at the Bessemer Plant refers to the result or activities of the processes. The primary product at the Bessemer Plant is ductile iron pipe and fabricated ductile iron pipe products. There are other products that are shipped with the pipe to the end user but are not produced at the Bessemer Plant.

4.0 QUALITY MANAGEMENT SYSTEM

4.1 GENERAL REQUIREMENTS

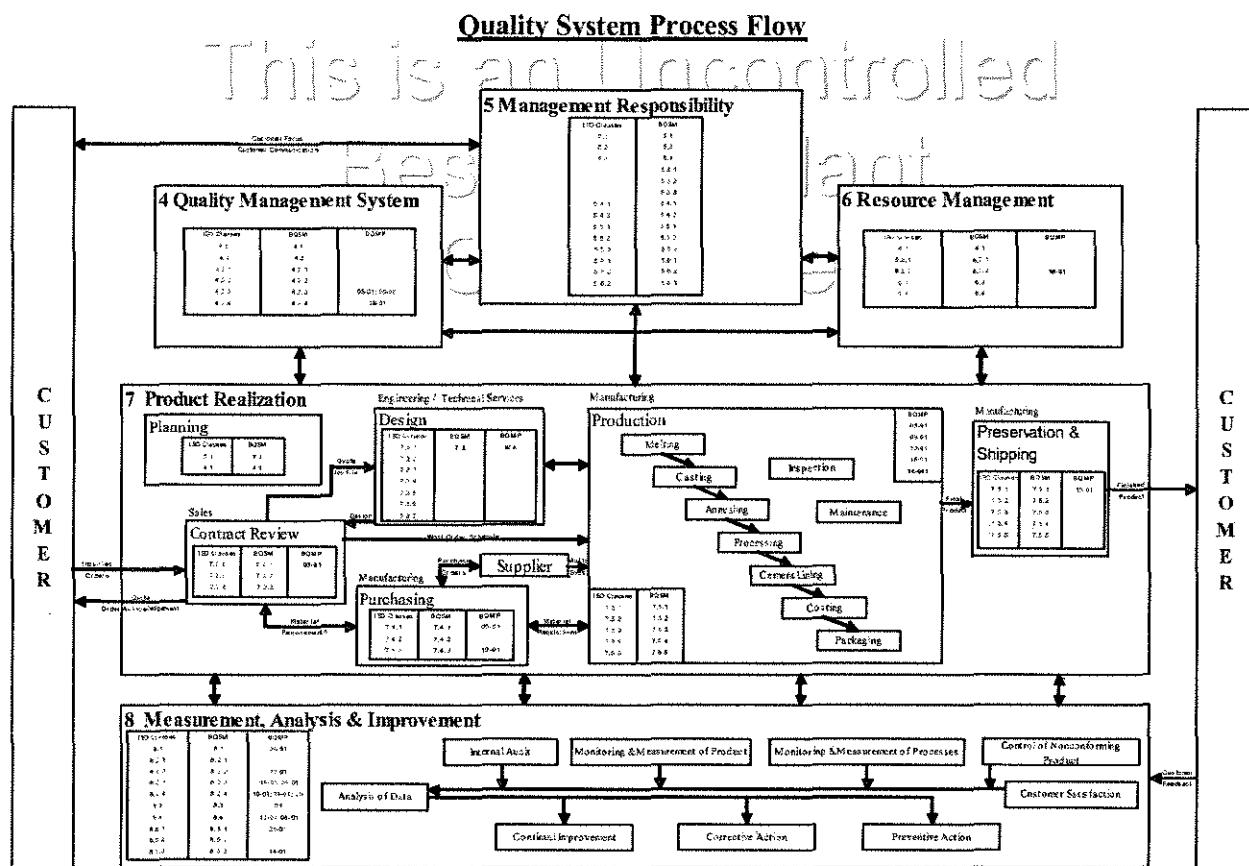
The Bessemer Plant does establish, document, implement, maintain and continually improve the QMS in accordance with ISO 9001.

The Bessemer Plant Management has implemented the QMS to:

- a) Identify the processes needed for the QMS
- b) Determine the sequence and interaction of the processes
- c) Determine criteria and methods required to ensure effective operation and control of the processes
- d) Ensure the availability of resources and information necessary to support the operation and control of the process

- e) Measure, monitor, and analyze the processes
- f) Implement action necessary to achieve planned results
- g) Continually improve the process

When Bessemer Plant outsources any process that affects product conformity with requirements, control over such outsourced processes are identified and established. (Also, see section 7.4 Purchasing.)



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4.2 DOCUMENTATION REQUIREMENTS

4.2.1 GENERAL

The Bessemer Plant has established and implemented QMS documents that describe the processes of the QMS in accordance with ISO 9001. These include:

- a) Documented quality policy and quality objectives
- b) Quality manual
- c) Documented procedures required by ISO 9001 and U. S. Pipe, Bessemer Plant
- d) Documents needed by Bessemer Plant to ensure effective planning, operation, and control of processes
- e) Records required by ISO 9001

Documents within the system are referred to by many different names in accordance with the activities needing to be described. The range and extent of the system documents are dependent upon the size and type of the activity, the complexity and interaction of the process, the methods used, and the skills and training of personnel involved in performing the work.

4.2.2 QUALITY MANUAL

This Quality Manual gives reference to the system level documents that describe the activities required to implement the QMS. This manual is the first part of a three-tier documentation plan for the QMS at the Bessemer Plant. In addition to the three-tier plan, other documents are in place, such as Manufacturing References and Quality Records. All applicable sections of the International Standard ISO 9001, "Quality Management Systems - Requirements" have been addressed within this Quality Manual. The titles and numbers of the sections in this manual are similar to the ISO 9001 Standard to facilitate cross referencing of this manual to the standard. The scope of the Bessemer Plant QMS does not include design control, customer property, or service. The reduction in the scope of this QMS is outlined in more detail in section 1.2 **Permissible Exclusions** at the beginning of the Quality Manual.

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4.2.3 CONTROL OF DOCUMENTS

BQMP 05-01 Document Control and 05-02 Document Preparation define the controls that ensure documents are reviewed, updated, approved, available, legible, and readily identifiable. This includes controlling documents of external origin and preventing the use of obsolete documents.

System level documents are contained in the level two documents, referred to as **Bessemer Quality Management Procedures-BQMP**. Plant Level documents are contained in level 3 documents that describe the sequence and interactive nature of the processes necessary to ensure the conformity of the product. The level three documents: **Bessemer Procedure Manual-BPM** - Work Instructions, describe the operating practice and control of process activities; **Bessemer Receiving Inspection Manual-BRIM** provides for systems and instructions for receiving and verifying quality and/or quantities of materials, supplies and components that are intended for use with or incorporation into our product; **Corporate Controlled Documents** define the quality system at the corporate level and provide the plant with established corporate policies and procedures. The Bessemer Plant has also established level four quality documents: Manufacturing References, Drawing and Technical References and Quality Records. The level four documents, Manufacturing References and Drawing and Technical References, provide reference information where the absence of such information could adversely affect product quality.

4.2.4 CONTROL OF RECORDS

Quality Records are used to document activities and/or denote status of an entity or product. BQMP 16-01 Quality Records provides the controls needed for identification, storage, protection, retrieval, retention time, and disposition of records.

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5.0 MANAGEMENT RESPONSIBILITY

5.1 MANAGEMENT COMMITMENT

The Bessemer Plant Management provides evidence of its commitment to the development of the QMS by:

- a) Bessemer Plant Management's communication to employees of the need for meeting customer requirements, including statutory and regulatory requirements, through meetings, procedures and documentation.
- b) Plant Manager and Staff's review of the established Quality Policy and Quality Objectives, which are a part of the QMS, during the management review meeting
- c) Plant Manager and Staff's review of the QMS, to ensure its continuing suitability, adequacy, and effectiveness during the management review meeting
- d) Bringing resources that are not available to the attention of the associated Bessemer Plant Management when needed to obtain set objectives.

5.2 CUSTOMER FOCUS

Customer needs and expectations are determined and converted into requirements with the aim of achieving customer satisfaction. With the use of the system level procedure entitled **BQMP 03-01** customer needs and expectations are determined and converted into requirements. Much of this process has become automatic with the implementation of SAP and the associated sales order process. The primary customer of the Bessemer Plant is the U.S. Pipe Sales department, including Customer Service. The U.S. Pipe Sales department is the organization that coordinates the needs of the end user of the product with the Bessemer Plant.

5.3 QUALITY POLICY

The Bessemer Plant Quality Policy is communicated to all employees and is posted in areas through out the plant. The Quality Policy is included in the orientation for new employees.

During management review, the Quality Policy is reviewed for continuing suitability. The Quality Policy provides a framework for establishing and reviewing the quality objectives.

5.3.1 BESSEMER PLANT QUALITY POLICY

THE BESSEMER PLANT WILL CONTINUOUSLY IMPROVE QUALITY IN ORDER TO PROVIDE PRODUCTS THAT CONSISTENTLY MEET OUR CUSTOMERS' REQUIREMENTS.

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5.3.2 BESSEMER PLANT EXPECTATIONS

The expectations of the Bessemer Plant are as follows:

For Our Customers . . . All resources are dedicated to providing products in a timely manner to meet our customer's needs. The interaction with customers and potential customers is one of a cooperative partnership in the expectation of developing and maintaining an environment of mutual trust, respect, and assistance.

For Our Employees . . . The importance of our human resources is expressed through the creation and maintenance of an environment of trust, respect, and teamwork. This environment encourages an opportunity for employee participation, development, and recognition. Each employee is educated and/or trained for their job assignments, with an emphasis on safety and the aspects that impact product quality.

For Our Suppliers . . . Suppliers who meet our specifications are utilized for purchased materials and services. The desired relationship with suppliers, as with customers, is one of a cooperative partnership.

For Our Environment . . . Safe and environmentally secure facilities are provided at all times for employees and the community. The company expects to continue to meet or exceed all provisions of local, state, and federal regulations related to safety and the environment.

For Our Management . . . Quality performance is expected at all levels of the company and is also expected from our employees; management assumes overall responsibility for quality and includes quality management as one of its major functions.

5.3.3 BESSEMER PLANT KEY VALUES

The following Key Values & Behaviors are developed by Walter Industries, Inc. Walter Industries, Inc. is the parent company of United States Pipe and Foundry Company. The Key Values reflect the philosophy throughout Walter Industries, Inc. and its subsidiaries.

- Customer Commitment . . . We make customers our first priority. We measure our success by how we meet their expectations.
- High-Performance Culture . . . We embrace opportunities to change and continuously improve. We are results driven.
- Fleet of Foot . . . We are quick and agile in response to the ever-changing business environment.
- Innovation . . . We think "outside the box" to find new, creative opportunities.
- Accountability . . . We take responsibility for our behavior and the results that stem from that behavior.
- Integrity . . . We are honest and ethical in all that we do.
- Respect for Others . . . We treat people with the respect each of us would want.
- Teamwork . . . We work together to create the best result. We share responsibility for the team success.

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- Safety... We will strive to provide a safe and healthy working environment and to avoid adverse impact to the environment and communities in which we do business.

5.4 PLANNING

5.4.1 QUALITY OBJECTIVES

The Bessemer Plant has established Quality Objectives at relevant functions and levels within the organization. The Quality Objectives are consistent with the Quality Policy and the commitment to continual improvement. Quality Objectives include those needed to meet requirements for products.

Our Quality Objectives . . .

- To maintain a communication system to measure and preserve the satisfaction of our customers.
- To review customer complaint performance and trends in quality related production to meet established annual quality objectives for customer complaints.
- To maintain a system for the continual monitoring and improvement of processes, products, and services to achieve customer satisfaction.
- To emphasize defect prevention and continual improvement to the QMS through a corrective and preventive action program that identifies and resolves problem areas and actual and potential nonconformities.
- To consistently use standardized and updated plant procedures, work instructions and technical references at all times.
- To conduct an annual program of internal Quality System audits for each clause of the ISO 9001 standards and/or area of the plant.
- To attain and then maintain certification to ISO 9001 standard

5.4.2 QUALITY PLANNING

The Plant Manager and Staff Members identify and plan the resources needed to achieve the Quality Objectives. The outputs of planning are documented within the QMS. If outputs are not documented within the QMS a Quality Plan will be implemented.

Quality planning includes:

- a) The processes of the QMS, with the exclusion of design controls
- b) The identification of the resources needed

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c) The continual improvement of the QMS

Planning will be conducted in a controlled manner to ensure that the integrity of the QMS is maintained during any change.

The QMS is the primary Quality Plan. A Quality Plan shall be initiated if there are issues outside of the QMS that need to be addressed to ensure the Quality Policy and Objectives continue to be met. The Quality Assurance Manager (QAM) will review requirements to ensure they fall within the QMS. When the QMS does not address specific requirements the Plant Manager will be notified of the need for a Quality Plan.

The Plant Manager will notify an employee of the need for a Quality Plan. The employee is responsible for documentation of any meetings or results of a Quality Plan. The employees responsible for a Quality Plan shall inform management of any resource needs that are not currently available. Quality Plans shall include or reference responsibilities, completion dates, and any other pertinent information.

The Plant Manager must approve all Quality Plans. The QAM will review Quality Plans to ensure the processes of the QMS are followed. The QAM will distribute Quality Plans to involved employees.

5.5 RESPONSIBILITY, AUTHORITY AND COMMUNICATION

5.5.1 RESPONSIBILITIES AND AUTHORITIES

Functions and their interrelations, responsibilities, and authorities are defined in order to facilitate effective quality management. These are communicated to relevant levels of the organization.

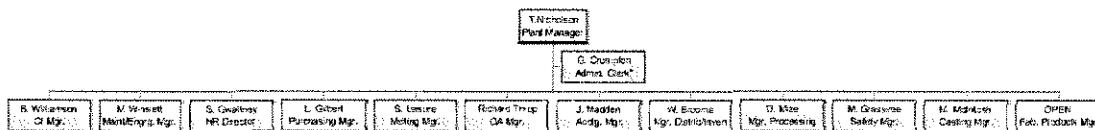
All employees at the Bessemer Plant, whether directly or indirectly, are responsible for:

- Quality
- The quality of our products
- Knowing and understanding the Quality Policy
- Understanding workmanship and/or quality requirements as they are applicable to their job
- Knowing and following plant procedures and work instructions
- Identifying and reporting errors/problems
- Correcting, when authorized, or supporting resolution of problems
- Identifying opportunities for improving products and processes

Through delegation of authority and assignment of tasks and responsibilities, supervisors and employees within each department, implement the QMS. The following organizational chart shows the management structure within the QMS. (For the balance of the Organizational chart see Human Resource department) All play some role and have to be accountable for their functions within the QMS. Further descriptions of duties, as pertaining to quality of Bessemer Plant products, can be found in the Human Resources Department job descriptions.

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MANAGEMENT



This is an Uncontrolled
Bessemer Plant
ISO Document

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5.5.2 MANAGEMENT REPRESENTATIVE

The Plant Manager has appointed the QAM as the management representative of the QMS. The authority and responsibilities of the QAM includes:

- a) Ensuring that the processes of the QMS are established, implemented, and maintained.
- b) Reporting to management on the performance of the QMS, including needs for improvement
- c) Promoting awareness of customer requirements throughout the organization
- d) Being the liaison with external parties on matters relating to the QMS

5.5.3 INTERNAL COMMUNICATION

The Bessemer Plant uses several methods of communication between supervision and the various areas regarding the processes of the QMS and its effectiveness. Those communication methods include voice mail, e-mail, reports, meetings, verbal, and posted documents. Depending on the information or data that needs to be communicated, an employee will generally refer to their direct Supervisor to convey or request information. For the supervisory structure of the Bessemer Plant, refer to **Bessemer Plant Organizational Chart** on page 13 of this BQSM.

Examples of how supervision communicates information to its employees are by having daily, weekly, and monthly meetings. Supervision also communicates by distribution of reports and forms.

- a) At the Scheduling Meeting, G.O. Scheduling and Plant employees discuss the production needs for the given working period. Scheduling informs Plant employees of the quantity and physical requirements of the product that needs to be produced to meet orders. For an explanation on how Scheduling communicates with Plant employees, refer to the procedures addressed in document **PCBPM 13-02 Daily Production and Mold Schedules**.
- b) Quality Assurance communicates information on QMS performance to Plant employees by conducting meetings, posting and distributing documents. An example of communication is the Quality Committee Meeting and/or Management Review. The meeting reviews the ISO 9001 requirements and any issues regarding the performance of the QMS.
- c) For a list of the reports and forms used by each of the areas, refer to document **BQMP-16-01**.

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5.6 MANAGEMENT REVIEW

5.6.1 GENERAL

The Plant Manager and employees from the Plant Manager's Staff will review the QMS, to ensure its continuing suitability, adequacy, and effectiveness. Review also includes assessing opportunities for improvement. A Management Review Meeting will be held a minimum of once per calendar year. This meeting will evaluate the need for changes to the organization's QMS, including quality policy and quality objectives.

The agenda for the meeting shall be prepared by the QAM and approved by the Plant Manager. The Plant Manager will determine the employees needing to attend the meeting. The QAM shall forward copies of the approved agenda to employees who are to attend the meeting.

This is an Uncontrolled Document.
The QAM is responsible for chairing the meeting. The QAM ensures that information is prepared and presented at the meeting.

Bessemer Plant

5.6.2 REVIEW INPUTS Document

Topics to be reviewed at the meeting include the current performance and improvement opportunities related to the following:

- Quality Policy
- Quality Objectives
- Results of audits
- Customer feedback
- Process performance
- Product conformance
- Status of preventive actions
- Status of corrective actions
- Supplier performance
- Follow up actions from earlier Quality Committee meetings/Mgt. Reviews
- Changes that could affect the QMS
- Recommendations for improvement

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Additional items may be added when necessary. The employees at the meeting are responsible for reviewing results and discussing any actions that may be needed. The Plant Manager will generate assignments in response to these actions. When corrective or preventive action is necessary as a result of decisions or assignments made during the meeting, refer to the instructions addressed in document **BQMP 14-01 Corrective and Preventive Action**.

5.6.3 REVIEW OUTPUTS

The outputs from the meeting shall include actions related to:

- Improvement of the effectiveness of the QMS and its processes
- Improvement of product related to customer requirements
- Resource needs

The QAM will generate a report summarizing the meeting and any assignments. The report will be distributed to affected employees at the meeting. Documentation for the meeting shall be maintained in accordance with the procedures addressed in document **BQMP 16-01 Quality Records**.

6.0 RESOURCE MANAGEMENT

6.1 PROVISIONS OF RESOURCES

The Bessemer Plant determines and provides, in a timely manner, the resources needed for:

- a) Implementation and maintenance of the QMS and its processes
- b) Improvement of the QMS effectiveness and its processes
- c) Addressing customer satisfaction issues

6.2 HUMAN RESOURCES

6.2.1 GENERAL

Management assigns responsibilities defined in the QMS to personnel who are competent based on applicable education, training, skills, and experience.

6.2.2 TRAINING, AWARENESS AND COMPETENCY

The Bessemer Staff are responsible for identifying and assessing the competency needs for personnel performing activities affecting quality. The Human Resource Department maintains the records of education, experience, training, and qualifications for employees.

The procedures addressing the requirements listed in section **6.2.2 Training, Awareness, And Competency** are specified in document **BQMP 18-01 Training**.

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6.3 INFRASTRUCTURE

The Bessemer Plant determines, provides and maintains the infrastructure needed to achieve the conformity of product. This includes:

- a) Buildings, workspace and associated facilities
- b) Process equipment (hardware, and software)
- c) Supporting services

6.4 WORK ENVIRONMENT

The Bessemer Plant identifies and manages those human and physical factors of the work environment needed to achieve conformity of products. This includes:

- a) Health and safety
- b) Work methods
- c) Work ethic
- d) Working conditions appropriate for the environment

7.0 PRODUCT REALIZATION

7.1 PLANNING OF REALIZATION PROCESSES

Product realization is that sequence of the processes and sub-processes required to achieve the product. This is how pipe is made at the Bessemer Plant. The Bessemer Plant processes operate under controlled conditions. Product is produced to meet customer requirements.

In planning for production of pipe the Bessemer Plant determines the following:

- a) Quality objectives and requirements for the product
- b) Quality objectives for projects
- c) The need to establish processes and documentation
- d) Resources and facilities specific to the product
- e) Verification, validation, monitoring, inspection and test activities specific to the product
- f) The criteria for acceptability
- g) The quality records necessary to provide confidence of conformity of the processes and the resulting product

The Bessemer Plant QMS defines our methods of operation. Production schedules and order information found in SAP provide further details about specific types of products, quantities, assigned equipment, and delivery requirements.

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7.2 CUSTOMER-RELATED PROCESSES

The Bessemer Plant's primary customer is United States Pipe and Foundry, Incorporated. Typically, majority of communications with the end user of the product are coordinated through Sales and Customer Service. The requirements in **7.2 Customer-related processes** are addressed in **BQMP 03-01**.

7.2.1 IDENTIFICATION OF CUSTOMER REQUIREMENTS

Requirements specified by the customer, including requirements for delivery, statutory and regulatory requirements, and any special requirements identified by the end-user are communicated to the Bessemer Plant via SAP. Other types of communication ensure the Bessemer Plant understands all of the Sales requirements.

Sales requirements are evaluated by the G. O. Scheduling, Bessemer Plant Superintendents and Operations Planner (and/or other personnel as required) for plant capabilities, including, but not limited to:

- a) Production scheduling requirements needed by Sales
- b) Requirements for availability, delivery and support for Sales
- c) Product requirements not specified by Sales but necessary for production of the product
- d) Obligations related to product, including regulatory and legal requirements

7.2.2 REVIEW OF PRODUCT REQUIREMENTS

The Bessemer Plant reviews the scheduling requirements identified by Scheduling before committing to the product schedule. This is done during scheduling of the product. Revisions to the product schedule will be reviewed prior to committing to the schedule. The Bessemer Plant ensures that:

- a) Product requirements are defined during the scheduling meeting and/or on SAP
- b) Orders will not be shipped without proper documentation
- c) Requirements differing from those previously scheduled are evaluated for capabilities before completion of a scheduled product
- d) The Bessemer Plant has the ability to meet requirements for the product

The Bessemer Plant records the results of the review and subsequent follow-up actions on a schedule that is distributed to affected Supervisors. Any revisions to a schedule are marked as revisions and distributed to the same Supervisors. If a change is needed before it can be documented, an Oral Alert is issued by the Operations Planner.

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7.2.3 CUSTOMER COMMUNICATION

The Bessemer Plant has communications with Sales and/or Customer Service relating to:

- a) Product information
- b) Questions related to contracts, order handling, including amendments
- c) Complaints and actions relating to nonconforming products
- d) Sales responses relating to performance of product

7.3 DESIGN AND/OR DEVELOPMENT

The scope of this quality manual does not include requirements for design control. United States Pipe and Foundry Company Corporate Office (Technical Services and Engineering) conduct design control in accordance with applicable Corporate Controlled Documents.

Documents, product drawings, and technical references provided to the plant by Technical Services and/or other Corporate Departments are controlled in accordance with system level procedure entitled **BQMP 05-01 Document Control**.

7.4 PURCHASING ISO Document

Requirements listed in section **7.4 Purchasing** are addressed in the system level procedure entitled **BQMP 06-01 Purchasing**.

7.4.1 PURCHASING CONTROL

The Bessemer Plant controls its purchasing processes to ensure purchased product conforms to requirements. The type and extent of methods to control these processes are dependent on the effect of the purchased product upon the realization process and the final product.

U. S. Pipe and Foundry evaluates and selects suppliers based on their ability to supply products in accordance with the set requirements. Bessemer Plant evaluates General Office Purchasing Department, North Birmingham Plant, and Burlington Plant to assure conformance to standard requirements and ability to supply products in accordance with the Bessemer Plant's requirements. The General Office Purchasing Department maintains an SAP Vendor List (those with assigned SAP vendor numbers) of all suppliers that supply quality related purchased components, raw materials, and services. The evaluations, re-evaluations and selection criteria for suppliers and subsequent follow-up actions are established and recorded.

7.4.2 PURCHASING INFORMATION

Requirements listed in section **7.4.2 Purchasing information** are addressed in the system level procedure entitled **BQMP 06-01 Purchasing**.

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7.4.3 VERIFICATION OF PURCHASED PRODUCT

The Purchasing and Stores department and the department Supervisors make the necessary arrangements for verifying purchased products. When the QAM and/or the plant's customer performs verification activities at the Supplier's premises, the Bessemer Plant will specify the required verification arrangements and method of product release on the purchase order and subsequent purchasing documents.

Incoming parts and materials are verified in accordance with **BQMP-10-01 Inspection and Testing and Bessemer Receiving Inspection Manual (BRIM)**.

7.5 PRODUCT AND SERVICE OPERATIONS

7.5.1 OPERATIONS CONTROL

The Bessemer Plant controls production operations with the use of specifications that define the characteristics of the product. Departmental procedures/instructions provide necessary information and criteria for producing and verifying the product.

Production equipment is used and maintained on a scheduled basis. Maintenance activities ensure equipment is available to meet production requirements.

Monitoring and measuring activities are implemented per plant documents for each production area. For how production operations are monitored and measured refer to the procedures addressed in document **BQMP 09-01 Process Control** and applicable Bessemer Plant Procedure Manuals (**BPM**).

The processes for release and delivery activities are defined within the work instructions in the Distribution and Inventory area and are addressed in part in document **BQMP 10-01 Inspection and Testing**.

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7.5.2 VALIDATION OF PROCESSES

Welding is considered a production process where the resulting output cannot be readily or economically verified by subsequent monitoring, inspection, and/or testing, and deficiencies may only become apparent after the product is in use. The effectiveness and acceptance of welding is validated.

The Bessemer Plant defines arrangements for validation that may include the following:

- a) Qualification of processes
- b) Qualification of equipment
- c) Qualification of personnel
- d) Use of specific procedures
- e) Requirements for records
- f) Re-validation

The evidence of the validated processes, qualified equipment and/or personnel are recorded and maintained. Requirements listed in section **7.5 Validation of Processes** are addressed in the system level procedure entitled **BQMP 09-01 Process Control**.

7.5.3 IDENTIFICATION AND TRACEABILITY

The Bessemer Plant identifies the product by suitable means (e.g. serial #, UPC label, color codes, etc.) throughout production. Product status is identified with respect to measuring and monitoring requirements with the use of plant procedures and work instructions.

Where traceability is a requirement, the Bessemer Plant controls and records the unique identification of product. All quality records are kept in accordance with plant procedure **BQMP 16-01 Quality Records**. For the requirements on identification and traceability refer to the procedures addressed in documents **BQMP 08-01 Product Identification and Traceability** and **BQMP 12-01 Inspection and Test Status**.

7.5.4 CUSTOMER PROPERTY

The Bessemer Plant does not receive or utilize customer property. The scope of the Bessemer Plant QMS does not include customer property. The reduction in the scope of this QMS is outlined in more detail in section 1.2 Permissible Exclusions at the beginning of the Quality Manual

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7.5.5 PRESERVATION OF PRODUCT

The Bessemer Plant preserves the conformity of product during processing. Product is moved by hand, conveyer, crane, fork truck, and trailer. Employees who handle materials are trained in proper handling methods. Storage locations are selected so that adequate protection from damage and/or deterioration is provided. **BQMP 15-01 Handling, Storage, Packaging, Preservation, and Delivery** and **BPM** procedures and work instructions address the proper methods for handling, storage and protection for the product.

Due to the weather resistant nature of ductile iron, pipe does not require protection from natural elements. Finished products are stored in the Distribution and Inventory areas. Materials that make up the product and accessories are placed into inventory per plant procedures and/or work instruction. For the identification of product refer to procedures addressed in document **BQMP 08-01 Product Identification and Traceability**.

The Bessemer Plant is responsible for the conformity of product during delivery to the intended destination. The product is packaged for delivery per plant procedures and/or work instructions or customer special requirements. Delivery companies are responsible to the Bessemer Plant for any damage that occurs during transit. The end-user assumes responsibility for any damage that occurs during and subsequent to the unloading of the product.

7.6 CONTROL MEASURING AND MONITORING DEVICES

The Bessemer Plant determines any monitoring and measurements to be made, and the monitoring and measuring devices required to assure conformity of product to specified requirements. The monitoring and measurements to be undertaken and the monitoring and measuring devices needed are addressed in procedures and/or work instruction in the QMS.

Requirements listed in section **7.6 Control of Measuring and Monitoring Devices** are addressed in the plant procedure entitled **BQMP 11-01 Control of Measuring and Test Equipment**.

8.0 MEASUREMENT, ANALYSIS AND IMPROVEMENT

8.1 PLANNING

The Bessemer Plant defines, plans and implements the measurement, monitoring, analysis and improvement activities needed to assure conformity of product and QMS and to improve effectiveness of the QMS. This includes determination of the need for, and use of, applicable methodologies including statistical techniques. Results of analysis and improvement activities are included in the management review process.

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The Bessemer Plant:

- a) Defines the type, location, timing, and frequency of measurements
- b) Defines the requirements for records in plant procedures and work instructions
- c) Evaluates the effectiveness of implemented measures
- d) Identifies and uses appropriate statistical tools when needed. Refer to **BQMP 20-01 Statistical Techniques**

8.2 MEASUREMENT AND MONITORING

8.2.1 CUSTOMER SATISFACTION

The QAM monitors information on customer perception, as related to the organization meeting customer requirements, as one of the measurements of performance of the QMS. The following information will be reviewed at each Management Review Meeting and be made available to all management on a monthly basis, if available:

- a) Quality complaint rate is used to indicate customer dissatisfaction related to product quality. This information is available from Technical Services Intranet Complaint Site. The quality complaint rate is the amount of complaint pieces per million pieces shipped for a given period of time.
- b) Shipping complaint rate is used to indicate customer dissatisfaction related to shipping and billing errors. This information is available from Technical Services Intranet Complaint Site. The shipping and billing complaint rate is the amount of complaint pieces per million pieces shipped for a given period of time or simply the number of shipping and billing complaints charged to the Bessemer Plant.
- c) The Plant on time shipment percentage is used to indicate customer satisfaction with reference to delivery. This information is available from the Corporate Manager of Inside Sales. The Plant on time shipment percentage is the amount of shipments made on time for a given period of time.
- d) A customer survey is performed approximately twice per year by Hughes Supply. The survey reviews end-user satisfaction and/or dissatisfaction (approximately 25% of U.S. Pipe sales). The results are made available by the Corporate Manager of Inside Sales.
- e) A Bessemer Plant Customer Survey is distributed in a postcard format with pipe shipments. Information from cards is summarized and reported at meetings, unless information gathered requires immediate attention.

Bessemer Plant personnel meet with Sales as needed to address customer service related issues, upon the request of the Plant Manager, Sales Representative, or company executive.

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8.2.2 INTERNAL AUDIT

Bessemer Plant conducts periodic audits to determine whether the QMS conforms to planned arrangements (BQSM 7.1), the requirements of ISO 9001 and to the QMS requirements. Periodic audits determine if the QMS has been effectively implemented and maintained. The applicable requirements, activities, areas and their schedules of being audited are listed on an audit schedule. The audit program is planned on the basis of the status and importance of the activities and areas to be audited as well as the results of previous audits.

The audit schedule will specify a lead auditor to audit those areas or activities. The audit team consists of employees other than those who perform the activity or are in the area being audited.

During an audit, the auditors will observe work in progress, interview employees, inspect product, and/or review documentation. The auditors will record any observed nonconformities during the audit. Where possible, the auditors will review and explain any recorded nonconformities with the supervisor before leaving the area or activity.

After the completion of the audit, the lead auditor will review the records and complete the audit report. If a nonconformity is determined to be valid, it will be documented on a Corrective/Preventive Action Request (QA-33). The lead auditor will present the audit report and any documented nonconformity to the department supervisor for a response. The department supervisor will take timely action to eliminate the nonconformity and its causes by implementing corrective action. Follow-up activities are utilized to verify and record the effectiveness of the corrective action taken. Internal audit reports become part of management review activities.

For the procedures addressing the requirements listed in **8.2.2 Internal Audits**, refer to the document **BQMP 17-01 Internal Quality Audits** and **BQMP 14-01 Corrective and Preventive Action**.

8.2.3 MEASUREMENT AND MONITORING OF PROCESSES

The Bessemer Plant has plant procedures and work instructions that describe the methods for measuring and monitoring quality management system processes. Many processes are monitored by a MONITORING AND MEASURING DEVICE. In each of the processes throughout the plant, supervisors ensure that the employees adhere to plant procedures and work instructions that are necessary to meet customer requirements and planned results. These methods confirm the continuing ability of each process to satisfy its intended purpose. In the event that planned results or customer requirements are not met, corrective action shall be taken to ensure conformity of the product. For a description of where measuring and monitoring of the process occurs, refer to **BQMP 10-01, Section 2, In Process Inspection and Testing**. For the measuring and monitoring data that is analyzed and distributed refer to **BQMP 20-01 Statistical Techniques**.

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8.2.4 MEASUREMENT AND MONITORING OF PRODUCT

The Bessemer Plant measures and monitors the characteristics of the product during the realization process. This verifies that specified requirements are met per the plant procedures, work instructions and product standards. It is carried out at appropriate stages of the product realization.

Evidence of conformity with the acceptance criteria is recorded within the areas and activities of the process and in documented procedures. These records document the authority responsible for release of product in each of the areas. For control of these records, refer to **BQMP 16-01 Quality Records**.

Product is released after all the specified activities have been satisfactorily completed, unless otherwise approved by the customer or a relevant authority. For a description of where measuring and monitoring of the product and recording of information occurs refer to **BQMP 10-01 Inspection and Testing**. For the measuring and monitoring of product that is analyzed and distributed refer to section **BQMP 20-01 Statistical Techniques**.

8.3 CONTROL OF NONCONFORMITY

The Bessemer Plant ensures that product that does not conform to requirements is identified with defect codes to prevent unintended use or delivery. These activities are defined in plant procedures and work instructions. The plant procedure that describes the control of nonconforming product is **BQMP 13-01 Control Of Nonconforming Product**.

The instructions for controlling, recording, correcting and re-verifying correction of nonconforming product are addressed within work instructions and records for the areas and activities that are affected and in **BQMP 13-01 Control of Nonconforming Product**. For the methods of identifying nonconforming product, refer to the plant procedures addressed in document **BQMP 08-01 Product Identification and Traceability**.

If nonconforming product is unintentionally shipped and/or put in service, QA will conduct an investigation, including tracking product and report to relevant management the potential effects. Decisions are made and actions are taken based upon the effects or potential effects of the nonconformity.

Although rare and unusual, product may be released without passing the required inspections and/or tests only under authorization by the customer. Concessions are documented on the sales order.

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8.4 ANALYSIS OF DATA

The Bessemer Plant determines, collects, and analyzes applicable data to determine the suitability and effectiveness of the QMS. The analyses are done to identify opportunities for improvement and preventive actions. The Bessemer Plant collects data generated by measuring and monitoring activities and any other relevant sources.

The Bessemer Plant analyzes data to provide information on:

- a) Customer satisfaction issues
- b) Conformance to customer requirements
- c) Characteristics of processes and products
- d) Trends related to process and products
- e) Suppliers

Requirements listed in section 8.4 Analysis of data are addressed, in part, in the plant procedure entitled **BQMP 20-01 Statistical Techniques**.

8.5 IMPROVEMENT

Bessemer Plant

8.5.1 PLANNING FOR CONTINUAL IMPROVEMENT

The Bessemer Plant continually improves the effectiveness of the QMS. The Bessemer Plant facilitates continual improvement with the use of quality policy, objectives, audit results, corrective and preventive action, management review, and analysis of data. Continual improvement activities will be assigned to appropriate personnel as a result of the analysis of data.

8.5.2 CORRECTIVE ACTION

The Bessemer Plant has a process for reducing or eliminating the causes of nonconformity, based on the potential effects, in order to prevent recurrence.

The documented corrective action process defines the requirements for:

- a) Identifying nonconformities
- b) Determining the causes of nonconformities
- c) Evaluating the need for actions to ensure that nonconformities do not recur
- d) Determining corrective action needed
- e) Implementing corrective action needed
- f) Recording results of action taken
- g) Reviewing corrective actions taken

Requirements listed in section 8.5.2 Corrective action are addressed in the plant procedure entitled **BQMP 14-01 Corrective and Preventive Action**.

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8.5.3 PREVENTIVE ACTION

The Bessemer Plant has a process for eliminating the causes of potential nonconformities to prevent occurrence. Preventive actions taken are appropriate to the impact of the potential problems. The QMS records and uses the results from the analysis of data as inputs to determine the need for preventive action.

The documented preventive action process addresses:

- a) Identification of potential nonconformities
- b) Determination of preventive action needed, if any, to eliminate causes of potential nonconformities, based on potential effects
- c) Implementation of preventive action
- d) Recording the results preventive action
- e) Reviewing effectiveness of preventive action taken

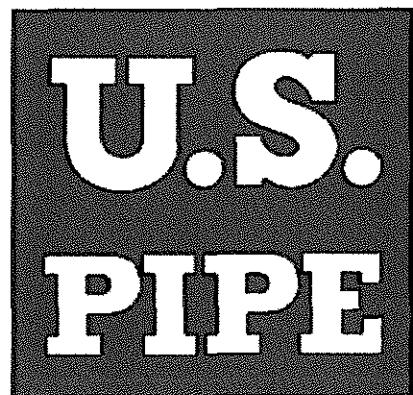
Requirements listed in section **8.5.3 Preventive action** are addressed in the plant procedure entitled **BQMP 14-01 Corrective and Preventive Actions**.

Bessemer Plant

ISO Document

UNITED STATES PIPE AND FOUNDRY COMPANY, LLC.

Quality Management System



World Class Products and Services



United States Pipe and Foundry Company

Quality Policy

**Quality products delivered on time - every
time.**



Quality Management System

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Quality Management System

1.0 Scope

The scope of the U.S. Pipe Quality Management System is the **“Manufacture of Ductile Iron Pipe to National and International Standards and Customer Specifications, and the Supply of Related Pipe Material Including Fittings and Valves”**.

1.2 Application

This manual describes the Quality Management System of United States Pipe and Foundry Company, LLC (U. S. Pipe) in support of the Quality Policy. This manual is intended for use at all U. S. Pipe facilities. It is expected for employees to use this manual as a reference to Company quality policy and as a guide for the continuous improvement of processes and product quality. In addition, this manual indicates to customers and potential customers the nature of the Quality Management System that supports the design, manufacture, and delivery of products produced by U. S. Pipe.

1.3 History

With corporate offices in Birmingham, Alabama, U. S. Pipe is one of the world's leading manufacturers of ductile iron pipe, joint restraint products, and related products for the water and wastewater industries.

U. S. Pipe traces its roots to a major consolidation of pipe producers, leading to the formation of United States Cast Iron Pipe and Foundry Company in 1899. This company represented approximately 75 percent of the production capacity in the United States at the time of its incorporation. The company name was changed to U. S. Pipe in 1929.

Since 1899, there have been many changes in the plants through consolidations, purchases, closures, and the building of new plants. These changes were the result of the need for mass production methods and mechanization in response to expanding demand. In 1921, a revolutionary centrifugal casting process was introduced through U. S. Pipe's purchase of the rights for the manufacture of cast iron pipe by the deLavaud Process. This process, with many improvements, is today the method by which most ductile iron pipe is produced worldwide. U. S. Pipe is now comprised of the following operating facilities:

- Bessemer Plant, Bessemer, AL.
- California Plant, Union City, CA.
- Marvel City Mini Mill, Bessemer, AL.

Today, U. S. Pipe is the largest U. S. producer of ductile iron pipe in 4" through 64" sizes. The Company pioneered the production of ductile iron pipe, which is superior in strength to gray cast iron, and was the first in the industry to use ductile iron exclusively for all of its pressure pipe, fittings, and valves. Ductile iron pipe and other products are sold in all 50 states, as well as in the international market.



Quality Management System

3.0 Terms and Definitions

Customer Satisfaction - Customer's perception of the degree to which the customer's requirements have been fulfilled.

Effectiveness - Extent to which planned activities are realized and planned results achieved.

Monitor - Observe, supervise, keep under review; measure or test at intervals, especially for the purpose of regulation or control

Procedure - A specified way to perform an activity.

Process - A set of interrelated resources and activities that transform inputs into outputs.

Product - The result of a process.

Quality Assurance - All the planned and systematic activities implemented within the **Quality System**, and demonstrated, as needed, to provide adequate confidence that an element, or elements, of the **Quality System** will fulfill the requirements for quality.

Quality Control - Operational techniques and activities that are used to fulfill the requirements for quality.

Quality Improvement - Actions taken throughout the organization to increase the effectiveness and efficiency of activities and **processes** in order to provide added benefits to both the Company and its customers.

Quality Management - All activities of the overall management function that determine the **Quality Policy**, objectives, and responsibilities, and implement them by means such as **Quality Planning**, **Quality Control**, **Quality Assurance**, and **Quality Improvement** within the **Quality System**.

Quality Objective - Something sought, or aimed for, related to quality

Quality Plan - A document setting out the specific quality practices, resources, and sequence of activities relevant to a particular product, project, or contract.

Quality Planning - Activities that establish the objectives and requirements for quality and for the application of **Quality System** elements.

Quality Policy - Overall intentions and direction of the Company with regard to quality, as formally expressed by top management.

Quality System - Organizational structure, procedures, processes, and resources needed to implement **Quality Management**.

Stakeholder - An individual or group of individuals with a common interest in the performance of the Company and the environment in which it operates.

Supplier - An organization that provides a product or service to U. S. Pipe.

Work Environment - a set of conditions under which work is performed.



Quality Management System

3.1 References

- ISO 9001-2000, Quality Management Systems
- QMP Corporate Quality Management Policies and Procedures
- SLS Corporate Sales Order Procedures
- PUR Corporate Purchasing Policies and Procedures
- USP Corporate Purchase Specifications
- PDP Corporate Product Design Policies and Procedures
- PQS Corporate Product Quality Standards
- QCP Corporate Quality Control Procedures
- ANSI/AWWA C104/A21.4 - Cement Mortar Lining for Ductile Iron Pipe
- ANSI/AWWA C104/A21.51 – Ductile Iron Pipe, Centrifugally Cast, for Water

3.2 Core Values of U. S. Pipe

Accountability	We take responsibility for our behavior and results.
Customer Commitment	We must make customers our first priority. Success is measured by how we meet their expectations.
Fleet of Foot	We are quick and agile in response to the ever changing business environment.
High Performance Culture	We embrace opportunities to change and continuously improve. We are results driven.
Innovation	We think "outside the box" to find new and creative opportunities.
Integrity	We are honest and ethical in all we do.
Respect for Others	We treat all people as you want to be treated.
Safety	We value the health and safety of our co-workers, their families, our customers, suppliers, guests, and the communities in which we live and operate in.
Teamwork	We work together to create the best result and we share responsibility for the team success.



Quality Management System

4.2 Documentation Requirements

4.2.1 General

Documented procedures have been established, and are maintained for controlling all documents including, as applicable, documents of external origin. Documents described in the Quality System Procedures section are electronic and are available in the Document Management System (DMS). Each plant is responsible for meeting the requirements of this policy and establishing references in their documentation to relevant corporate procedures. Plant documentation may be in electronic form or hard copy.

4.2.2 Control of Documents

Plants maintain documented procedures that establish and define the controls needed to comply with this policy.

- Documents and data are reviewed and approved for adequacy by authorized personnel prior to issue.
- Documents are reviewed and updated as necessary.
- Changes and the current revision status of documents are identified. Changes to documents and data are reviewed and approved by the same functions/organizations that performed the original review and approval, except in very unusual circumstances that are specifically designated otherwise or are carefully justified. The designated functions/organizations have full access to pertinent background information upon which to base their review and approval.
- Pertinent issues of appropriate documents are available at all locations where operations essential to the effective functioning of the quality management system are performed.
- Documents are produced and protected to remain legible and their identity known at all times.
- Documents of external origin are identified to segregate them from internal documents.
- Documents of external origin are controlled the same as internal documents.
- Invalid and/or obsolete documents are promptly removed from all points of issue or use, or otherwise assured against unintended use.
- Obsolete documents retained for legal and/or historical purposes are suitably identified.

Hard copies printed from the DMS for reference or training purposes are considered UNCONTROLLED DOCUMENTS.

4.2.2.1 Quality System Procedures

Quality System documentation consists of documented policies, procedures, standards, and specifications which affect process and product quality. The documentation of the Corporate Quality System is contained within the following Corporate Controlled Documents:

- QMP Corporate Quality Management Policies and Procedures
- SLS Corporate Sales Order Procedures



Quality Management System

- PUR Corporate Purchasing Policies and Procedures
- USP Corporate Purchase Specifications
- PDP Corporate Product Design Policies and Procedures
- PQS Corporate Product Quality Standards
- QCP Corporate Quality Control Procedures

Plants establish, maintain, and control procedures that are needed to plan, operate, and control processes that affect product quality and the quality system.

4.2.3 Control of Records

Quality records are maintained to demonstrate conformance to specified requirements and the effective operation of the quality management system.

Procedures have been established, and are maintained, for the identification, collection, indexing, filing, storage, retrieval, maintenance, retention time, and disposition of quality records.

All quality records are legible, stored, and retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss. Security and confidentiality of records are maintained.

Specific quality records are identified in the appropriate plant documentation and the Corporate Quality Management Policies and Procedures, Corporate Sales Procedures, Corporate Purchasing Policies and Procedures, Corporate Purchase Specifications, Corporate Product Design Policies and Procedures, Corporate Product Quality Standards, and Corporate Quality Control Procedures.

The following records will be maintained:

- Management Review
- Training
- Product Realization Planning
- Product Requirement Reviews
- Design Inputs
- Design Reviews
- Design Verification
- Design Validation
- Design Changes
- Supplier Assessment



Quality Management System

- Process Validation
- Special Requirements for Identification of Product
- Equipment Calibrations
- Internal Assessments
- Inspection and Testing
- Nonconformances and Corrective/Preventive Action

5 Management Responsibility

5.1 Management Commitment

Quality goals and objectives are established by Corporate and the Plants. Key indices are measured and analyzed to determine the capability to meet customer requirements with the goal of enhancing the quality management system. Continual improvement and growth of the quality system is measured by determining suitability of the quality policy, analysis of data, reports, assessment results, corrective and preventive actions, and review of the quality management system.

5.2 Customer Focus

Our customers are first priority and success is measured by our ability to meet customer requirements and expectations.

5.3 Quality Policy

The quality policy is reviewed at intervals to insure it continues to be appropriate to the business plan and strategic goals of the company. An annual review occurs during management review of the quality management system. The policy applies to internal and external customers and focuses on delivering quality products on a continual basis.

Quality Management System

5.4 Planning

5.4.1 Quality Objectives

Quality Objectives are to:

- Provide confidence to customers, internal management, and other employees that the requirements for quality are being fulfilled, maintained, and that quality improvement is continual.
- Maintain certification to ISO 9001-2008 for those plants serving the international market.
- Utilize ISO 9001-2008 as a model for the fundamental structure of our Quality System.
- Seek, achieve, and maintain continuous improvement to the quality of our products and services in relationship to the requirements for quality.
- Improve the quality of our operations, thereby continually meeting the stated and implied needs of our customers, and other stakeholders.

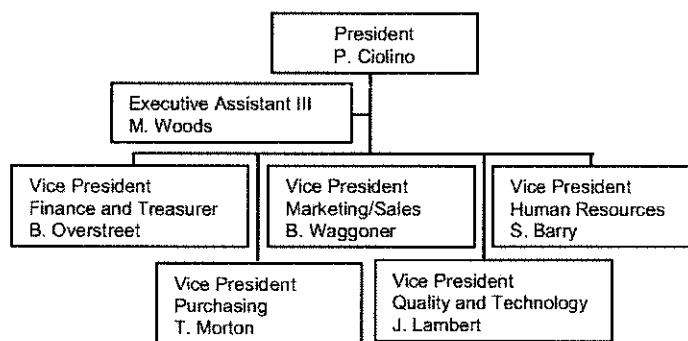
5.4.2 Quality Management System Planning

Quality planning generally includes all corporate quality procedures and manuals, and plant documented procedures. Individual quality plans are developed for specific projects arising from unusual orders and may consist of specification requirements for process development, equipment evaluation, process qualification/validation, product design/development/validation, quality assurance, measurement, verification or tests, standards of acceptability, and quality records. These steps are structured to insure that the integrity of the quality management system is maintained when changes to the system are planned and implemented.

5.5 Responsibility, Authority, and Communication

5.5.1 Responsibility and Authority

The interrelationship of personnel who manage, perform, and verify work affecting quality is given in the Organization Charts for each Department. The Executive Department of U. S. Pipe is shown on the following organization chart:





Quality Management System

Executives and managers of the various functional units within the organization and plant are responsible for all quality matters within their respective units.

Resource requirements have been identified and adequate resources provided, including the assignment of trained personnel for management, performance of work, and verification activities including quality assessments.

Employees have the authority to:

- Identify opportunities for improving operations, processes, and product
- Recommend solutions for improving processes and product
- Initiate corrective and preventive measures to prevent the occurrence of nonconformances
- Determine and verify implementation and effectiveness of solutions
- Control and contain nonconforming product until process/product deficiencies are corrected

5.5.2 Management Representative

The Manager - Corporate Quality is the Management Representative with executive responsibility for quality. Through task assignment and authority delegation from the Vice President, Quality and Technology, the Corporate Management Representative has the responsibility for developing, implementing, maintaining, and improving the Quality System throughout the Company. A major quality management function of the Corporate Management Representative is the determination and implementation of a quality policy. The Corporate Management Representative briefs Executive Management regularly on quality matters and communicates with plant personnel on a frequent basis. Meetings with managers of corporate and plant functions are held as needed to resolve process and quality related problems and to direct quality improvements.

5.5.3 Internal Communication

Communication processes are in place to insure that goals and objectives are known throughout the organization. Key quality indices goals and objectives are established and performance against these goals and objectives is measured and communicated to the plants and positions related to the quality management system. Customer requirements are communicated through sales orders and production scheduling at the plants. Records of customer requirements and production scheduling are maintained.

5.6 Management Review

5.6.1 General

The performance and effectiveness of the Quality Management System are reviewed at planned intervals to insure its continuing suitability and adequacy. Review may be in the form of monthly plant manufacturing performance meetings, monthly plant Continuous Improvement meetings, and market feedback.



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5.6.2 Review Input

Inputs to the review process that include performance and improvement opportunities are:

- Assessment results
- Customer complaints
- Process, product, and delivery performance
- Status of corrective and preventive actions
- Follow-up from previous management reviews
- Changes that could affect the Quality Management System
- Recommendations for improvement

5.6.3 Review Output

Results from the review process include decisions and actions related to:

- Improvement to the effectiveness of the Quality Management System and processes
- Product improvement related to customer requirements
- Resource needs

6 Resource Management

6.1 Provision of Resources

Each plant is responsible for determining and providing the resources necessary to implement and maintain its Quality Management System, and continuously improve processes and products to enhance customer satisfaction by meeting customer requirements.

6.2 Human Resources

6.2.1 General

Personnel performing activities and work affecting product quality are competent on the basis of education, training, skills, and experience.

6.2.2 Competence, Awareness, and Training

Competency and skill requirements for personnel performing activities and work affecting product quality are defined in various Corporate and plant procedures. These requirements may be defined in job descriptions, procedures, and checklists. Training of personnel may be conducted in the classroom and/or during on the job training. Effectiveness of



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training and associated actions is measured using tools such as performance evaluations, process monitoring, assessments or audits, and checklists. Records of education, training, skills, and experience are maintained to demonstrate compliance with competency requirements.

6.3 Infrastructure

Buildings, equipment, workstations, communication, and support services are provided and maintained to support operations and achieve conformance to process and product requirements.

6.4 Work Environment

Suitable work environments are provided and maintained to support operations and achieve conformance to process and product requirements.

7 Product Realization

7.1 Planning of Product Realization

The processes and sub-processes needed for product realization are planned and developed to achieve conformance to product requirements. Product realization planning is consistent with the requirements of the other processes of the Quality Management System. Product realization planning may consist of the following:

- Quality objectives and requirements for the product
- Identifying and providing equipment, suitable environment, controls, processes, resources, and competency requirements
- Establishing processes, documentation, and providing resources specific to the product
- Verification, process and product validation, monitoring, inspection and test requirements, and product acceptance criterion
- Records that demonstrate conformance to process and product requirements

Processes are documented to the extent necessary to provide and support effective and efficient operation.

7.2 Customer Related Processes

7.2.1 Determination of Requirements Related to the Product

Sales determines the following through communication with customers:

- Requirements specified by the customer including the requirements for delivery and post delivery activities
- Requirements not stated by the customer, but necessary for specified or intended use where known

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- Standards, statutory, and regulatory requirements related to the product
- Any addition requirements determined by the organization

7.2.2 Review of Requirements Related to the Product

Before submission or the acceptance of a contract or order, the contract or order is reviewed to insure that:

- The requirements are adequately defined and documented.
- Any differences between the contract or accepted order requirements and those in the tender are resolved.
- The Company has the capability to meet the contract or accepted order requirements.
- For orders received verbally without a written statement of requirements, an effort is made to insure that the order requirements are agreed before their acceptance.
- The methodology for identifying how to make an amendment to a contract and correctly transferring relevant information to the functions concerned within the Company is defined in appropriate procedures.

Records of the review and subsequent actions are maintained.

7.2.3 Customer Communication

Methods of effective customer communications have been determined and implemented. Such communication is related to:

- Product information
- Inquiries, contracts or order processing including changes and amendments
- Customer feedback including customer complaints

7.3 Design and Development

7.3.1 Scope of Design and Development Activities

Technology and Product Development is responsible for design and development of pipe and pipe fittings, including piping components such as sealing gaskets, restraining mechanisms for joints, coatings, linings, and pipeline corrosion protection systems. These design activities include verification and validation that the product is capable of meeting the requirements for the intended application and use.

The design and development of product are controlled to insure compliance with established objectives for manufacturing of the product, functionality, safety, quality, reliability, serviceability, and customer satisfaction.

The interrelation and interface between different groups involved in design and development are managed to insure effective communication and clear assignment of responsibility. Planning output is updated, when appropriate, as design



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and development progresses.

7.3.2 Design and Development Inputs

Design inputs may be generated internally by Management, Manufacturing Department, or Sales Department requests or from identification by U. S. Pipe employees of a product deficiency or need. Design inputs may include internal sources such as company design standards, specifications, and limitations of production and processing equipment. External sources may include industry standards and specifications, customer requests, and identification of market opportunities.

The inputs may include the following:

- Functional and performance requirements
- Applicable statutory and regulatory requirements
- Information from previous and similar designs when applicable
- Essential requirements for design and development

7.3.3 Design and Development Outputs

Design outputs to verify against design input may include calculations, specifications, and drawings.

Review of the design is conducted at stages throughout the design and development process and problems detected may be documented through changes to drawings and internal specifications. All product drawings and changes are approved by the appropriate Engineering Section Manager at Technology and Product Development.

7.3.4 Design and Development Review

New designs and design changes are reviewed as appropriate to assure compliance with design objectives.

7.3.5 Design and Development Verification

Design verification is conducted to ensure the product meets input requirements. Such verification may include computer modeling and simulation, dimensional and metallurgical inspection of the product, and testing of prototype parts.

7.3.6 Design and Development Validation

Design validation is conducted to confirm the product is capable of meeting the requirements for the intended application and use. Design validation is applicable to tests conducted on production parts of designs that are proposed for sale. Such validation may include assembly testing, restraint testing, pressure testing, and corrosion testing. In certain instances, nationally recognized third party inspection agencies such as Underwriter's Laboratory and Factory Mutual may witness product validation to approve the product for listing with their agencies. For products not requiring nationally known listing agency approval, but that are to be certified by U. S. Pipe, local independent inspection laboratories and agencies shall be utilized to witness and authenticate product validation tests. A copy of all validation tests shall be maintained on file at Technology and Product Development.

7.3.7 Control of Design and Development Changes

Design changes may be recorded through changes to drawings, specifications, tolerances, and procedures where applicable. Such changes are approved by the appropriate Section Manager at Technology and Product Development.



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7.4 Purchasing

7.4.1 Purchasing Process

The Company has established and maintains documented procedures to insure that purchased product conforms to specified requirements. Purchase Specifications have been prepared to accurately define the characteristics, performance, and testing requirements for materials that affect product quality.

Corporate Purchasing Department personnel and where applicable, plant purchasing personnel performs the following:

- Evaluate and select suppliers on the basis of their ability to meet specified requirements and their quality system status. This evaluation may be done by any of several methods, or a combination of methods, including:
 - A review of supplier performance
 - Evaluation of a completed U. S. Pipe Supplier Quality assessment
 - A current ISO 9001-2000 certificate from a registrar recognized by ANAB
 - A Quality System Assessment by U. S. Pipe
- Define the type and extent of control exercised over suppliers. The type and extent of control is dependent upon the type of product, the evaluation method chosen, and the applicable Purchase Specification. Inspectors may be assigned where material and/or services purchased are applied at the supplier's premises.
- Maintain a list of acceptable suppliers with supporting records

7.4.2 Purchasing Information

Purchase orders state the data necessary for the supplier including terms and conditions of purchase. Specifically, purchase orders describe where appropriate:

- Requirements for approval of product, procedures, processes, and equipment
- Requirements for qualification of personnel
- Quality management system requirements

Purchase orders may reference some or all of the following:

- The applicable Purchase Specification, if appropriate. If a Purchase Specification is not available for the product ordered, the purchase order will specify or contain:
 - The type, class, grade or other precise identification
 - A positive identification of specifications, drawings, process requirements, inspection instructions and other relevant technical data, including requirements for approval or qualification of product, procedures, process equipment and personnel



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- Delivery date
- The various standards which must be applied to the product ordered

Purchase orders are reviewed for adequacy prior to being communicated to the supplier.

7.4.3 Verification of Purchased Product

The Company uses various methods to verify the quality of purchased products and materials including first article inspection, requiring Certificates of Conformance with or without test reports from the supplier, by product/material inspection at the receiving facility, and verification at the supplier's premises. Some materials may not be verified, or may be partially verified. The method used will depend on the importance of the item to product quality, the state of control exercised by the supplier, and information available from the supplier.

Where it is necessary for the Company to verify or inspect purchased product at the supplier's or supplier's premises, the verification arrangements and the method of product release are specified in the purchase documents.

Where specified in the contract, the Company's customer or the customer's representative is afforded the right to verify at the Company's or supplier's locations, that subcontracted product conforms to specified requirements. Verification by the Company's customer is not taken by the Company as evidence of effective control of quality, nor does it absolve the Company of the responsibility to provide acceptable product. Whether verified by the customer or not, the Company's specified verification procedures apply, and the customer retains the right to reject product that does not conform to specified requirements.

7.5 Production and Service Provision

7.5.1 Control of Production and Service Provision

The manufacturing plants have developed quality systems providing for process control that are specific to their individual operations. The Company has identified and planned the production, installation, and servicing processes which directly affect product quality to insure that these processes are carried out under controlled conditions. These controlled conditions include the following:

- Application of Quality Control Procedures, which are documented procedures defining the manner of production, and where applicable, installation and servicing where the absence of such procedures could adversely affect quality.
- Use of Quality Planning, where applicable, for determining suitable production, measurement, testing, installation, and servicing equipment, and a suitable working environment.
- Application of Product Quality Standards, National Standards, and International Standards to insure compliance with all applicable referenced standards, codes, and where applicable, quality plans and/or documented procedures.



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- Application of Quality Control Procedures for the monitoring and control of suitable process parameters and product characteristics. Critical product characteristics are specified in the Product Quality Standards.
- Use of Quality Planning for the approval of processes and equipment, as appropriate
- Application, where appropriate, of Quality Control Procedures and Product Quality Standards which establish criteria for workmanship in the clearest practical manner
- Recommending, where appropriate, suitable maintenance schedules for equipment to insure continuing process capability. This is specifically applicable in situations where Corporate or Plant Engineering is responsible for the design and/or installation of new or improved production equipment.
- Scheduling of production for the plants and the implementation of procedures defining the release, delivery, and post delivery activities, if applicable.

Several of the processes for which Corporate maintains documented procedures and product standards require prequalification of process capability. Prequalification requirements for processes are specified in the appropriate Product Quality Standard or Quality Control Procedures. The qualification procedures are specified in the appropriate Quality Control Procedure. Most personnel qualifications are documented by the plants.

Quality records are maintained for qualified processes and are identified in the appropriate procedure for a particular process.

7.5.2 Validation of Processes for Production and Service Provision

Processes affecting product quality in which the results cannot be fully verified by subsequent monitoring, inspection, testing of the product, including processes where deficiencies of a product may not be apparent until the product is in use, are carried out by qualified personnel and require continuous monitoring and control of process parameters to insure that specified requirements are met. Examples of such processes are welding on the product and annealing. Validation of such processes may be performed by approval of equipment, testing, statistical analysis, training records, documented procedures for approved processes, continuous monitoring of the process output, records of output, and revalidation.

7.5.3 Identification and Traceability

Where appropriate or required by contract, a national or international standard, or where a specific need has been identified, the Company has established and maintains documented procedures for identifying the product by suitable means from receipt and during all stages of production, processing, inspection, testing, delivery, and installation.

Where and to the extent that traceability is a specified requirement, the Company has established and maintains documented procedures for unique identification of product.

Quality records are maintained for unique identification of product.

7.5.4 Customer Property

Customer property such as equipment, tooling, materials, and intellectual property including specifications and drawings



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are identified, verified, protected, and maintained in a suitable environment. If customer property is lost, damaged, or becomes unfit for use, the customer supplying the property is notified and a record of the issue is created and maintained.

7.5.5 Preservation of Product

The Company has established and maintains documented procedures for handling, storage, packaging, preservation and delivery of product. In addition to Corporate procedures and standards, the manufacturing plants have developed internal procedures to address the requirements of the Standard.

7.5.5.1 Handling

Methods of handling product to prevent damage or deterioration are described in applicable Corporate Purchase Specifications, Corporate Product Quality Standards, Corporate Quality Control Procedures and Corporate Sales Procedures, and plant documentation.

7.5.5.2 Storage

Procedures have been established and are maintained which identify how designated storage areas are used to prevent damage and deterioration of product, pending use or delivery. Appropriate methods for authorizing receipt to and dispatch from such areas are stipulated in one or more of the following procedures and applicable product specific Corporate Purchase Specifications, Corporate Quality Management Policies and Procedures, Corporate Product Quality Standards, Corporate Quality Control Procedures and Corporate Sales Procedures, and plant documentation.

The condition of product in finished goods inventory is assessed at appropriate intervals, as well as immediately prior to shipping in order to detect damage or deterioration.

7.5.5.3 Packaging

Control of packing, packaging, and marking processes, including materials used, is controlled to the extent necessary to insure conformance to specified requirements.

7.5.5.4 Preservation

Appropriate methods for preservation and segregation of product are specified and applied when product is under the control of the Company.

7.5.5.5 Delivery

Protection requirements for the quality of product after final inspection and testing are provided by applicable procedures and specifications. Where contractually specified, this protection is extended to include delivery to destination.

7.6 Control of Monitoring and Measuring Devices

The standard ISO 10012-1, Quality Assurance Requirements for Measuring Equipment, is used as a guide for planning,



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structuring, implementing, and maintaining metrology and calibration systems.

The inspection, measuring, and test equipment is specific to the plants' individual operations. The manufacturing plants have developed quality system procedures and quality plans specific to their individual operations which provide for control of inspection, measuring, and test equipment that is designed to determine compliance with product specification requirements.

Inspection, measuring, and test equipment is also used at Technology and Product Development in product and process design/development, and in support of other Corporate requirements such as customer complaint investigation. The Company has established and maintains documented procedures to control, calibrate, and maintain inspection, measuring, and test equipment used to demonstrate the conformance of product to the specified requirements. Quality plans may also be designed to address special requirements. Inspection, measuring, and test equipment is used in a manner which insures that the measurement uncertainty is known and is consistent with the required measurement capability.

Where test software or comparative references such as test hardware are used as suitable forms of inspection, checks to validate capability of verifying the acceptability of product prior to release for use during production, installation, or servicing are rechecked at prescribed intervals. In these situations, the Company establishes the extent and frequency of such checks and maintains records as evidence of control.

Where the availability of technical data pertaining to the inspection, measuring, and test equipment is a specified requirement, such data is made available when required by the customer or customer's representative, for verification that the inspection, measuring, and test equipment is adequate to determine product compliance with specified requirements.

Procedures have been developed and are maintained to address the requirements for the control and calibration of inspection, measuring, and test equipment used to measure product compliance with specified requirements. By means of these procedures, the Company:

- Determines the measurements to be made, the accuracy required, and selects the appropriate inspection, measuring, and test equipment that is capable of the necessary accuracy and precision
- Identifies all inspection, measuring, and test equipment that can affect product quality, adjusts and calibrates them at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to internationally or nationally recognized standards. Where no such standards exist, the basis used for calibration is documented.
- Defines the process employed for the calibration of inspection, measuring, and test equipment including details of equipment type, unique identification, location, frequency of checks, check method, acceptance criteria, and the action to be taken when results are unsatisfactory
- Identifies inspection, measuring, and test equipment with a suitable indicator or approved identification record to show the calibration status



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- Identifies and maintains calibration records for inspection, measuring and test equipment
- Assesses and documents the validity of previous inspection and test results when inspection, measuring, and test equipment is found to be out of calibration
- Insures that the environmental conditions are suitable for the calibrations, inspections, measurements, and tests being carried out
- Insures that the handling, preservation, and storage of inspection, measuring, and test equipment is such that the accuracy and fitness for use are maintained
- Safeguards the inspection, measuring, and test facilities, including both test hardware and test software, from adjustments which would invalidate the calibration setting

8 Measurement, Analysis, and Improvement

8.1 General

Measurement, analysis, and improvement activities are in place to analyze product conformance to specified requirements, insure conformance to the Quality Management System, and insure effectiveness and continuous improvement to the Quality Management System. Where appropriate, statistical techniques are used in monitoring and control of processes affecting product quality and in the analysis of process and product performance.

8.2 Monitoring and Measurement

8.2.1 Customer Satisfaction

Metrics to assess customer satisfaction and perception are in place. Such measurements include a detailed, comprehensive customer complaint system which is capable of providing detailed analysis, sales office feedback, and Sales visits to customers. On time delivery of product to customers is another important metric considered important to customers that is measured and analyzed.

8.2.2 Internal Assessment

Procedures have been established and are maintained for planning and implementing internal quality assessments to verify quality activities and related activities comply with planned arrangements, and to determine the effectiveness of the Quality Management System. These procedures are also applicable to assessment of suppliers and to Corporate assessments of the manufacturing plants.

Plants maintain an internal assessment schedule in addition to random, daily assessment of process performance. Checklists are often used to conduct and report the results of the daily assessments.

Product and process quality assessments are planned, conducted, and reported by a team of Corporate and Plant Quality



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and Processing personnel. The assessments are scheduled at least annually on the basis of the status and importance of the activities to be assessed. Results of previous assessments are used in planning assessments. The assessments are carried out by personnel independent of those having direct responsibility for the activity being assessed.

The results of the assessments are recorded and brought to the attention of the personnel having responsibility in the area assessed. Management personnel responsible for the area assessed are required to take timely corrective and preventive actions of deficiencies found during the assessment.

Personnel responsible for the area being assessed insure that actions to correct and prevent nonconformances are implemented without undue delay. Follow-up assessment activities are conducted to verify and record the implementation and effectiveness of the corrective and preventive actions taken.

8.2.3 Monitoring and Measurement of Processes

Procedures and methods for measuring and monitoring quality system processes throughout all stages of product realization are established and maintained. Although certain corporate procedures are applicable to plant processes, each plant is responsible for establishing, revising, and maintaining their respective procedures that support the objectives and planned requirements of the Quality Management System. When planned results are not achieved, corrective and preventive actions are initiated, if appropriate.

8.2.4 Monitoring and Measurement of Product

8.2.4.1 General

The manufacturing plants have developed quality systems providing for certain inspection and testing activities which are specific to their individual operations. The Company has established and maintains documented procedures and purchase specifications which are applicable to inspection and testing activities to verify that the specified requirements for the product are met. Quality plans are prepared, where appropriate, to address special testing and inspection required by the sales order, contract, or special projects. The required inspection and testing and the records established are detailed in the quality plan or documented procedures.

8.2.4.2 Receiving Inspection and Testing

Receiving inspection and testing or verification of incoming product that affects product quality is performed by the Company facility receiving the product. In the event that incoming product does not conform to specified requirements, Corporate Purchasing may be notified of the nonconformance by the receiving facility. When production requirements demand prompt action, the plants may contact suppliers directly and notify Corporate Purchasing afterward.

Through the use of documented procedures, specifications, standards, and quality plans, the Company insures that incoming product that affects product quality is not used or processed until it has been inspected or otherwise verified as conforming to specified requirements. Verifications of conformance to the specified requirements are in accordance the applicable purchase specification and/or documented procedures.

In determining the amount and nature of receiving inspection, consideration is given to the amount of control exercised at the supplier's premises and the recorded evidence of conformance provided.



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Where incoming product is released for urgent production purposes prior to verification, the product is positively identified and recorded to permit immediate recall and replacement in the event of nonconformance to specified requirements.

8.2.4.3 In-process Inspection and Testing

Documented procedures and product standards which specify in-process inspection and testing activities are established and maintained. When appropriate, the Company also prepares quality plans for special projects or contracts. Accordingly, the Company provides for:

- Inspecting and testing the product as required by the sales order, quality plan and/or documented procedures
- Holding the product until the required inspection and tests have been completed or the necessary reports have been received and verified, except when the product is released under positive recall procedures (see 8.2.4.2)
- Release under positive recall procedures does not preclude the activities outlined in 8.2.4.2.

8.2.4.4 Final Inspection and Testing

National and international standards establish the final inspection and testing requirements for products that are of generic industry design. Testing of product may in some cases, exceed industry standards. The Company has many product designs of its own origin for which it has developed final inspection and testing requirements. In some cases, specific contracts require final inspection and testing which may vary from or exceed national and international standards. The Company has developed documented procedures and/or quality plans, product standards and/or product drawings which establish final inspection and testing requirements. These measures enable the Company to carry out all final inspection and testing in accordance with the quality plan and/or documented procedures, and to complete evidence of conformance of the finished product to the specified requirements.

The quality plan and/or documented procedures for final inspection and testing require that all specified inspection and testing activities, including those specified either on receipt of product or in-process, have been carried out and that the results meet specified requirements.

No product is released or dispatched until all the activities specified in the sales order, quality plan and/or documented procedures have been satisfactorily completed and the associated data and documentation available and authorized.

8.2.4.5 Inspection and Test Records

Routine inspection and testing according to national, international, and U. S. Pipe standards are primarily performed within the Company at its manufacturing plants. The manufacturing plants have developed individual quality systems which identify inspection and test records that are specific to their operations. Quality plans are prepared, where appropriate, to address special testing and inspection required by sales order, contract, or special projects. Inspection and test records required in these special cases are identified in the quality plan.

First article inspection of accessories is performed by Technology and Product Development when required by product purchase specifications or other purchase documents. The test records are identified in the appropriate Corporate Purchasing Policies and Procedures, Corporate Purchase Specifications, or quality plan.



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Where appropriate, Corporate Quality, Sales Engineering, Technology and Product Development, and/or Plant Quality Assurance Engineering may participate in the investigation of product for which a customer complaint has been received. The inspection and test records resulting from these investigations are identified in the appropriate Quality Control Procedure.

Records identify the inspection authority responsible for the release of product.

8.2.4.6 Inspection and Test Status

Procedures for identifying the inspection and test status of product are established and maintained by the plants. Quality plans are developed, as appropriate, to identify inspection and test status of products having special requirements. The inspection and test status of products is identified to indicate conformance or nonconformance of product with regard to inspection and tests performed. The identification of inspection and test status is maintained, as defined in the quality plan and/or documented procedures, throughout production, installation, and servicing of the product to insure that only product that has passed the required inspections and tests (or released under an authorized concession) is dispatched or released.

8.3 Control of Nonconforming Product

8.3.1 General

Documented procedures to insure that product which does not conform to specified requirements is prevented from unintended use or installation are established and maintained. This control provides for identification, documentation, evaluation, segregation (when practical), disposition of nonconforming product, and for notification to the functions concerned. Quality Control Procedures, Quality Management Policies and Procedures, Purchasing Procedures, Purchase Specifications, and Corporate Product Quality Standards are used to define requirements, and/or to describe particular aspects of the quality system.

The plants have developed additional procedures for internal control of nonconforming product within their respective systems.

8.3.2 Review and Disposition of Nonconforming Product

The responsibility for review and authority for the disposition of nonconforming product is defined in the appropriate plant procedures.

Nonconforming product may be:

- reworked to meet the specified requirements
- accepted with or without repair or concession
- reclassified for alternative applications and/or classes
- rejected or scrapped



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When required by the sales order or contract, the proposed use or repair of product which does not conform to specified requirements is reported for concession to the customer or the customer's representative. The description of the nonconformance that has been accepted, and of repairs, is recorded to denote the actual condition.

Repaired and/or reworked product is re-inspected in accordance with the appropriate Quality Control Procedure, quality plan, or plant procedure.

8.4 Analysis of Data

Data from various processes throughout production is collected and analyzed to determine the suitability and effectiveness of the Quality Management System, and to evaluate where opportunities for continual improvement of the Quality Management System exist. Such data used in the analysis may come from process monitoring, inspection and test results, key process indices, internal assessment results, customer complaints, and corrective and preventive actions.

Data analysis provides information relating to:

- Customer satisfaction
- Conformance to product requirements
- Characteristics and trends of processes and products including opportunities for preventive actions
- Suppliers

8.5 Improvement

8.5.1 Continual Improvement

Data used to determine compliance with specified requirements is also used to assess the continual growth and improvement of the Quality Management System. Baselines are established in key indices to which performance is compared. Improvement goals and objectives are established for key indices, and performance results and trends are analyzed to determine effectiveness of the Quality Management System and its continual improvement.

Data collected from process monitoring, inspection and test results, key process indices, internal assessment results, customer complaints, and corrective and preventive actions is used to analyze performance and also to identify opportunities for improvement of the Quality Management System. Corrective and preventive actions may result from the analysis.

Statistical tools such as process capability analysis and control charts are used to measure performance against established baselines and to assess the effectiveness and continual improvement of the Quality Management System. Other tools such as brainstorming, cause and effect diagrams, Pareto charts, and regression analysis are used by personnel trained and qualified to perform data analysis using these established methods.



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The 8D Problem Solving Model is used throughout the Company by improvement teams to establish a consistent and disciplined approach to addressing issues including corrective and preventive actions and follow-up for effectiveness.

8.5.2 Corrective Action

Documented procedures have been established and are maintained for implementing corrective action. The procedure defines requirements for:

- Review of nonconformances including customer complaints
- Determining the cause of the nonconformance
- Evaluating the need for action to insure that nonconformances do not recur
- Determining and implementing the action(s) needed
- Records of the results of action taken
- Reviewing the corrective action for effectiveness and sustainability

An 8D problem solving approach is used by the plants to standardize investigations into the cause of an excursion and the associated corrective/preventive actions. The approach taken during an excursion investigation is to eliminate the cause of the nonconformance to prevent recurrence.

Any corrective or preventive action taken to eliminate the causes of actual or potential nonconformances is to a degree appropriate for the magnitude of the problems and commensurate with the risks encountered.

Any changes to procedures resulting from corrective and preventive action which is implemented are recorded. Corrective and preventive action procedures are included in both Corporate and plant procedures.

8.5.3 Preventive Action

Documented procedures have been established and are maintained for implementing preventive action. The procedure defines requirements for:

- The use of appropriate sources of information such as processes and work operations which affect product quality, concessions, assessment results, quality records, production records, service reports, and customer complaints to determine, analyze, and eliminate potential causes of nonconformances
- Evaluating the need for action required to prevent nonconformances
- Determining and implementing preventive action and the application of controls
- Confirmation that relevant information on actions taken is recorded
- To review and insure that the preventive action is effective and sustainable



Quality Management System

QUALITY SYSTEM PROCEDURES, SPECIFICATIONS, AND STANDARDS SUPPORTING THE QUALITY MANAGEMENT SYSTEM

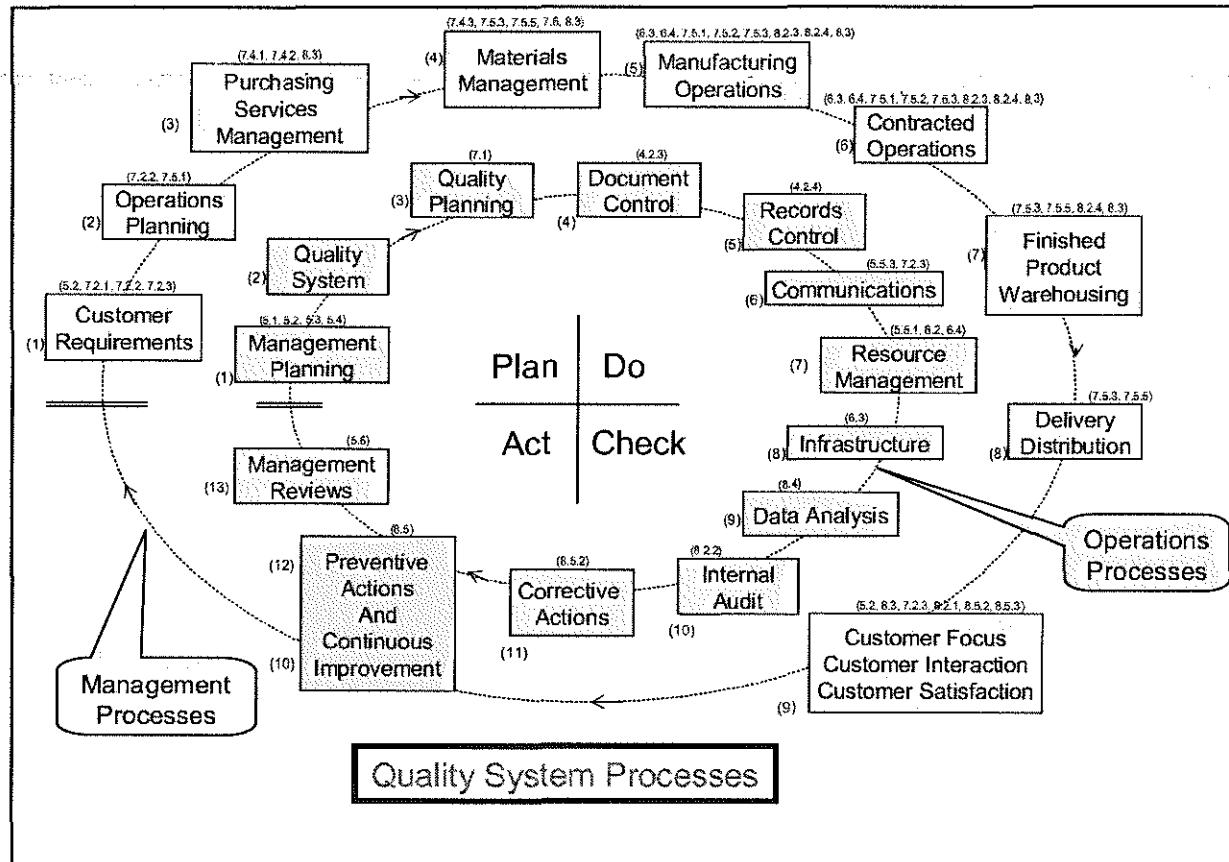
Quality System Section Number	Corporate Controlled Documents							Plant Controlled Procedures	
	Quality Management Procedures	Sales Procedures	Purchasing Policies and Procedures	Purchase Specifications	Design Procedures	Product Quality Standards	Quality Control Procedures		
4	Quality Management System								
4.1	General Requirements								
4.2	Documentation Requirements								
4.2.1								X	
4.2.2								X	
4.2.3	X							X	
5	Management Responsibility								
5.1	X							X	
5.2	X							X	
5.3	X							X	
5.4	Planning								
5.4.1	X							X	
5.4.2	X							X	
5.5	Responsibility, Authority, and Communication								
5.5.1	X							X	
5.5.2	X							X	
5.5.3	X							X	
5.6	Management Review								
5.6.1	X							X	
5.6.2	X							X	
5.6.3	X							X	
6	Resource Management								
6.1	X							X	
6.2	Human Resources								
6.2.1	X							X	
6.2.2	X				X	X	X	X	
6.3	X		X		X	X	X	X	
6.4	X					X		X	
7	Product Realization								
7.1	X	X	X	X	X	X	X	X	
7.2	Customer Related Processes								
7.2.1	X	X					X	X	
7.2.2	X	X						X	
7.2.3	X	X					X	X	



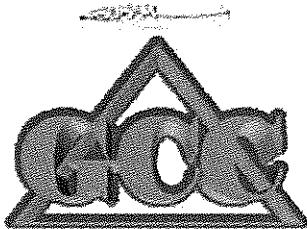
Quality Management System

Quality System Section Number	Corporate Controlled Documents							Plant Controlled Procedures
	Quality Management Procedures	Sales Procedures	Purchasing Policies and Procedures	Purchase Specifications	Design Procedures	Product Quality Standards	Quality Control Procedures	
7.3	Design and Development							
7.3.1	X				X			
7.3.2	X				X			
7.3.3	X				X			
7.3.4	X				X			
7.3.5	X				X			
7.3.6	X				X			
7.3.7	X				X			
7.4	Purchasing							
7.4.1	X			X				X
7.4.2	X			X				X
7.4.3	X			X			X	X
7.5	Production and Service Provision							
7.5.1	X					X	X	X
7.5.2	X						X	X
7.5.3	X					X	X	X
7.5.4	X							X
7.5.5	X	X		X		X	X	X
7.6	X						X	X
8	Measurement, Analysis, and Improvement							
8.1	X						X	X
8.2	Monitoring and Measurement							
8.2.1	X							X
8.2.2	X							X
8.2.3	X						X	X
8.2.4	X			X		X	X	X
8.3	X			X		X	X	X
8.4	X		X				X	X
8.5	Improvement							
8.5.1	X							X
8.5.2	X							X
8.5.3	X							X

Quality Management System

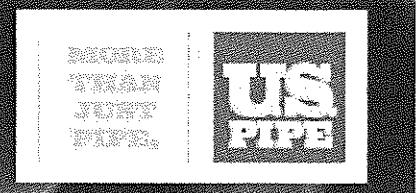


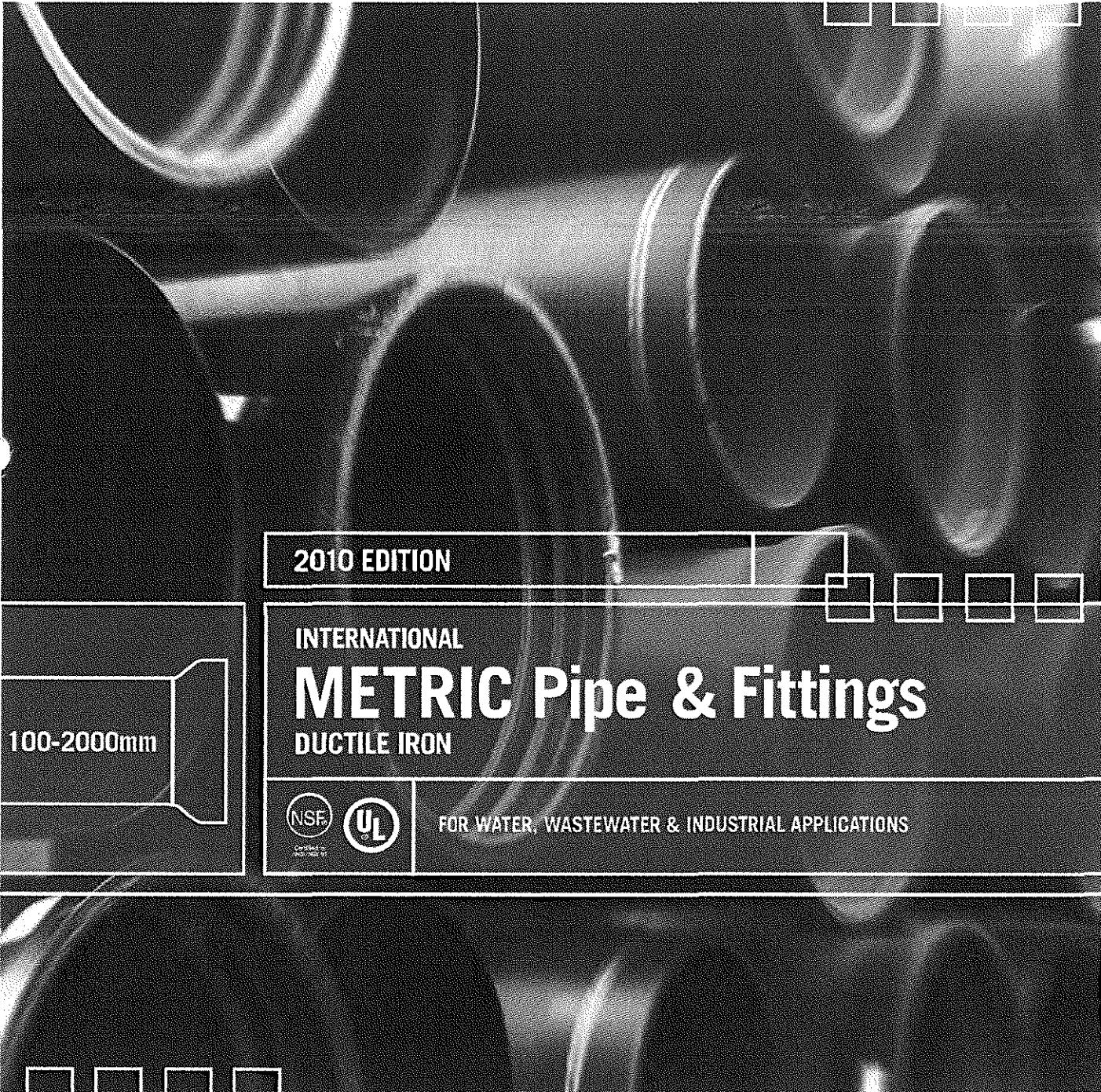
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PUSHON JOINT PIPE AND FITTINGS





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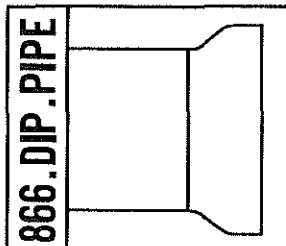
100-2000mm



FOR WATER, WASTEWATER & INDUSTRIAL APPLICATIONS

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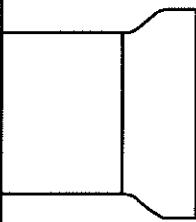
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Introduction

Based in Birmingham, Alabama, U.S. Pipe and Foundry Company, LLC. is America's leading manufacturer of Ductile Iron pipe, joint restraint products and other products for the water and wastewater industry.

U.S. Pipe operates four manufacturing plants and numerous sales locations throughout the country. These domestic sales offices combined with the International Sales office and their worldwide network of sales associates gives U.S. Pipe one of the broadest domestic and international marketing coverages in the industry.

From its beginning in 1899, U.S. Pipe has consistently lead the industry with innovations and product developments.

The company lineage dates back to 1882, when Colonel James Withers Sloss founded Sloss Furnace Company in Birmingham. Sloss Furnace Company became Sloss Iron and Steel Company. After acquiring Sheffield Iron Company, the Sloss-Sheffield Steel and Iron Company was incorporated in 1899.

In that same year U.S. Cast Iron Pipe and Foundry Company was incorporated with the consolidation of eleven small cast iron pipe companies located in eight states. Prominent among these was the Bessemer, Alabama plant, one of the three original plants still in operation today.

In 1911, U.S. Pipe purchased the Dimmick Pipe Company, which included a plant in North Birmingham that still operates today.

The name of the company was changed to United States Pipe and Foundry Company in 1929. U.S. Pipe also operates one other pipe plant in Union City, California.

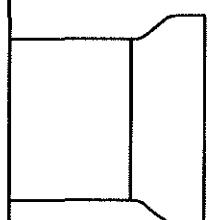
In 1952, the Sloss-Sheffield Steel and Iron Company was merged into U.S. Pipe, and the General Offices of U.S. Pipe moved from Burlington, New Jersey to Birmingham. The company quickly became a fully integrated producer of cast iron pipe and related products.

While the original plants produced pipe by the so called "pit cast" method, in which molten iron was poured into static, vertical molds lined and cored with sand, today's plants and production bear little resemblance to the old. In 1921, U.S. Pipe revolutionized the production of cast iron pipe when it purchased the rights for the centrifugal casting method, developed by Dimitri Sensaud Delavaud, a French engineer living in Brazil. In this process, the molten iron is poured into a rapidly spinning metal mold. The centrifugal force of the rotating mold distributes the molten iron uniformly around the inner surface of the mold. Upon cooling, extraction and heat treatment, high quality pipe with uniform thickness results.

In the early 1960's, U.S. Pipe perfected the production of Ductile Iron pipe, which is superior to gray iron in strength and durability. U.S. Pipe, since 1977, has used Ductile Iron exclusively for all its pressure pipe and fittings, making the company the first in the industry to do so.

Having produced pipe and fittings in imperial (inch) diameter sizes to ANSI/AWWA standards for a

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Introduction (cont.)

number of years, U.S. Pipe, in the 1970's, increased its production and marketing scope to include metric sized pipe and fittings to International Organization for Standardization (ISO) Standards.

Today U.S. Pipe and Foundry Company, LLC., a wholly owned subsidiary of Mueller Water Products, Inc., is the largest domestic producer of Ductile Iron pipe in the United States. U.S. Pipe perfected the production of Ductile Iron pipe, which is superior in strength to cast iron, and was the first in the industry to use Ductile Iron exclusively for all its pressure pipe and fittings.

This U.S. Pipe Metric catalog covers DN 100 - 2000mm ISO Pipe and Fittings. For information on products of ANSI/AWWA imperial (inch) diameter sizes, please contact your U.S. Pipe Sales Representative.

U.S. Pipe products have been shipped to Colombia, Ecuador, Egypt, El Salvador, Jamaica, Jordan, Kuwait, Nigeria, Oman, Paraguay, The Philippines, Saudi Arabia, Canada, Mexico, Qatar, The United Arab Emirates and many, many other countries around the world. Both abroad and in the United States customers and specifiers alike have come to depend upon products and services from the "new ideas" company to keep their work flowing.

Standards

ISO 2531 Ductile iron pipes, fittings, accessories and their joints for water or gas applications

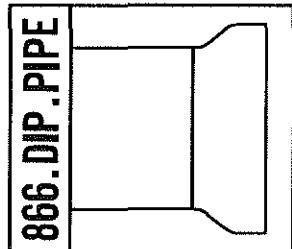
ISO 4179 Ductile iron pipes and fittings for pressure and non-pressure pipelines – Cement mortar lining

ISO 4633 Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for material

ISO 8179-1 Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer

ISO 8179-2 Ductile iron pipes – External zinc coating – Part 2: Zinc rich paint with finishing layer

ISO 8180 Ductile iron pipes – Polyethylene sleeving for site application



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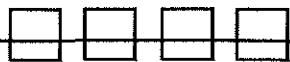
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General Specifications: Dimensions and Masses

The following descriptions of dimensions are in accordance with the requirements of ISD 2531. Variations from the Standard are so noted.

a. **Thickness** — The standard thicknesses of pipe and fittings are calculated as a function of their nominal diameter by the following formula:

$$e = \kappa (0.5 + 0.001 DN)$$

where

e = Standard wall thickness (mm)

DN = Nominal Diameter (mm)

κ = A coefficient selected from a series of whole numbers... 8, 9, 10, 11, 12...

The external diameter of the pipe, expressed in millimeters is fixed as a function of the nominal diameter and independent of the pipe wall thickness. Increases or decreases in the pipe wall thickness result in change of the internal diameter.

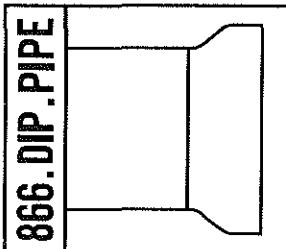
For fittings, both internal and external diameters may be varied to change wall thicknesses. Actual wall thicknesses may be adjusted to accommodate internal stresses for each point of the casting. In bends, for example, the wall thickness at the inner radius may be greater than that at the outer radius. The thickness "e" indicated in each table and on the drawings of the fittings is the mean thickness.

b. **Thickness Tolerances** — The tolerances on wall thicknesses are as given in Table 1.

Table 1.

Type of Casting	Tolerance Dimensions in Millimeters
Pipe	-(1.3 + 0.001 DN) ¹
Fittings & Accessories	-(2.3 + 0.001 DN) ¹

¹ No Limit for the plus tolerance has been set.



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NSE UL

General Specifications: Dimensions and Masses (cont.)

c. **Lengths and Tolerances: Spigot and Socket Pipe** — Metric Pipe are produced to the manufacturing working lengths shown in Table 2.

In accordance with ISO 2531, of the total number of spigot and socket pipe to be supplied in each diameter, up to 10% may be supplied in shorter lengths than the working lengths stated in Table 2. The Standard allows a ± 30 mm tolerance on manufacturing working lengths to allow for variations due to shrinkage and growth, depending on the composition and heat treatment of the Ductile Iron.

d. **Lengths and Tolerances: Fittings** — Fittings were designed using the performance requirements of ISO 2531 as the minimal requirements.

Casting Tolerances on the laying lengths vary by fitting type and are given in the fitting tables.

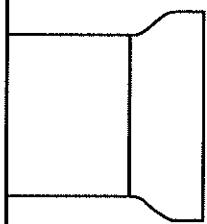
e. **Tolerance on the Straightness of Centrifugally Cast Pipe** — When pipe are rolled along two gantries separated by approximately two-thirds of the length "L" of the pipe to be checked, the maximum deviation " f_m ", in millimeters, shall not be greater than 1,25 times the length "L", in meters of this pipe:

$$f_m < 1,25L$$

Table 2.

Nominal Diameters DN	Manufacturing Nominal Working Lengths in
100 to 1000	5,5 & 6,0
1200 to 2000	6,0 & 8,0

Dimensions in millimeters.



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General Specifications: Mechanical Testing

The following mechanical tests and acceptance values are in accordance with the requirements of ISO 2531. At the end of this section additional control tests used by U.S. Pipe during the production of centrifugally cast Ductile Iron pipe, the Ball Impression Test and Charpy Impact Test, are shown. These latter tests are not required by the International Standard.

a. Tensile Tests - Test Bars:

Pipe centrifugally cast in metal molds — The machined test bar for the tensile test is taken from the spigot end of the pipe, at approximately mid-thickness of the wall, with its axis parallel to the axis of the pipe.

The test bar includes a cylindrical part, with a gauge length at least five times its diameter; the latter given in Table 3, according to the thickness of the pipe, "e".

Table 3.

Thickness of Pipe	Diameter of Test Bar
$e < 6$	2,5
$6 < e < 8$	3,5
$8 < e < 12$	5
$12 > e$	6

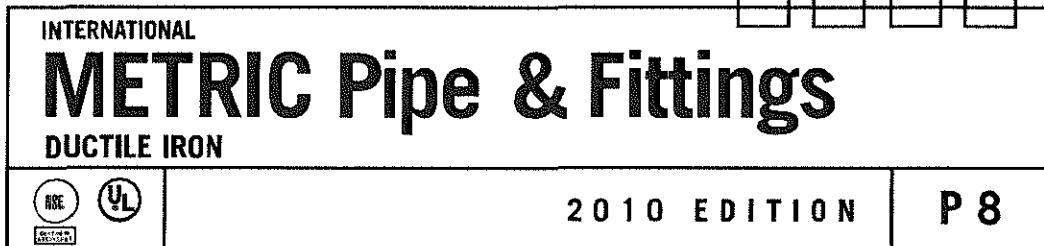
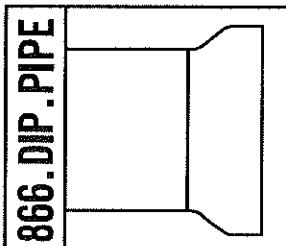
Dimensions in millimeters.

Fittings cast in sand molds — The machined bar for the Tensile Test is taken from a sample attached to the casting or a sample cast separately from the same iron. Where heat treatment of the fitting or accessory is required, a separately cast sample shall be subjected to the same heat treatment. The thickness of the sample and the diameter of the test bar is given in Table 4 as a function of the mean thickness of the casting. The gauge length of the machined bar is at least five times its diameter.

Table 4.

Mean thickness of casting	Thickness of sample	Diameter of test bar
≤ 12	12,5	6
> 12	25,0	12

Dimensions in millimeters.



General Specifications: Mechanical Testing (cont.)

b. **Tensile Test: Methods and Results** - These mechanical tests are carried out during the manufacturing process on castings grouped in accordance with the following batch size limitations:

Pipe centrifugally cast in metal molds

DN 100 to 300.....200 pipe

DN 350 to 600.....100 pipe

DN 700 to 1000.....50 pipe

DN 1200 to 2000... 25 pipe

Fittings not centrifugally cast - Castings made from iron of substantially the same composition and, if necessary, having been subjected to the same heat treatment, shall be considered as one batch.

For one pipe, or from one sample of each batch of fittings, one test bar is taken which shall satisfy the requirements of Table 5.

If a result of this test is below the specified minimum values, two other test bars are taken from the same pipe, or from the same sample in the case of fittings and these must both satisfy the same requirements.

Table 5.

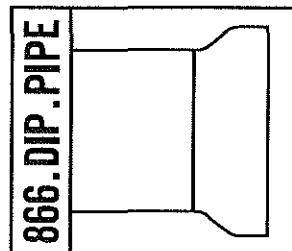
Type of Casting	Minimum tensile strength R_m N/mm ²	Minimum elongation after fracture A	
		DN 100 to 1000	DN > 1000
Pipe centrifugally cast	420	10	7
Fittings	400	5	5

Dimensions in millimeters.

NOTE: By agreement between manufacturer and purchaser, the 0,2% proof test may be used to determine the proof stress (yield strength). It shall not be less than:

-270 MPa when > 12% for DN 100 to 1000
or A > 10% for DN > 1000

*300 MPa in other cases.



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General Specifications: Mechanical Testing (cont.)

- c. Internal Pressure Proof Test — Pipe are subjected to a works hydrostatic test for a minimum duration of 10 seconds and at a pressure based on the formula and limitations given in Table 6.

Table 6.

Nominal size DN	Hydrostatic works test pressure for $K \geq 9$ pipe	Minimum Test Pressure (bar)
	Formula (bar)	
100 < DN < 300	$0.5 (\lambda + 1)^2$	50
350 < DN < 600	$0.5 \lambda^2$	40
700 < DN < 1000	$0.5 (\lambda - 1)^2$	32
1200 < DN < 2000	$0.5 (\lambda - 2)^2$	25

λ is the thickness coefficient of the pipe

Dimensions in millimeters.

Fittings are subjected to a leak-tightness test carried out with water at the test pressures given in Table 7 or with air at a minimum pressure of 1 bar.

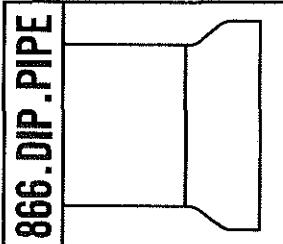
Table 7.

Nominal size DN	Hydrostatic leak-tightness test pressure for fittings (bar)
80 < DN < 300	25
350 < DN < 600	16
700 < DN < 2000	10

Dimensions in millimeters.

For pipe and fittings, the acceptance criteria are that after completion of the test there shall be no visible leakage, sweating or other fault of any kind.

- d. Other Mechanical Tests - The Charpy Test is a quality and process control test utilized by U.S. Pipe to assure consistent quality of centrifugally cast Ductile Iron pipe. The Charpy Impact Test is a requirement of *ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water*.



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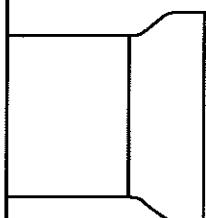
General Specifications: Mechanical Testing (cont.)

Charpy Impact Test — The Charpy Impact Test is a fracture toughness test used to measure the mechanical properties of centrifugally cast Ductile Iron pipe. A notched test specimen of full wall thickness is tested in accordance with the requirements of **ASTM E 23**. The pendulum type test equipment strikes the properly positioned test specimen and measures the energy required to fracture it.

Samples for Charpy testing are selected to represent production through the heat treating operation.

The acceptance value, corrected for actual thickness, is 7 ft-lbs (9.49 J) at 70° (21C). Pipe failing to meet this requirement are subjected to metallurgical evaluation and additional heat treatment or rejection as appropriate.

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General Specifications: Coatings, Linings, and Markings

COATINGS AND LININGS

Coatings and linings applied to pipe and fittings are as follows:

EXTERNAL - COATINGS

Pipe and fittings:

Bituminous paint.

When specified, metallic zinc with a bituminous finishing layer in accordance with ISO 8179-1 and/or ISO 8179-2 *Ductile Iron Pipes - External Zinc Coating* can be furnished.

Polyethylene encasement as specified in ISO 8180, *Ductile Iron Pipes - Polyethylene Sleeving*, or ANSI/AWWA C105/A21.5, *Polyethylene Encasement for Ductile Iron Pipe*, is available when the soil is corrosive to Ductile Iron and protection against exterior corrosion should be provided.

INTERNAL LININGS

Pipe:

Cement mortar in accordance with ISO 4179, *ductile iron pipes for pressure and non-pressure pipelines — Centrifugal cement mortar lining — general requirements*.

Fittings:

Cement mortar in accordance with the applicable requirements of ISO 4179.

When specified, cement mortar linings can be furnished made with ASTM C150 Type V sulfate resisting Portland cement. Pipe and fittings can be furnished with or without a bitumen seal-coat on the cement mortar lining. Sealcoating furnished meets the health effects requirements of ANSI/NSF 61, *Drinking Water System Components-Health Effects*.

NOTE: The above standard coatings and linings are suitable for the majority of soil conditions and raw or potable waters to be conveyed. Should supplemental protection be required for aggressive soils or waters carried by the pipeline, contact International Sales for additional methods of protection.

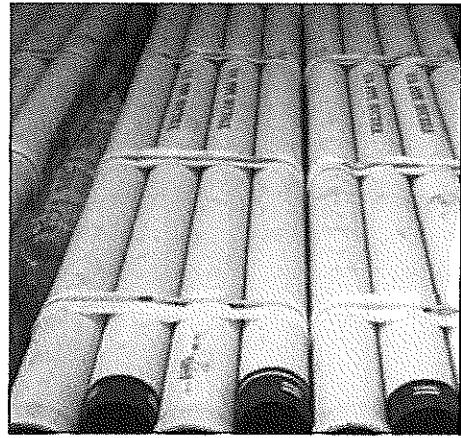
CAST-ON OR COLD STAMPED MARKINGS

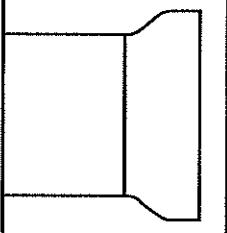
All pipe and fittings shall be marked as follows:

- Identification of the manufacturer
- Identification of the year of manufacture
- DN
- identification of Ductile Iron
- PN of flanges where applicable

Other markings, painted or attached, as appropriate:

- length, etc.
- identification of third party certification
- special markings





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METRIC Ductile Iron Pipe Assembly

CAUTION: The inside of the socket, the gasket, and the inserting plain end must be kept clean throughout the assembly. Joints are only as watertight as they are clean. If the joint is somewhat difficult to assemble, inspect for proper gasket position, adequate lubricant and presence of foreign matter in the joint.

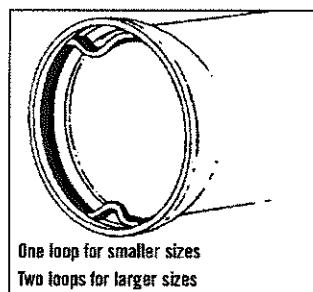
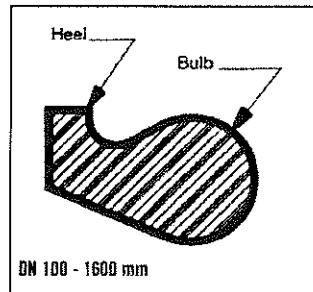
Figure 1. Insertion of Gasket

All foreign matter in the socket must be removed, i.e., mud, sand, cinders, gravel, pebbles, trash, frozen material, etc. The gasket seat should be thoroughly inspected to be certain it is clean. Foreign matter in the gasket seat may cause a leak. The gasket must be wiped clean with a clean cloth, flexed, and then placed into the socket with the rounded bulb end entering first. Looping the gasket in the initial insertion will facilitate seating the gasket heel evenly around the retainer seat. Smaller sizes require only one loop. With larger sizes, looping the gasket at twelve o'clock and six o'clock positions will be helpful. When installing Metric Pipe in sub-freezing weather, the gaskets, prior to their use, must be kept at a temperature of at least 40°C by suitable means, such as storing in a heated area or keeping immersed in a tank of warm water. If the gaskets are stored in warm water, they should be dried before placing into the pipe socket.

Figure 2. Application of Lubricant

A thin film of lubricant should be applied onto the inside surface of the gasket which will come into contact with the plain end of the pipe. The plain end of the pipe must be cleaned of all foreign matter on the outside from the end to the stripes. Frozen material may cling to the pipe in cold weather and must be removed. In some cases it is desirable to apply a thin film of lubricant onto the outside of the plain end for about 75mm back from the end. Do not allow the plain end to touch the ground or the trench side after lubricating since foreign matter may adhere to the plain end and cause a leak. Lubricant other than that furnished with the pipe should not be used.

Figure 1.



If the gasket is difficult to insert, apply a thin film of lubricant to gasket seat only prior to installing the gasket. Avoid getting lubricant inside the gasket retainer groove.

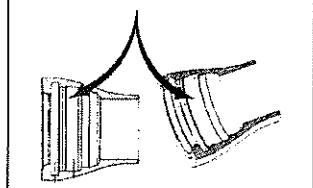
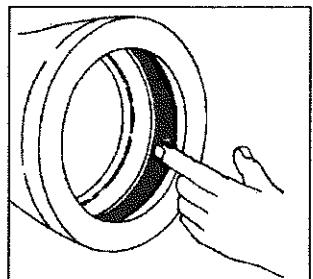
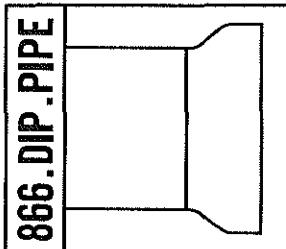


Figure 2.





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METRIC Ductile Iron Pipe Assembly (cont.)

Figure 3. Initial Entry of Plain End In Socket

The plain end of the pipe should be aligned and carefully entered into the socket until it just makes contact with the gasket. This is the starting position for the final assembly of the joint. Note the two painted stripes near the plain end.

Figure 4. Completely Assembled Joint

Joint assembly should then be completed by forcing the plain end of the entering pipe past the gasket (which is thereby compressed) until the plain end makes contact with the bottom of the socket. Note that the first painted stripe will have disappeared into the wall socket and the front edge of the second stripe will be approximately flush with the socket face. If the assembly is not accomplished with reasonable force by methods indicated, the plain end of the pipe should be removed to check for the proper positioning of the gasket, adequate lubrication, and removal of foreign matter in the joint.

Figure 5. Crowbar Method of Assembly

For joint assemblies DN 200 mm and smaller, socketing of the plain end may be accomplished by pushing against the face of the bell of the entering pipe with a crowbar or spade.

Figure 3.

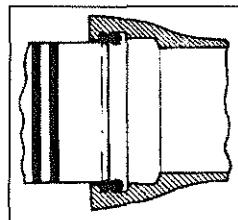


Figure 4.

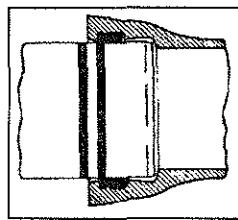
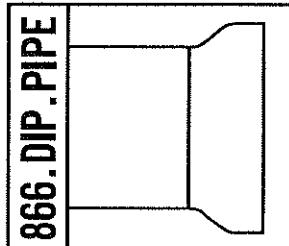


Figure 5.





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METRIC Ductile Iron Pipe Assembly (cont.)

Procedures outlined in figures 1-3 on the preceding pages should be followed before proceeding with the following procedure steps.

Figure 6. Tools needed for final assembly

Two (2) 3/4 ton chain hoists, with 7.5 m of chain and two (2) bell choker slings for DN 100 - 600 mm sizes or two (2) 1 1/2 ton chain hoists for DN 800 - 1600 mm sizes. See Table 8 below.

Figure 7.

Wrap the bell choker slings around the pipe just behind the bell so that the free ends will be located on the horizontal centerline on opposite sides of the bell with the loose ends projecting in front of the bell face.

Figure 8.

Double-wrap the chains of the two chain hoists around the pipe barrel at the spigot end approximately two meters from the spigot end. Position the hooks of the chain hoists on the horizontal centerline on opposite sides of the spigot.

Figure 9.

Attach the hook of each chain hoist into the eye of each bell choker sling.

Figure 10.

Assemble the joint by pulling evenly with both chain hoists, keeping the pipe in alignment.

Table 8.

Size DN	Bell Choker Sling
100 thru 500	10 mm (3/8") Diameter x 2100 mm
600 thru 800	10 mm (3/8") Diameter x 3000 mm
900	10 mm (3/8") Diameter x 3600 mm
1000	10 mm (3/8") Diameter x 4100 mm
1200	10 mm (3/8") Diameter x 4600 mm
1400	10 mm (3/8") Diameter x 5200 mm
*1500	16 mm (5/8") Diameter x 5700 mm
*1600	16 mm (5/8") Diameter x 6000 mm

***NOTE:** These sizes may require the use of 3 chain hoists and choker sling units.

Dimensions in millimeters.

THE BACKHOE METHOD OF ASSEMBLY

A backhoe may be used to assemble pipe of intermediate and larger sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to push the pipe until fully seated. A timber header should be used between the pipe and bucket to avoid damage to the pipe.

Figure 6.

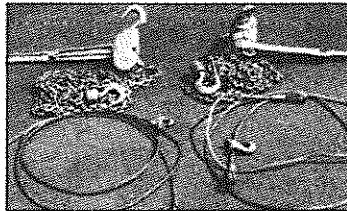


Figure 7.

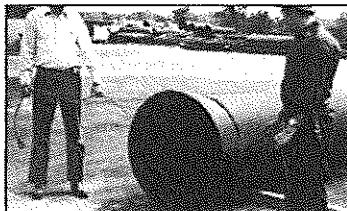


Figure 8.



Figure 9.

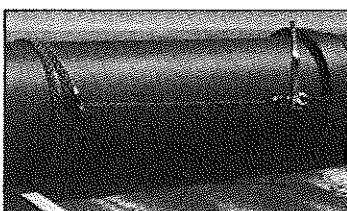
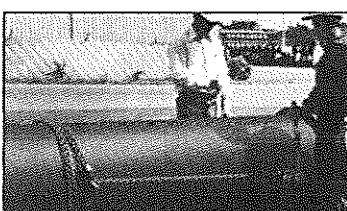
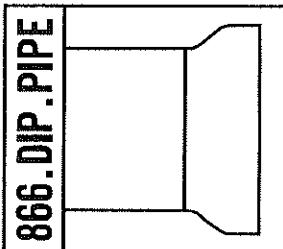
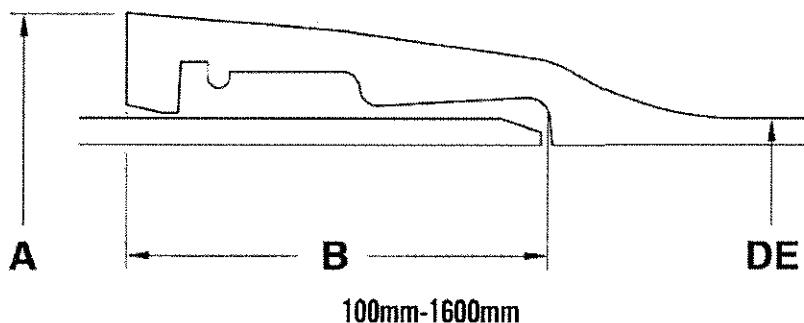


Figure 10.



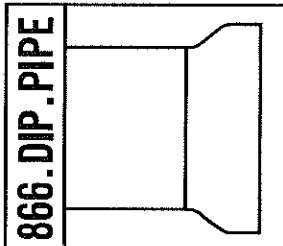


Push On Joint Pipe

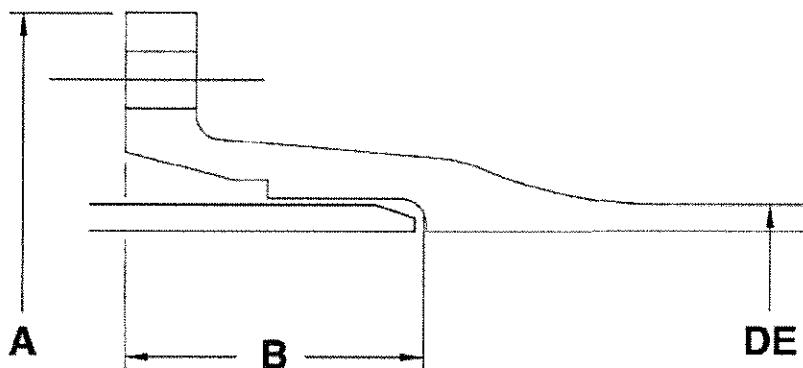


Nominal Diameter DN	O.D. Barrel DE	O.D. Bell A	Socket Depth B	Wall Thickness					
				K7	K8	K9	K10	K11	K12
100	118	163	88	—	—	6,1	6,1	6,6	7,2
150	170	217	94	—	—	6,3	6,5	7,2	7,8
200	222	278	100	—	—	6,4	7,0	7,7	8,4
250	274	336	105	—	—	6,8	7,5	8,3	9,0
300	326	393	110	—	—	7,2	8,0	8,8	9,6
350	378	448	113	—	—	7,7	8,5	9,4	10,2
400	429	500	116	—	—	8,1	9,0	9,9	10,8
450	480	540	120	—	—	8,6	9,5	10,5	11,4
500	532	604	120	—	—	9,0	10,0	11,0	12,0
600	635	713	120	7,7	8,8	9,9	11,0	12,1	13,2
700	738	824	150	8,4	9,6	10,8	12,0	13,2	14,4
800	842	943	160	9,1	10,4	11,7	13,0	14,3	15,6
900	945	1052	175	9,8	11,2	12,6	14,0	15,4	16,8
1000	1048	1158	185	10,5	12,0	13,5	15,0	16,5	18,0
1200	1255	1377	215	11,9	13,6	15,3	17,0	18,7	20,4
1400	1462	1610	239	13,3	15,2	17,1	19,0	20,9	22,8
1600	1668	1850	265	14,7	16,8	18,9	21,0	23,1	25,2

Dimensions in millimeters.



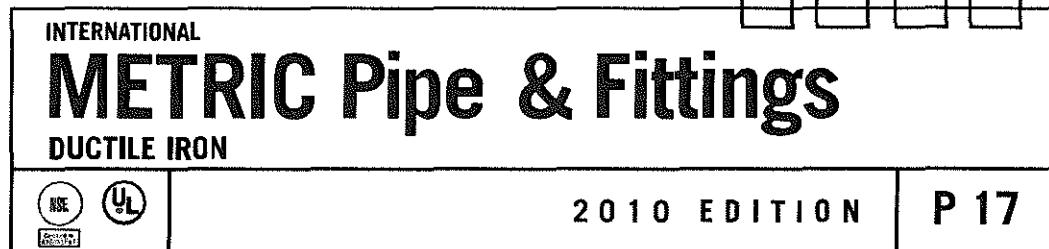
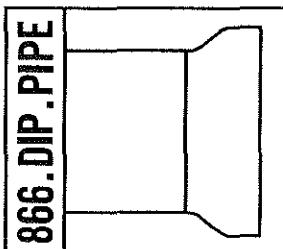
Mechanical Joint Pipe



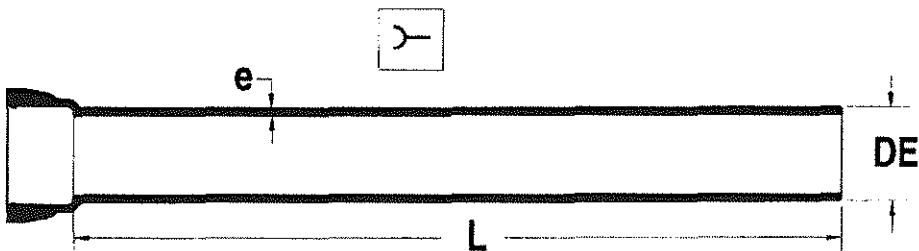
100mm-1600mm

Nominal Diameter DN	O.D. Barrel DE	O.D. Bell A	Socket Depth B	Wall Thickness					
				K7	K8	K9	K10	K11	K12
1000	1048	1231	130	10,5	12,0	13,5	15,0	16,5	18,0
1200	1255	1444	130	11,9	13,6	15,3	17,0	18,7	20,4
1400	1462	1657	130	13,3	15,2	17,1	19,0	20,9	22,8
1600	1668	1874	160	14,7	16,8	15,3	21,0	23,1	26,2
1800	1875	2089	170	16,1	18,4	20,7	23,0	25,3	27,6
2000	2082	2305	180	17,5	20,0	22,5	25,0	27,5	30

Dimensions in millimeters.



METRIC Push On Joint Ductile Iron Pipe: *Dimensions and Masses K7 - K8*



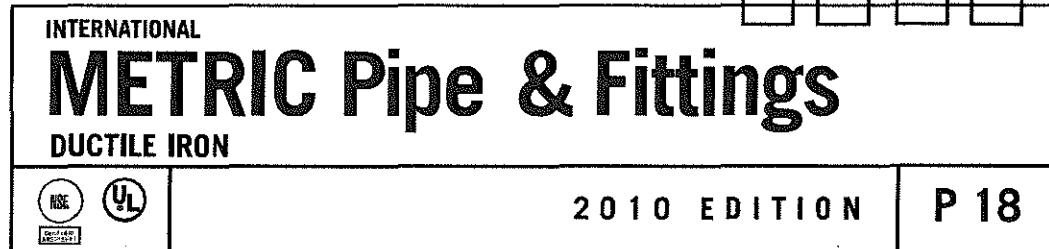
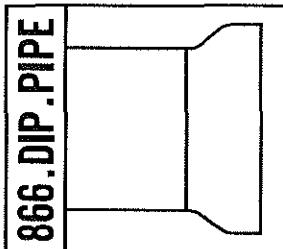
K7

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter 6	Mass per Meter 8
				6	8		
600	635	7,7	107,0	59,3	59,3	—	—
700	738	8,4	135,7	79,1	79,1	—	—
800	842	9,1	167,9	102,6	102,6	—	—
900	945	9,8	203,0	129,0	129,0	—	—
1000	1048	10,5	241,3	161,3	161,3	161,3	161,3
1200	1255	11,9	327,6	237,7	237,7	237,7	237,7
1400	1462	13,3	426,8	279,3	279,3	279,3	279,3
1600	1668	14,7	538,3	375,4	375,4	375,4	375,4

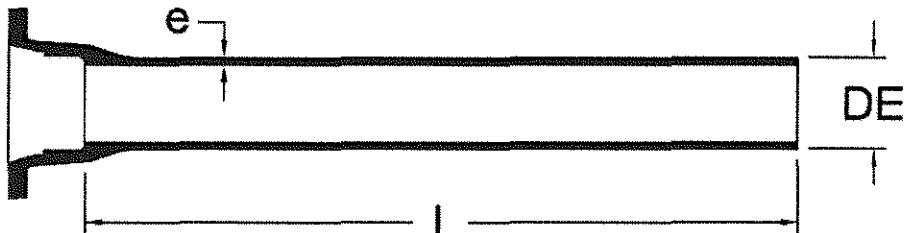
K8

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter 6	Mass per Meter 8
				6	8		
600	635	7,7	122,1	59,3	791,9	—	—
700	738	8,4	154,9	79,1	1008,5	—	—
800	842	9,1	191,6	102,6	1252,2	—	—
900	945	9,8	231,6	129,0	1518,6	—	—
1000	1048	10,5	275,3	161,3	1813,1	2363,7	—
1200	1255	11,9	373,9	237,7	2481,1	3228,9	—
1400	1462	13,3	487,1	279,3	3201,9	4176,1	—
1600	1668	14,7	614,4	375,4	4061,8	5290,6	—

Dimensions in millimeters.
Masses in kilograms.



METRIC Mechanical Joint Ductile Iron Pipe: *Dimensions and Masses K7 - K8*



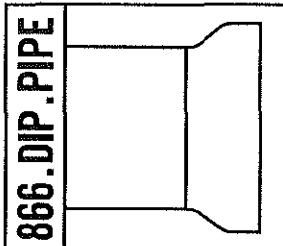
K7

Nominal Diameter DN	Barrel			Socket Mass	Mass per Meter	
	DE	e	Mass per Meter		6	8
1000	1048	10,5	241,3	146,6	1594,4	2077,0
1200	1255	11,9	327,6	201,1	2166,6	2821,8
1400	1462	13,3	426,8	265,8	2826,6	3680,2
1600	1668	14,7	538,3	375,4	3605,2	4681,8
1800	1875	16,1	660,8	490,6	4455,4	5777,0
2000	2082	17,5	797,6	626,4	5412,0	7007,2

K8

Nominal Diameter DN	Barrel			Socket Mass	Mass per Meter	
	DE	e	Mass per Meter		6	8
1000	1048	12,0	275,3	146,6	1798,4	2349,0
1200	1255	13,6	373,9	201,0	2444,4	3192,2
1400	1462	15,2	487,1	265,8	3188,4	4162,6
1600	1668	16,8	614,4	375,4	4061,8	5290,6
1800	1875	18,4	755,2	490,6	5022,1	6532,6
2000	2082	20,0	911,5	626,4	6095,7	7918,8

Dimensions in millimeters.
Masses in kilograms.



INTERNATIONAL

METRIC Pipe & Fittings

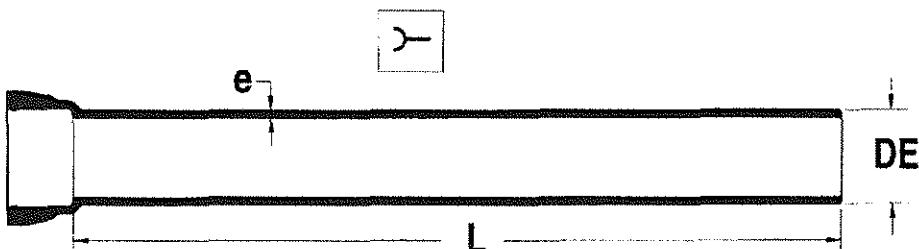
DUCTILE IRON



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METRIC Push On Joint Ductile Iron Pipe: *Dimensions and Masses K9*

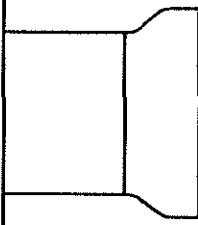


K9

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter	
				6	8	6	8
100	118	6,1	15,1	4,3	95	—	—
150	170	6,3	22,8	7,1	144	—	—
200	222	6,4	30,6	10,3	194	—	—
250	274	6,8	40,2	14,2	255	—	—
300	326	7,2	50,8	18,9	323	—	—
350	378	7,7	63,2	23,7	403	—	—
400	429	8,1	75,5	29,5	482	—	—
450	480	8,6	89,8	38,3	577	—	—
500	532	9,0	104,3	42,8	669	—	—
600	635	9,9	137,1	59,3	883	—	—
700	738	10,8	173,9	79,1	1123	—	—
800	842	11,7	215,2	102,6	1394	—	—
900	945	12,6	260,2	129,0	1691	—	—
1000	1048	13,5	309,3	161,3	2017	2936	—
1200	1255	15,3	420,1	237,7	2758	3598	—
1400	1462	17,1	547,2	279,3	3563	4657	—
1600	1668	18,9	690,3	375,4	4517	5898	—

Dimensions in millimeters.
Masses in kilograms.

866.DIP.PIPE



INTERNATIONAL

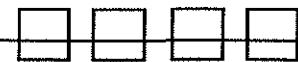
METRIC Pipe & Fittings

DUCTILE IRON

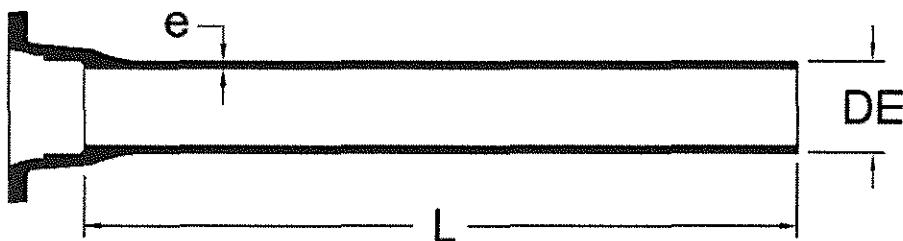


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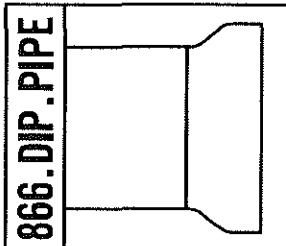
METRIC Mechanical Joint Ductile Iron Pipe: *Dimensions and Masses K9*



K9

Nominal Diameter DN	DE	e	Barrel	Mass per Meter	Socket Mass		Mass per Meter	
					6	8	6	8
1000	1048	13,5		309,3	146,6	2002,4	2621,0	
1200	1255	15,3		420,1	201,0	2721,6	3561,8	
1400	1462	17,1		547,2	265,8	3549,0	4643,4	
1600	1668	15,3		690,3	375,4	4517,2	5897,8	
1800	1875	20,7		850,1	490,6	5591,2	7291,4	
2000	2082	22,5		1026,3	626,4	6784,2	8836,8	

Dimensions in millimeters.
Masses in kilograms.



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METRIC Pipe & Fittings

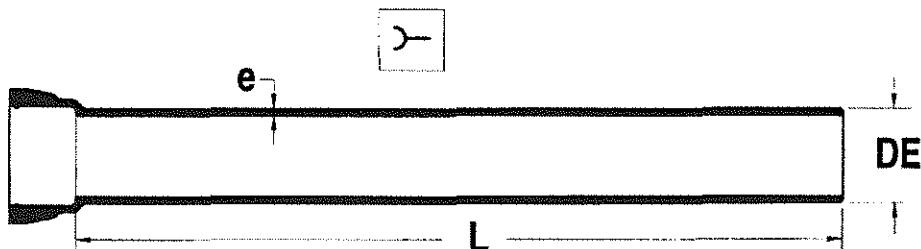
DUCTILE IRON



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METRIC Push On Joint Ductile Iron Pipe: *Dimensions and Masses K10*

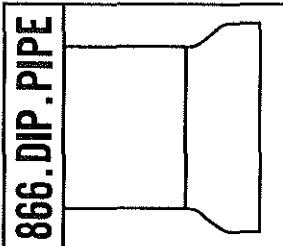


K10

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter	
				6	8	6	8
100	118	6,1	15,1	4,3	94,9	—	—
150	170	6,5	23,5	7,1	148,1	—	—
200	222	7,0	33,3	10,3	210,1	—	—
250	274	7,5	44,3	14,2	280,0	—	—
300	326	8,0	56,3	18,9	356,7	—	—
350	378	8,5	69,6	23,7	441,3	—	—
400	429	9,0	83,7	29,5	531,7	—	—
450	480	9,5	99,0	38,3	632,3	—	—
500	532	10,0	115,6	42,8	736,4	—	—
600	635	11,0	152,0	59,3	971,3	—	—
700	738	12,0	193,0	79,1	1237,1	—	—
800	842	13,0	238,7	102,6	1534,8	—	—
900	945	14,0	288,7	129,0	1861,2	—	—
1000	1048	15,0	343,2	161,3	2220,5	2906,9	—
1200	1255	17,0	466,1	237,7	3034,3	3966,5	—
1400	1462	19,0	607,2	279,3	3922,5	5136,9	—
1600	1668	18,9	684,4	375,4	4481,8	5850,6	—

Dimensions in millimeters.

Masses in kilograms.



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METRIC Pipe & Fittings

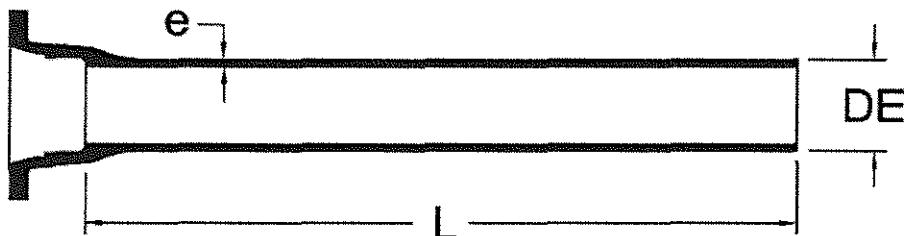
DUCTILE IRON



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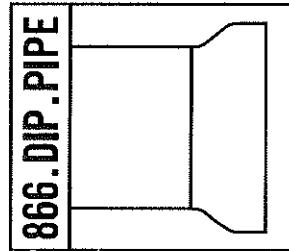
METRIC Mechanical Joint Ductile Iron Pipe: *Dimensions and Masses K10*



K10

Nominal Diameter DN	Barrel		Mass per Meter	Socket Mass	Mass per Meter	
	DE	e			6	8
1000	1048	15,0	343,2	146,6	2205,8	2892,2
1200	1255	17,0	466,1	201,0	2997,6	3929,8
1400	1462	19,0	607,2	265,8	3909,0	5123,4
1600	1668	21,0	766,0	375,4	4971,4	6503,4
1800	1875	23,0	944,1	490,6	6155,2	8043,4
2000	2082	25,0	1026,1	626,4	6783,0	8835,2

Dimensions in millimeters.
Masses in kilograms.



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DUCTILE IRON

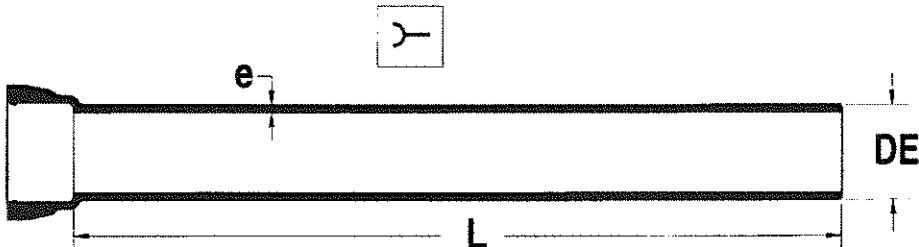


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METRIC Push On Joint Ductile Iron Pipe: Dimensions and Masses K11



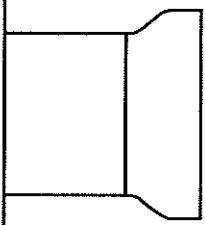
K11

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter
				6	8	
100	118	6,1	16,3	4,3	102,1	—
150	170	6,5	26,0	7,1	163,1	—
200	222	7,0	36,5	10,3	229,3	—
250	274	7,5	48,8	14,2	307,0	—
300	326	8,0	61,8	18,9	389,7	—
350	378	8,5	76,7	23,7	483,9	—
400	429	9,0	91,9	29,5	580,9	—
450	480	9,5	109,2	38,3	693,5	—
500	532	10,0	126,9	42,8	804,2	—
600	635	11,0	166,9	59,3	1060,7	—
700	738	12,0	211,9	79,1	1350,5	—
800	842	13,0	262,2	102,6	1675,8	—
900	945	14,0	317,1	129,0	2031,6	—
1000	1048	15,0	377,0	161,3	2423,3	3177,3
1200	1255	17,0	512,0	237,7	3309,7	4333,7
1400	1462	19,0	667,1	279,3	4281,9	5616,1
1600	1668	18,9	841,6	375,4	5425,0	7108,2

Dimensions in millimeters.

Masses in kilograms.

866.DIP.PIPE



INTERNATIONAL

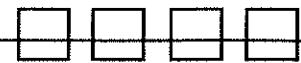
METRIC Pipe & Fittings

DUCTILE IRON

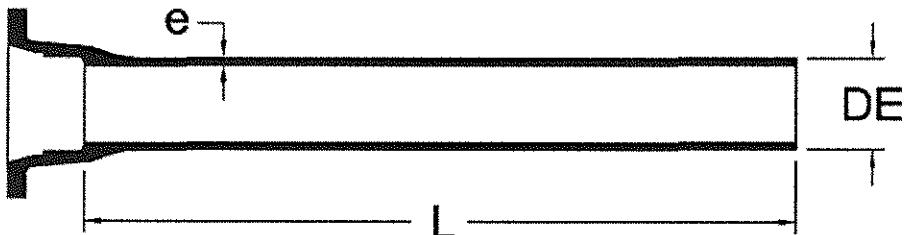


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METRIC Mechanical Joint Ductile Iron Pipe: *Dimensions and Masses K11*

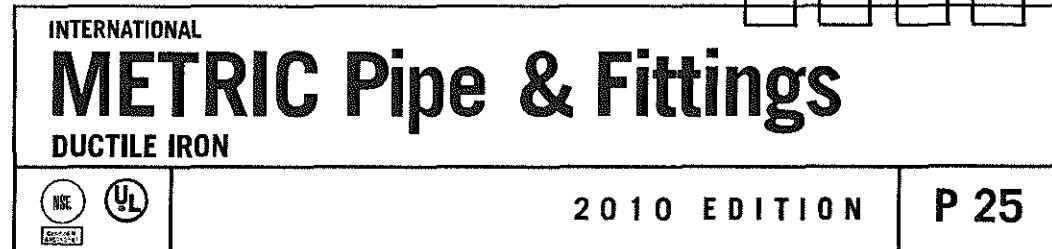
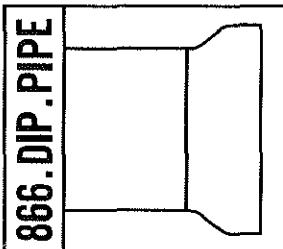


K11

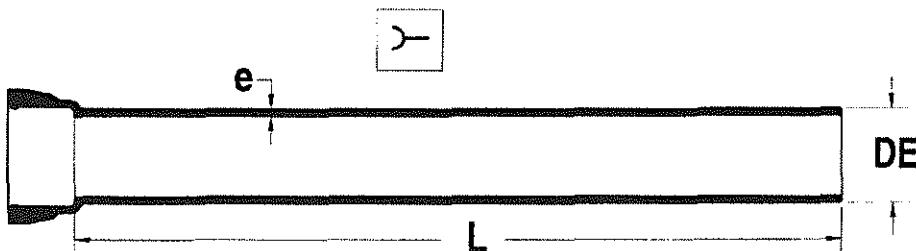
Nominal Diameter DN	DE	e	Barrel Mass per Meter	Socket Mass		Mass per Meter	
				6	8	6	8
1000	1048	16,5	377,0	146,6	2408,6	3162,6	
1200	1255	18,7	512,0	201,0	3273,0	4297,0	
1400	1462	20,9	667,1	265,8	4268,4	5602,6	
1600	1668	23,1	841,6	375,4	5425,0	7108,2	
1800	1875	25,3	1038,5	490,6	6721,6	8798,6	
2000	2082	27,5	1128,8	626,4	7399,2	9656,8	

Dimensions in millimeters.

Masses in kilograms.



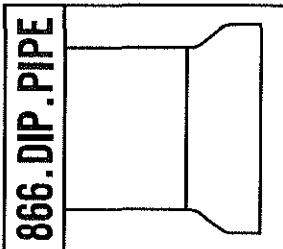
METRIC Push On Joint Ductile Iron Pipe: *Dimensions and Masses K12*



K12

Nominal Diameter DN	DE	Barrel e	Mass per Meter	Socket Mass		Mass per Meter	
				6	8	6	8
100	118	6,1	17,7	4,3	110,5	—	—
150	170	6,5	28,0	7,1	175,1	—	—
200	222	7,0	39,7	10,3	248,5	—	—
250	274	7,5	52,8	14,2	331,0	—	—
300	326	8,0	67,3	18,9	422,7	—	—
350	378	8,5	83,1	23,7	522,3	—	—
400	429	9,0	100,0	29,5	629,5	—	—
450	480	9,5	118,3	38,3	748,1	—	—
500	532	10,0	138,2	42,8	872,0	—	—
600	635	11,0	181,8	59,3	1150,1	—	—
700	738	12,0	230,8	79,1	1463,9	—	—
800	842	13,0	285,5	102,6	1815,6	—	—
900	945	14,0	345,4	129,0	2201,4	—	—
1000	1048	15,0	410,6	161,3	2624,9	3446,1	—
1200	1255	17,0	557,8	237,7	3584,5	4700,1	—
1400	1462	19,0	726,8	279,3	4640,1	6093,0	—
1600	1668	25,2	916,9	375,4	5876,8	7710,6	—

Dimensions in millimeters.
Masses in kilograms.



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METRIC Pipe & Fittings

DUCTILE IRON

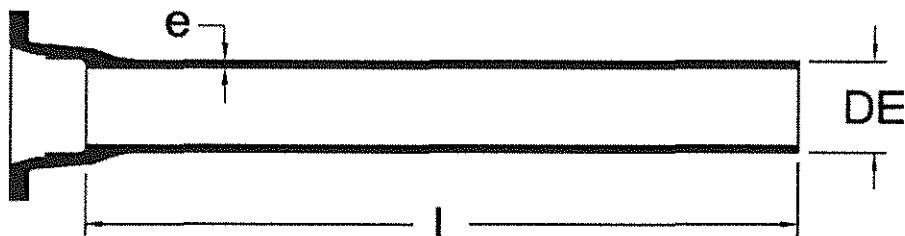


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METRIC Mechanical Joint Ductile Iron Pipe: *Dimensions and Masses K12*

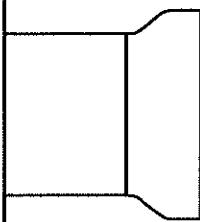


K12

Nominal Diameter DN	DE	e	Barrel Mass per Meter	Socket Mass	Mass per Meter	
					6	8
1000	1048	18,0	343,2	146,6	2205,8	2892,2
1200	1255	20,4	466,1	201,0	2997,6	3929,8
1400	1462	22,8	607,2	265,8	3909,0	5123,4
1600	1668	26,2	766,0	375,4	4971,4	6503,4
1800	1875	27,6	1132,9	490,6	7288,0	9553,8
2000	2082	30,0	1231,4	626,4	8014,8	10477,6

Dimensions in millimeters.

Masses in kilograms.



INTERNATIONAL

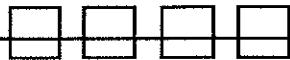
METRIC Pipe & Fittings

DUCTILE IRON



2010 EDITION

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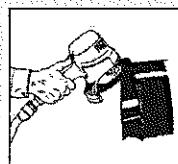


Push On Fittings

U.S. Pipe's boltless rubber-gasketed Ductile Iron push on fittings shown here are the push-in flexible joint fittings covered by the standards listed to the right.

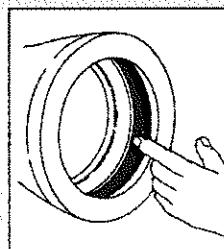
Push On Gaskets are normally furnished with Push On Fittings, one for each socket.

Assembly of Push On Fittings



Inspect gasket, socket and spigot for cleanliness. Remove any foreign matter and excessive coating. When pipe is cut in the field, the cut end must be conditioned so that it may be used to make up the joint. The outside of the cut end should be tapered back about 7mm at an angle of about 30 degrees. This can be done with a portable grinder, as shown, removing any sharp, rough edges which might otherwise injure the gasket.

Insert the Push On Gasket into the bell socket, large or bulb end of the gasket entering first. A small loop or V-shaped fold in the gasket will facilitate its entry. Check that the heel of the gasket is uniformly seated and does not protrude above the bell throat into the pipe way. A thin film of lubricant should be applied to the inside surface of the gasket which will come in contact with the plain end of the pipe. The plain end of the pipe must be cleaned of all foreign matter on the outside from the end to the stripes. Frozen materials may cling to the pipe in cold weather and must be removed. Apply a thin film of lubricant to the outside of the plain end for about 75mm back from the end. Do not allow the plain end to touch the ground or trench side after lubricating since foreign matter may adhere to the lubricant and cause a leak. Lubricant other than that furnished with the pipe should not be used.

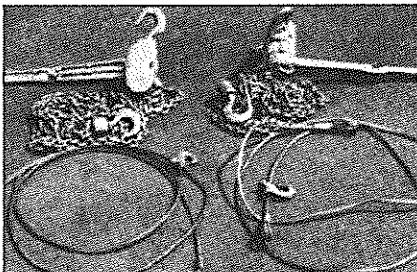


The fitting and the pipe must be aligned and the spigot entered into the socket until it just makes contact with the gasket. This is the starting position for the assembly of the joint. Joint assembly should then be continued by forcing the spigot of the entering pipe past the gasket (which is thereby compressed) until the first painted stripe has disappeared into the socket and the front edge of the second stripe is approximately flush with the bell face. If the assembly is not accomplished with the application of reasonable force, the plain end of the pipe should be removed to check for the proper positioning of the gasket. Keep the joint in alignment during assembly.

Photographs 1 through 5 show assembly tools and a method of assembling 350 - 1600mm fittings. These assembly tools and method of assembly may also be used for sizes smaller than 350mm.

Some installers may prefer assembling Push On Fittings with a backhoe. If this is done, care should be taken not to damage the gasket, pipe or fitting. A timber between the backhoe bucket and the fitting will help to prevent such damage.

PHOTO 1.

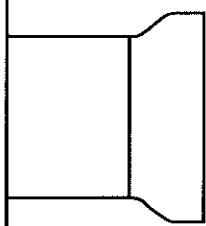


Tools needed for assembly of 350 - 1600mm Push On Fittings: Two (2) 1 1/2 ton chain hoists with 8 meters of chain, two (2) bell choker slings of the size indicated below.

Size	Bell Choker Sling
350 thru 500	8mm by 2m long
600 thru 800	10mm by 3m long
900, 1000	10mm by 4m long
1200	10mm by 4.5m long
1400	10mm by 5.5m long
1500 *	15mm by 5.7m long
1600 *	15mm by 6m long

*These sizes may require the use of 3 chain hoists and choker sling units. Dimensions in millimeters.

NOTE: Care must be taken not to damage products furnished with polyethylene encasement.



INTERNATIONAL

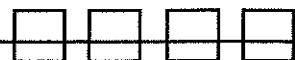
METRIC Pipe & Fittings

DUCTILE IRON



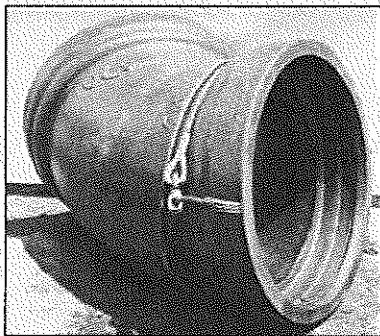
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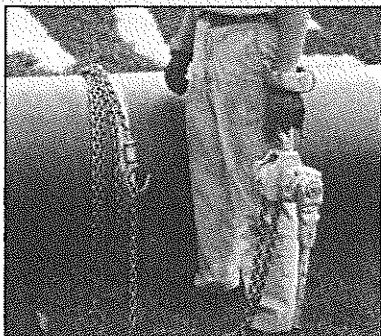
Push On Fittings (cont.)

PHOTO 2.



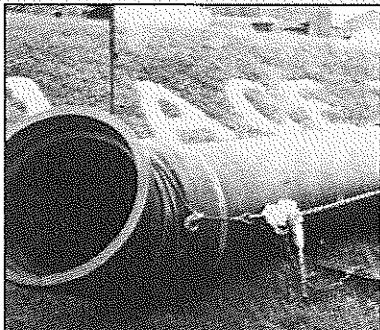
Place the two bell choker slings behind the bell with the free ends located on the horizontal centerlines on opposite sides of the bell with the loose ends projecting in front of the bell face.

PHOTO 3.



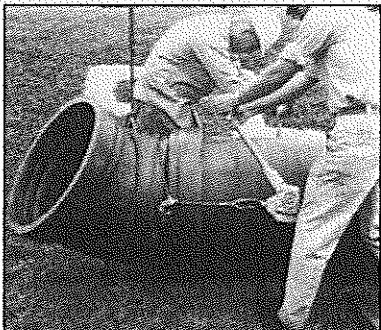
Double-wrap the chains of the two 1-1/2 ton chain hoists around the spigot end approximately two meters from the spigot end. Position the hooks of the chain hoists on the horizontal centerlines on opposite sides of the spigot.

PHOTO 4.



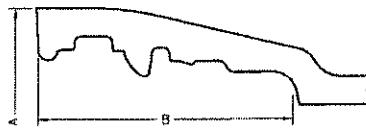
Attach the hook of each chain hoist into the eye of the respective cables.

PHOTO 5.



Assemble the joint by pulling evenly with both chain hoists, keeping the pipe in alignment.

Push On Typical Fitting Bell Dimensions



SIZES 100 mm through 1 600 mm

Nominal Diameter (DN)	A	B
100	163	88
150	217	94
200	278	100
250	336	105
300	393	110
350	448	113
400	500	116
450	540	120
500	604	120
600	713	120
700	824	150
800	943	160
900	1052	175
1000	1158	185
1200	1377	215
1400	1610	239
1600	1850	262

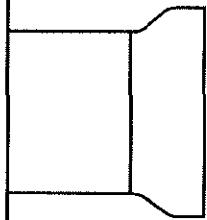
Dimensions in millimeters

Lengths and Tolerances: Fittings

Fittings were designed using the performance requirements of ISO 2531 as the minimal requirements.

Nominal laying lengths of fittings are given in the fitting tables.

NOTE: Actual bell configurations may vary from illustration shown.



INTERNATIONAL

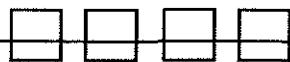
METRIC Pipe & Fittings

DUCTILE IRON

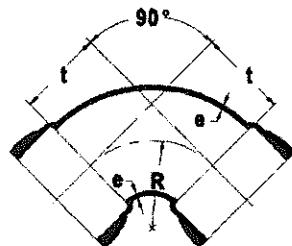
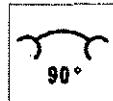


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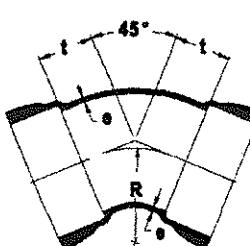
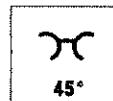


Push On Joint Fittings — 90° and 45° Bends



90° Bend

DN	e	t	Mass
100	7,2	120	11,4
150	7,8	170	20,5
200	8,4	220	33
250	9	270	48,5
300	9,6	320	68
350	10,2	370	97,5
400	10,8	420	124
450	11,4	470	156
500	12	520	193
600	13,2	620	280
700	14,4	720	455
800	15,6	820	605
900	16,8	920	813
1000	18	1020	1045
1200	20,4	1220	1663
1400	22,8	1220	1949
1500	24	1270	2276
1600	25,2	1290	2626



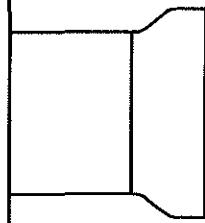
45° Bend

DN	e	t	Mass
100	7,2	65	10,1
150	7,8	85	17,4
200	8,4	110	27
250	9	130	38,5
300	9,6	150	53
350	10,2	175	70
400	10,8	195	89
450	11,4	220	117
500	12	240	139
600	13,2	285	202
700	14,4	330	282
800	15,6	370	378
900	16,8	415	496
1000	18	460	635
1200	20,4	550	986
1400	22,8	515	1273
1500	24	540	2025
1600	25,2	565	1740

Dimensions in millimeters.

Masses in kilograms.

866.DIP.PIPE



INTERNATIONAL

METRIC Pipe & Fittings

DUCTILE IRON



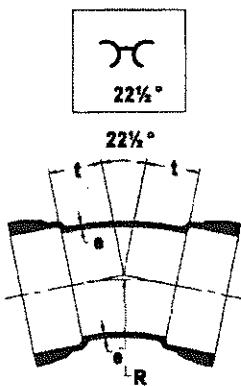
DUCTILE IRON

2010 EDITION

P 30

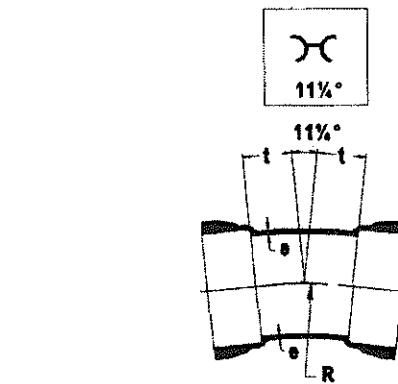


Push On Joint Fittings — 22½° and 11¼° Bends



22 1/2° Bend

DN	ϵ	t	Mass
100	7,2	40	9,3
150	7,8	55	15,9
200	8,4	65	24
250	9	75	33,5
300	9,6	85	44,5
350	10,2	95	58
400	10,8	110	74
450	11,4	120	95
500	12	130	111
600	13,2	150	157
700	14,4	175	217
800	15,6	195	287
900	16,8	220	373
1000	18	240	470
1200	20,4	285	716
1400	22,8	260	933
1500	24	270	1627
1600	25,2	280	1659

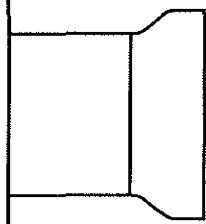


11 1/4° Bend

DN	ϵ	t	Mass
100	7,2	30	8,9
150	7,8	35	14,8
200	8,4	40	22
250	9	50	30,5
300	9,6	55	40,5
350	10,2	60	52
400	10,8	65	65
450	11,4	70	84
500	12	75	96
600	13,2	85	134
700	14,4	95	181
800	15,6	110	239
900	16,8	120	305
1000	18	130	381
1200	20,4	150	568
1400	22,8	130	747
1500	24	140	1204
1600	25,2	140	1007

Dimensions in millimeters.

Masses in kilograms.



INTERNATIONAL

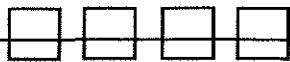
METRIC Pipe & Fittings

DUCTILE IRON

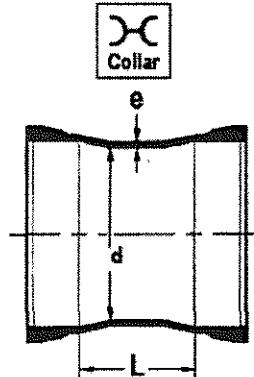
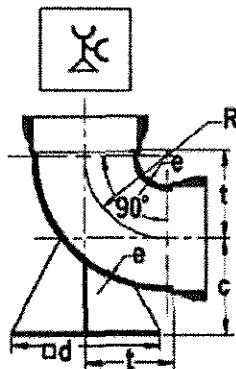


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Push On Joint Fittings — Duckfoot 90° Bend and Collar



Duckfoot 90°

DN	e	t	R	c	d	Mass
100	7,2	120	950	125	200	14,8
150	7,8	170	145	160	250	28,5
200	8,4	220	195	190	300	44,5
250	9,0	270	245	225	350	68,5
300	9,6	320	290	225	400	100,0
350	10,2	370	340	290	450	133,0
400	10,8	420	390	320	500	180,0
450	11,4	470	435	355	550	230,0
500	12,0	520	485	385	600	294,0
600	13,2	620	580	450	700	442,0
700	14,4	720	655	515	800	618,0
800	15,6	820	745	580	900	832,0
900	16,8	920	855	645	1000	1113,0
1000	18,0	1020	945	710	1100	1435,0
1200	20,4	1220	1155	840	1300	2153,0

Dimensions in millimeters.

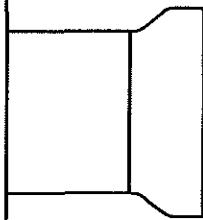
Masses in kilograms.

Collar

DN	e	L	d	Mass
100	7,2	160	130	9,9
150	7,8	165	183	15,9
200	8,4	170	235	23
250	9	175	288	31,5
300	9,6	180	340	41
350	10,2	185	393	52
400	10,8	190	445	64
450	11,4	195	498	80
500	12	200	550	93
600	13,2	210	655	129
700	14,4	220	760	172
800	15,6	230	865	223
900	16,8	240	970	282
1000	18	250	1075	349
1200	20,4	270	1285	560
1400	22,8	340	1492	816
1500	24	350	1596	829
1600	25,2	360	1699	1094

Dimensions in millimeters.

Masses in kilograms.

866.DIP.PIPE

INTERNATIONAL

METRIC Pipe & Fittings

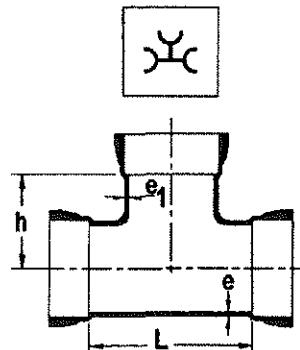
DUCTILE IRON



2010 EDITION

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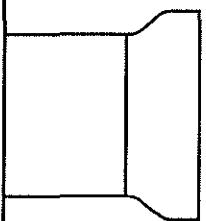
Push On Joint Fittings — All Socket Tee



DN x dn	e	L	e ₁	h	Mass
100 x 80	7,2	170	7,0	95	14,8
100 x 100	7,2	190	7,2	95	16,1
150 x 80	7,8	170	7,0	120	21,5
150 x 100	7,8	195	7,2	120	23,5
150 x 150	7,8	255	7,8	125	28,0
200 x 80	8,4	175	7,0	145	30,0
200 x 100	8,4	200	7,2	145	32,0
200 x 150	8,4	255	7,8	150	37,0
200 x 200	8,4	315	8,4	155	43,0
250 x 80	9,0	200	7,0	210	40
250 x 100	9,0	200	7,2	215	47,5
250 x 150	9,0	255	7,8	220	59,0
250 x 200	9,0	315	8,4	225	63,5
250 x 250	9,0	375	9,0	230	71,5
300 x 100	9,6	205	7,2	235	54,5
300 x 150	9,6	260	7,8	240	68,0
300 x 200	9,6	320	8,4	245	72,0
300 x 250	9,6	375	9,0	250	79,9
300 x 300	9,6	435	9,6	260	90,5
350 x 100	10,2	205	7,2	260	70,5
350 x 150	10,2	260	7,8	265	86,5
350 x 200	10,2	325	8,4	270	90,5
350 x 250	10,2	375	9,0	275	96,9
350 x 300	10,2	435	9,6	285	111,0
350 x 350	10,2	495	10,2	290	124

DN x dn	e	L	e ₁	h	Mass
400 x 100	10,8	210	7,2	285	83,0
400 x 150	10,8	265	7,8	290	101
400 x 200	10,8	325	8,4	295	105
400 x 250	10,8	375	9,0	300	116
400 x 300	10,8	435	9,6	310	127
400 x 350	10,8	495	10,2	315	137
400 x 400	10,8	560	10,8	320	155
450 x 100	11,4	215	7,2	320	106
450 x 150	11,4	270	7,8	320	117
450 x 200	11,4	325	8,4	320	121
450 x 250	11,4	375	9,0	325	138
450 x 300	11,4	445	9,6	335	146
450 x 350	11,4	495	10,2	340	161
450 x 400	11,4	560	10,8	345	175
450 x 450	11,4	620	11,4	350	190
500 x 100	12,0	215	7,2	345	115
500 x 150	12,0	275	7,8	345	135
500 x 200	12,0	330	8,4	345	139
500 x 250	12,0	380	9,0	350	161
500 x 300	12,0	450	9,6	360	167
500 x 350	12,0	500	10,2	365	187
500 x 400	12,0	565	10,8	370	198
500 x 450	12,0	620	11,4	375	214
500 x 500	12,0	680	12,0	380	231

Dimensions in millimeters.
Masses in kilograms.



INTERNATIONAL

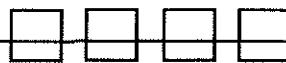
METRIC Pipe & Fittings

DUCTILE IRON

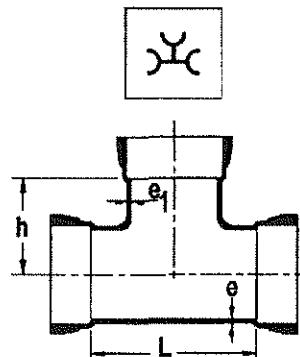


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Push On Joint Fittings — All Socket Tee (cont.)

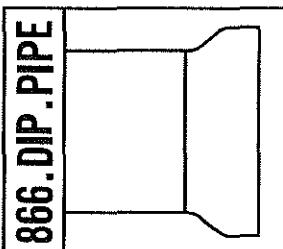


DN x dn	e	L	e ₁	h	Mass
600 x 100	13,2	220	7,2	395	169
600 x 150	13,2	285	7,8	395	175
600 x 200	13,2	340	8,4	395	178
600 x 250	13,2	380	9,0	400	205
600 x 300	13,2	455	9,6	410	211
600 x 350	13,2	500	10,2	415	246
600 x 400	13,2	570	10,8	420	248
600 x 450	13,2	620	11,4	425	280
600 x 500	13,2	685	12,0	430	296
600 x 600	13,2	800	13,2	440	326
700 x 100	14,4	345	7,2	445	224
700 x 150	14,4	395	7,8	445	241
700 x 200	14,4	345	8,4	445	289
700 x 300	14,4	575	9,6	460	326
700 x 400	14,4	575	10,8	470	361
700 x 500	14,4	810	12,0	480	380
700 x 600	14,4	810	13,2	490	461
700 x 700	14,4	925	14,4	500	536
800 x 100	15,6	350	7,2	495	287
800 x 150	15,6	350	7,8	495	307
800 x 200	15,6	350	8,4	495	353
800 x 300	15,6	580	9,6	510	399
800 x 400	15,6	580	10,8	520	439
800 x 500	15,6	815	12,0	530	472
800 x 600	15,6	815	13,2	540	629

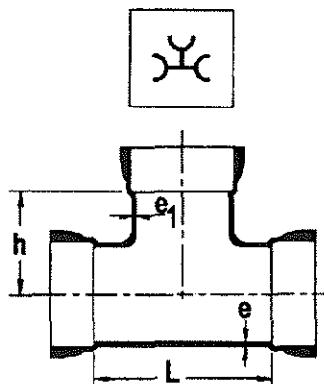
DN x dn	e	L	e ₁	h	Mass
800 x 700	15,6	1045	14,4	550	586
800 x 800	15,6	1045	15,6	560	701
900 x 100	16,8	355	7,2	545	360
900 x 150	16,8	355	7,8	545	386
900 x 200	16,8	355	8,4	545	458
900 x 300	16,8	590	9,6	570	462
900 x 400	16,8	590	10,8	570	556
900 x 500	16,8	820	12,0	590	574
900 x 600	16,8	820	13,2	590	833
900 x 700	16,8	1050	14,4	615	878
900 x 800	16,8	1050	15,6	615	903
900 x 900	16,8	1170	16,8	625	944
1000 x 100	18,0	360	7,2	595	443
1000 x 150	18,0	360	7,8	595	474
1000 x 200	18,0	360	8,4	595	557
1000 x 300	18,0	595	9,6	620	564
1000 x 400	18,0	595	10,8	620	672
1000 x 500	18,0	830	12,0	640	690
1000 x 600	18,0	830	13,2	640	1008
1000 x 700	18,0	1055	14,4	665	1081
1000 x 800	18,0	1055	15,6	665	1129
1000 x 900	18,0	1290	16,8	685	1150
1000 x 1000	18,0	1290	18,0	685	1209

Dimensions in millimeters.

Masses in kilograms.



Push On Joint Fittings — All Socket Tee (cont.)

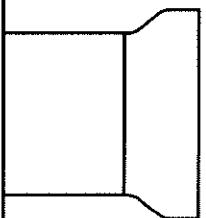


DN x dn	e	L	e ₁	h	Mass
1200 x 100	20,4	375	7,0	700	648
1200 x 150	20,4	375	7,8	700	685
1200 x 200	20,4	375	8,4	700	725
1200 x 300	20,4	605	9,6	720	816
1200 x 400	20,4	605	10,8	720	978
1200 x 500	20,4	840	12,0	740	1095
1200 x 600	20,4	840	13,2	740	1139
1200 x 700	20,4	1070	14,4	765	1390
1200 x 800	20,4	1070	15,6	765	1449
1200 x 900	20,4	1300	16,8	785	1596
1200 x 1000	20,4	1300	18,0	785	1657
1200 x 1200	20,4	1535	20,4	805	1900
1400 x 100	22,8	385	7,2	820	790
1400 x 200	22,8	385	8,4	820	890
1400 x 400	22,8	800	10,8	820	890
1400 x 600	22,8	1030	13,2	840	1096
1400 x 800	22,8	1260	15,6	865	1340
1400 x 1000	22,8	1495	18,0	885	1527
1400 x 1200	22,8	1725	20,4	905	1774
1400 x 1400	22,8	1960	22,8	930	2049

DN x dn	e	L	e ₁	h	Mass
1600 x 100	25,2	400	7,2	920	2323
1600 x 200	25,2	400	8,4	920	-
1600 x 400	25,2	810	10,8	920	-
1600 x 600	25,2	1040	13,2	940	-
1600 x 800	25,2	1275	15,6	965	-
1600 x 1000	25,2	1505	18,0	985	-
1600 x 1200	25,2	1740	20,4	1010	-
1600 x 1400	25,2	1970	22,8	1030	-
1600 x 1600	25,2	2200	25,2	1050	-

Dimensions in millimeters.
Masses in kilograms.

866.DIP.PIPE



INTERNATIONAL

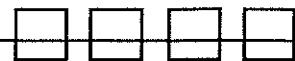
METRIC Pipe & Fittings

DUCTILE IRON

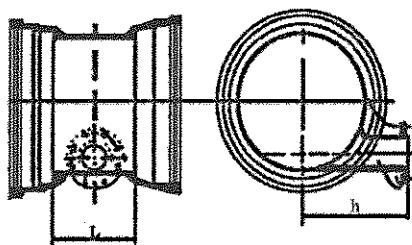


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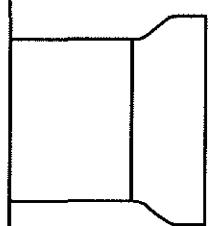


Push On Joint Fittings — Double Socket Level Invert Tees with Flanged Branch



DN x dN	L	h	Mass		
			PN10	PN16	PN25
200 x 80	245	250	39,5	39,5	39,5
250 x 80	250	275	49,5	49,5	49,5
300 x 80	255	300	62,0	62,0	62,0
350 x 100	280	325	83,0	83,0	83,5
400 x 100	280	350	97,5	97,5	98,0
450 x 100	285	375	115	115	116
500 x 100	290	400	134	134	134
600 x 100	295	450	173	173	173
700 x 150	360	500	-	296	-
800 x 150	365	550	-	360	-
900 x 150	370	600	-	467	-
1000 x 200	435	650	-	569	-
1200 x 200	445	750	-	840	-
1400 x 200	460	850	-	-	-
1500 x 200	465	900	-	-	-
1600 x 400	700	950	-	-	-

Dimensions in millimeters.
Masses in kilograms.

866.DIP.PIPE

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DUCTILE IRON

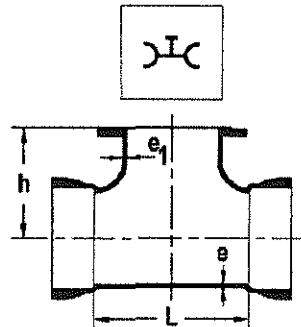


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Push On Joint Fittings — Socket Body with Flanged Tee

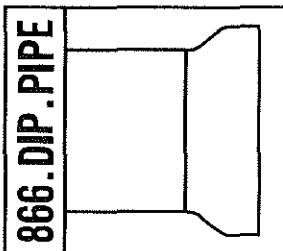


DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
100 x 80	7,2	170	7,0	175	15,8	15,8	15,8
100 x 100	7,2	190	7,2	180	17,2	17,2	17,7
150 x 80	7,8	170	7,0	205	23,0	23,0	23,0
150 x 100	7,8	195	7,2	210	24,5	24,5	25,0
150 x 150	7,8	255	7,8	220	29,5	29,5	30,5
200 x 80	8,4	175	7,0	235	31,5	31,5	31,5
200 x 100	8,4	200	7,2	240	33,5	33,5	34
200 x 150	8,4	255	7,8	250	39,0	39,0	40,0
200 x 200	8,4	315	8,4	260	45,6	46,0	47,5
250 x 80	9,0	200	7,0	270	47,0	47,0	47,0
250 x 100	9,0	200	7,2	270	43,5	43,5	44,0
250 x 150	9,0	255	7,8	280	59,0	59,0	60,0
250 x 200	9,0	315	8,4	290	57,0	57,0	59,0
250 x 250	9,0	375	9,0	300	65,0	66,0	69,0
300 x 100	9,6	205	7,2	300	55,0	55,0	55,5
300 x 150	9,6	260	7,8	310	68,5	68,5	69,5
300 x 200	9,6	320	8,4	320	71,0	70,0	73,0
300 x 250	9,6	375	9,0	330	83,0	81,0	85,0
300 x 200	9,6	435	9,6	340	89,0	91,0	95,0
350 x 100	10,2	205	7,2	330	68,0	68,0	68,0
350 x 150	10,2	260	7,8	340	87,5	87,5	88,5
350 x 200	10,2	325	8,4	350	86,0	86,0	88,0
350 x 250	10,2	375	9,0	360	103	114	125
350 x 300	10,2	435	9,6	370	113	113	118
350 x 350	10,2	495	10,2	380	117	120	129

DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
400 x 100	10,8	210	7,2	360	83,0	83,0	83,0
400 x 150	10,8	265	7,8	370	102	102	103
400 x 200	10,8	325	8,4	380	103	102	104
400 x 250	10,8	375	9,0	390	119	118	122
400 x 300	10,8	435	9,6	400	129	129	134
400 x 350	10,8	495	10,2	410	143	146	153
400 x 400	10,8	560	10,8	420	150	156	167
450 x 100	11,4	215	7,2	395	98,5	98,5	99,0
450 x 150	11,4	270	7,8	400	119	119	119
450 x 200	11,4	325	8,4	410	122	122	122
450 x 250	11,4	375	9,0	420	141	140	140
450 x 300	11,4	455	9,6	430	149	149	149
450 x 350	11,4	495	10,2	440	166	169	169
450 x 400	11,4	560	10,8	450	177	181	181
450 x 450	11,4	620	11,4	460	192	200	200
500 x 100	12,0	215	7,2	420	116	116	116
500 x 150	12,0	275	7,8	430	137	137	137
500 x 200	12,0	330	8,4	440	142	141	143
500 x 250	12,0	380	9,0	450	165	165	169
500 x 300	12,0	450	9,6	460	171	171	176
500 x 350	12,0	500	10,2	470	192	195	203
500 x 400	12,0	565	10,8	480	199	205	216
500 x 450	12,0	620	11,4	490	220	228	244
500 x 500	12,0	680	12,0	500	232	247	259

Dimensions in millimeters.

Masses in kilograms.



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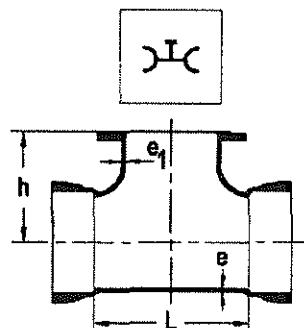
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Push On Joint Fittings — Socket Body with Flanged Tee (cont.)

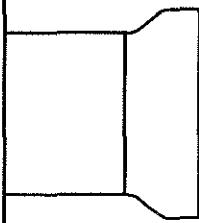


DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
600 x 100	13,2	220	7,2	480	146	146	147
600 x 150	13,2	285	7,8	490	177	177	178
600 x 200	13,2	340	8,4	500	189	189	191
600 x 250	13,2	380	9,0	510	219	218	222
600 x 300	13,2	455	9,6	520	216	216	221
600 x 350	13,2	500	10,2	530	252	255	263
600 x 400	13,2	570	10,8	540	258	263	274
600 x 450	13,2	620	11,4	550	285	293	309
600 x 500	13,2	685	12,0	560	304	309	331
600 x 600	13,2	800	13,2	580	340	366	380
700 x 100	14,4	345	7,2	510	242	242	243
700 x 150	14,4	345	7,8	520	246	246	247
700 x 200	14,4	345	8,4	525	249	249	251
700 x 300	14,4	575	9,6	540	300	300	306
700 x 400	14,4	575	10,8	555	320	325	344
700 x 500	14,4	810	12,0	570	391	406	418
700 x 600	14,4	810	13,2	585	421	445	456
700 x 700	14,4	925	14,5	600	460	475	525

Dimensions in millimeters.

Masses in kilograms.

DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
800 x 100	15,6	350	7,2	570	304	304	305
800 x 150	15,6	350	7,8	580	308	308	309
800 x 200	15,6	350	8,4	585	311	311	313
800 x 300	15,6	580	9,6	600	371	371	377
800 x 400	15,6	580	10,8	615	398	403	421
800 x 500	15,6	815	12,0	630	522	537	549
800 x 600	15,6	815	13,2	645	579	605	624
800 x 700	15,6	1045	14,4	660	620	635	669
800 x 800	15,6	1045	15,6	675	623	642	708
900 x 100	16,8	355	7,2	630	378	378	378
900 x 150	16,8	355	7,8	640	381	381	382
900 x 200	16,8	355	8,4	645	384	384	386
900 x 300	16,8	590	9,6	660	455	455	461
900 x 400	16,8	590	10,8	675	490	495	513
900 x 500	16,8	820	12,0	690	666	681	693
900 x 600	16,8	820	13,2	705	748	774	794
900 x 700	16,8	1050	14,4	720	788	803	837
900 x 800	16,8	1050	15,6	735	808	823	876
900 x 900	16,8	1170	16,8	750	835	854	920



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DUCTILE IRON

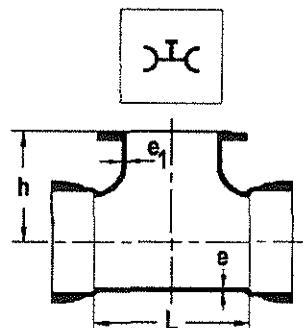


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Push On Joint Fittings — Socket Body with Flanged Tee (cont.)



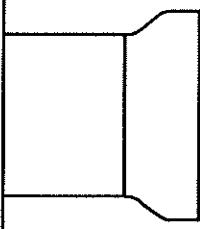
DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
1000 x 100	18,0	360	7,2	690	461	461	462
1000 x 150	18,0	360	7,8	700	464	464	465
1000 x 200	18,0	360	8,4	705	467	467	469
1000 x 300	18,0	595	9,6	720	552	552	558
1000 x 400	18,0	595	10,8	735	591	596	614
1000 x 500	18,0	830	12,0	750	852	867	879
1000 x 600	18,0	830	13,2	765	947	973	994
1000 x 700	18,0	1055	14,4	780	985	1000	1032
1000 x 800	18,0	1055	15,6	795	1006	1021	1074
1000 x 900	18,0	1290	16,8	810	1062	1076	1137
1000 x 1000	18,0	1290	18,0	825	1044	1086	1192
1200 x 100	20,4	375	7,0	810	676	676	676
1200 x 150	20,4	375	7,8	820	678	678	678
1200 x 200	20,4	375	8,4	825	682	682	684
1200 x 300	20,4	605	9,6	840	769	769	775
1200 x 400	20,4	605	10,8	855	855	856	867
1200 x 500	20,4	840	12,0	870	968	973	995
1200 x 600	20,4	840	13,2	885	1000	1027	1067
1200 x 700	20,4	1070	14,4	900	1169	1184	1218
1200 x 800	20,4	1070	15,6	915	1190	1210	1295
1200 x 900	20,4	1300	16,8	930	1367	1427	1452
1200 x 1000	20,4	1300	18,0	945	1406	1448	1556
1200 x 1200	20,4	1535	20,4	975	1682	1736	1846

Dimensions in millimeters.

Masses in kilograms.

DN x dn	e	L	e ₁	h	Mass		
					PN10	PN16	PN25
1400 x 100	22,8	385	7,2	910	1120	1120	1120
1400 x 200	22,8	385	8,4	920	1189	1189	1189
1400 x 400	22,8	800	10,8	950	1357	1368	1374
1400 x 600	22,8	1030	13,2	980	1478	1505	1519
1400 x 800	22,8	1260	15,6	1010	1709	1728	1777
1400 x 1000	22,8	1495	18,0	1040	1955	1996	2075
1400 x 1200	22,8	1725	20,4	1070	2375	2439	2539
1400 x 1400	22,8	1960	22,8	1100	2697	2765	2917
1600 x 100	25,2	400	7,2	1020	1261	1261	1261
1600 x 200	25,2	400	8,4	1030	1361	1361	1361
1600 x 400	25,2	810	10,8	1060	1561	1565	1576
1600 x 600	25,2	1040	13,2	1090	1908	1934	1942
1600 x 800	25,2	1275	15,6	1120	2192	2211	2264
1600 x 1000	25,2	1505	18,0	1150	2480	2522	2607
1600 x 1200	25,2	1740	20,4	1180	2799	2863	2962
1600 x 1400	25,2	1970	22,8	1210	3129	3186	3349
1600 x 1600	25,2	2200	25,2	1240	3517	4607	4792

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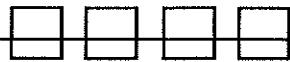
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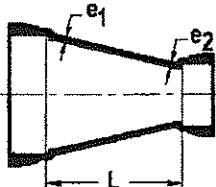


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Push On Joint Fittings — Double Socket Taper

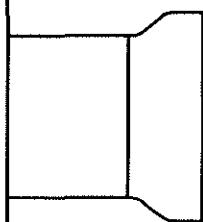


DN x dn	e ₁	e ₂	L	Mass T
100 x 80	7,2	7,0	90	8,5
150 x 80	7,8	7,0	190	13,5
150 x 100	7,8	7,2	150	13,8
200 x 100	8,4	7,2	250	20,5
200 x 150	8,4	7,8	150	21,0
250 x 150	9,0	7,8	250	29,0
250 x 200	9,0	8,4	150	29,0
300 x 150	9,6	7,8	350	39,5
300 x 200	9,6	8,4	250	39,5
300 x 250	9,6	9,0	150	38,0
350 x 200	10,2	8,4	360	52,0
350 x 250	10,2	9,0	260	51,0
350 x 300	10,2	9,6	160	49,5
400 x 250	10,8	9,0	360	66,0
400 x 300	10,8	9,6	260	64,0
400 x 350	10,8	10,2	160	62,0

Dimensions in millimeters.
Masses in kilograms.

DN x dn	e ₁	e ₂	L	Mass T
450 x 350	11,4	10,2	260	69,5
450 x 400	11,4	10,8	160	66,0
500 x 350	12,0	10,2	360	98,0
500 x 400	12,0	10,8	260	94,0
600 x 400	13,2	10,8	460	14,2
600 x 500	13,2	12,0	260	131
700 x 500	14,4	12,0	480	194
700 x 600	14,4	13,2	280	178
800 x 600	15,6	13,2	480	252
800 x 700	15,6	14,4	280	229
900 x 700	16,8	14,4	480	318
900 x 800	16,8	15,6	280	288
1000 x 800	18,0	15,6	480	392
1000 x 900	18,0	16,8	280	354
1200 x 1000	20,4	18,0	480	570
1400 x 1200	22,8	20,4	360	711
1500 x 1400	24,0	22,8	260	-
1600 x 1400	25,2	22,8	360	951

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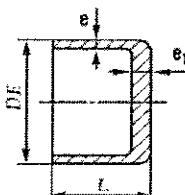
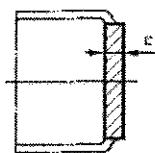


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Push On Joint Fittings — Caps and Plugs



CAPS

DN	e	Mass
100	18,0	8,5
150	18,0	14,1
200	18,0	19,8
250	19,5	27,4
300	23,0	42,8
350	24,0	61,7
400	25,0	76,3
450	26,0	93,7
500	27,0	107
600	29,5	132
700	31,0	202
800	33,0	275
900	35,0	-
1000	37,0	353
1100	39,0	454
1200	41,0	813
1400	43,0	1018

Dimensions in millimeters.
Masses in kilograms.

PLUGS

DN	DE	e	e ₁	L	Mass
100	118	18,0	7,2	200	4,5
150	170	18,0	7,8	225	4,5
200	222	18,0	8,4	250	14,8
250	274	19,5	9,0	250	21,5
300	326	23,0	9,6	275	33,5
350	378	24,0	10,2	275	45,5
400	429	25,0	10,8	275	56,0
450	480	26,0	11,4	275	68,5
500	532	27,0	12,0	275	81,0
600	635	29,5	13,2	300	112
700	738	31,0	14,4	300	193
800	842	33,0	15,6	300	259
900	945	35,0	16,8	350	337
1000	1048	37,0	18,0	350	437
1200	1255	41,0	20,4	350	783
1400	1462	43,0	22,4	350	1078

Dimensions in millimeters.
Masses in kilograms.

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SADDLE OUTLETS

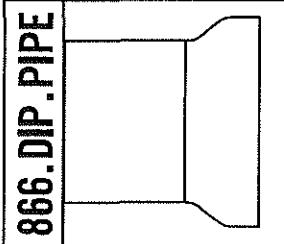
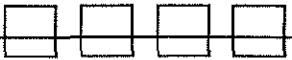
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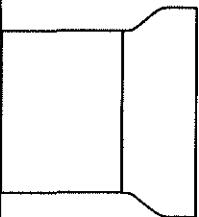
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Assembly Instructions	5
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Products for Water, Wastewater, and Fire Protection	7

866.DIP.PIPE



SADDLE OUTLETS



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Saddle Outlets

Purpose and Use

U.S. Pipe's saddle outlets should be considered and specified as an economical and readily available alternative of 250 psi rated tees and tapping sleeves where branch outlets (4", 6", 8" and 12") are required on pipe 16"-64" in diameter. Saddles are recommended for use on Ductile Iron mains for pressure connections (wet taps). Also saddle outlets are recommended for branch connections: tees, blowoffs, or devices such as air release valves, etc.

All saddles are rated for 250 psi operating pressure. Saddles are provided with a boss which can be tapped for a 3/8" test plug.

Product Data

The saddle outlet body is made of Ductile Iron. Corrosion resistant straps and nuts are made of the same corrosion resistant, high strength, low alloy steel used in mechanical joint bolts and nuts. Pressure rating for the assembled saddle is 250 psi. 316 Stainless Steel Straps are available by special order.

Types of Saddles

The counterbore dimensions conform to MSS SP-60 Connecting Flanged Joint Between Tapping Sleeves and Tapping Valves. The counterbore mates with the projecting lip on the inside of the flanged end of a tapping valve and ensures concentricity of the saddle/valve assembly and proper alignment for the shell cutter of the tapping machine.

The presence of the counterbore on the flange does not affect the pressure rating and does not prevent or interfere with the connection of any device such as a fitting, air release valve, ASME/ANSI B 16.1 Class 125, or B 16.5 Class 150 flanges, etc. Rubber ring gaskets at least 1/8" thick should be used with all flanged joints. U.S. Pipe's FLANGE-TYTE® Gasket is recommended and will be included with the saddle.

ANSI/AWWA Standard C151/A21.51 Ductile Iron Pipe, Centrifugally Cast, for Water.

Saddles are available in the sizes listed in the table on Page 6. Saddles are contoured to fit all sizes of Ductile Iron pipe shown in the table on Page 6, and with all pipe having diameters as shown in ANSI/AWWA C151/A21.51.

ANSI/AWWA Standard C111/A21.11 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

The O-ring type sealing gasket is SBR rubber conforming to the material requirements of ANSI/AWWA Standard C111/A21.11.

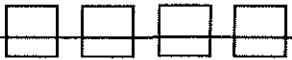
ANSI/AWWA Standard C110/A21.10 Ductile Iron and Gray Iron Fittings for Water Flanges.

Flanged Saddle Outlets (tapping saddles) are made with ANSI/AWWA Standard C110/A21.10 which are counterbored for use with tapping valves.

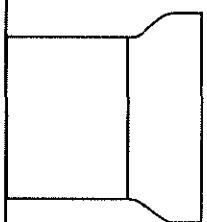
ASTM A536 "Standard Specification for Ductile Iron Castings."

NOTE: If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA Standard C105/A21.5 Polyethylene Encasement for Ductile Iron Pipe Systems for proper protection procedures.

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SADDLE OUTLETS



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Application

For branch outlets (tee connections) in new construction, saddle outlets may be used and should be considered for use in place of tee fittings or welded-on bosses. The saddle outlet may be placed anywhere on the pipe barrel to suit the plan, thus eliminating the need to cut the pipe to accommodate the precise location requirements of a fitting. Flanged saddle outlets are suggested if a valve is to be attached to the saddle. Branch lines can be laid from the valve after the main is pressurized and operational. Also, flanged saddle outlets are recommended for the attachment of devices such as air release valves, blowoffs, etc.

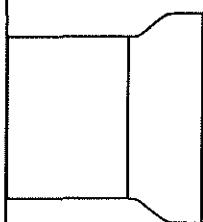
Normally, saddle outlets are installed on pipe having a prepared, pre-cut hole. These "dry taps" can be made anytime before the pipe is filled with water. Pipe with shop-cut holes can be ordered from the factory (specify distance from centerline of hole to the face of the pipe bell and the diameter of the hole).

For flanged outlets, dry taps can be made in the pipe with the use of a standard tapping machine. Connect the tapping machine with the appropriate adapter directly to a flanged saddle outlet and cut the hole or tap through a tapping valve connected to the flanged saddle outlet.

Flanged saddle outlets are frequently used in wet taps or "pressure connections". In these cases the flanged tapping valve is mounted onto the saddle outlet and a special flange gasket is used.

A tapping machine with an appropriate adapter is then connected to the valve. The tapping machine shell cutter removes a coupon from the pipe wall which is then withdrawn and the valve is closed. This kind of tap is made without interruption of service and can be made on Ductile Iron pipe. The use of a flanged tapping saddle, tapping valve, and tapping machine to make the "pressure connection" is a safe, reliable and economical way to connect new pipe to an existing Ductile Iron pipe main.

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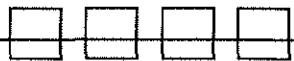


SADDLE OUTLETS



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Assembly Instructions

1. Thoroughly clean the pipe barrel in the area to come into contact with the straps, saddle outlet, and O-ring.
2. Use a grinder, if necessary, to remove any roughness from the pipe at the saddle outlet O-ring sealing area.
3. Insert the O-ring gasket into the groove on the underside of the saddle outlet.
4. Place the saddle onto the pipe and attach the straps.
5. Position the saddle over the pre-cut outlet hole or where the hole is to be cut with the tapping machine.
6. Alternatively tighten the strap nut nuts until a uniform torque of 100 foot-pounds is attained.
7. If a dry tap is to be made, attach the tapping machine to the outlet and proceed with the tap. The gasket mentioned in Item 8 (below) is not required.
8. If a wet tap is to be made, place the special tapping valve flange gasket provided with the tapping valve onto the flange of the saddle. Attach the tapping valve to the saddle outlet, then attach the tapping machine and proceed with the tap.

Precautions to Take When Making Taps in Iron Pipe

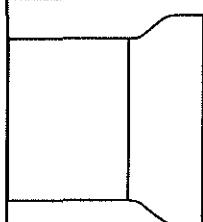
Prior to cutting or tapping a hole in the pipe, it is important to determine the exact outer diameter of the pipe to ensure that the proper size saddle outlet is used and that the pipe diameters conform to those specified in ANSI/AWWA Standard C151/A21.51.

U.S. Pipe does not recommend the use of saddle outlets on gray iron pipe. Extremely old gray iron pipe may have outer diameters larger than pipe produced during the last 30 to 40 years. Standard saddle outlets will not fit such pipe. It is also important to know if the pipe is Ductile Iron or gray iron. Ductile Iron pipe has been produced only since the 1960's.

Dry taps can be made in Ductile Iron pipe by using tapping machines or Oxyarc cutting techniques. After tapping or Oxyarc cutting, the area should be carefully inspected for cracks and, if found, they should be removed by grinding. If the pipe to be tapped has a special external coating or internal lining, care should be taken to ensure that neither the coating nor the lining is damaged in the tapping operation. Cut edges on such coatings or linings need to be recoated to prevent undercutting and disbondment.

Wet taps should not be made in pipe which have special polymer linings since it is not possible to recoat the cut edges after the tap is made. Oxyarc or similar hole cutting methods should not be used on special polymer coated or lined pipe. Such high heat input cutting methods may damage these coatings. Pipe with special lining can be furnished with shop cut holes if ordered.

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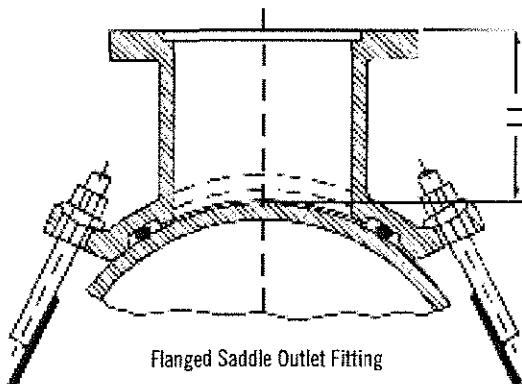
SADDLE OUTLETS



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Saddle Outlet Sizes and Types



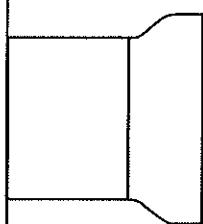
OUTLET SIZE Inches	PIPE SIZE Inches										NUMBER OF STRAPS	WEIGHT* Pounds
	16	20	24	30	36	42	48	54	60	64		
4	6.45LL	6.68LL	6.25LL	6.40LL	6.25LL	6.32LL	—	6.41LL	—	—	3	40
6	6.25LL	6.64LL	6.25LL	6.55LL	6.25LL	6.35LL	6.43LL	6.50LL	—	—	3	55
8	6.25LL	6.87LL	6.25LL	6.61LL	6.25LL	6.40LL	6.51LL	6.60LL	—	—	4	75
12	—	—	6.25LL	6.96LL	6.25LL	6.52LL	6.73LL	6.89LL	7.02LL	7.02LL	7	140

NOTE: LL in the table is the laying length of the fitting.--

*Weights as shown do not include accessories, i.e., straps, gaskets, O-rings and nuts.



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SADDLE OUTLETS



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Pipe	30"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
Grooved Pipe	4"-36" Ductile Iron
USIFLEX® Boltless Ball Joint Pipe For Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Restrained Joint	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
HP LOK® Fittings and HP LOK® Telescoping Sleeves	30"-64" Ductile Iron
Mechanical Joint Fittings	30"-48" Ductile Iron
Flanged Fittings	30"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
GLASS Lined Ductile Iron Pipe for Wastewater Treatment Plants	4"-30" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
MJ Harness-Lok	4"-48" Ductile Iron
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.



*All U.S. Pipe brochures and/or products are
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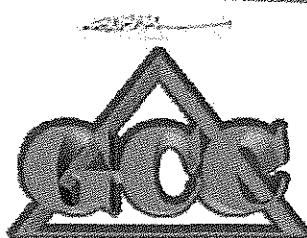
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RESTRAINED JOINT PIPE AND FITTINGS





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100 - 1600 mm

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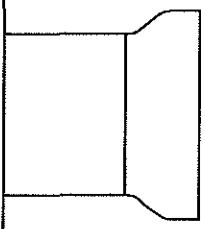


WATER & WASTEWATER

REINFORCED
DUCTILE
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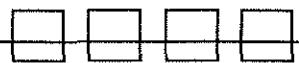
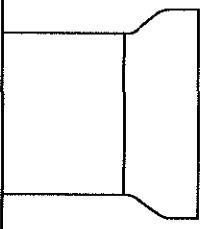


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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS
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Introduction

Based in Birmingham, Alabama, U.S. Pipe and Foundry Company, LLC, is America's leading manufacturer of Ductile Iron pipe, joint restraint products and other products for the water and wastewater industry.

U.S. Pipe operates four manufacturing plants and numerous sales locations throughout the country. These domestic sales offices combined with the International Sales office and their worldwide network of sales associates gives U.S. Pipe one of the broadest domestic and international marketing coverages in the industry.

From its beginning in 1899, U.S. Pipe has consistently lead the industry with innovations and product developments.

Centrifugal casting, pioneered by U.S. Pipe, revolutionized the industry. TYTON JOINT® Pipe, using a single rubber gasket, patented by U.S. Pipe and licensed throughout the world, is the most widely used joint for Ductile Iron pipe today.

The company lineage dates back to 1882, when Colonel James Withers Sloss founded Sloss Furnace Company in Birmingham, Sloss Furnace Company became Sloss Iron and Steel Company. After acquiring Sheffield Iron Company, the Sloss-Sheffield Steel and Iron Company was incorporated in 1899.

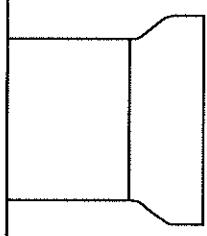
In that same year U.S. Cast Iron Pipe and Foundry Company was incorporated with the consolidation of eleven small cast iron pipe companies located in eight states. Prominent among these was the Bessemer, Alabama plant, one of the three original plants still in operation today.

In 1911, U.S. Pipe purchased the Dimmick Pipe Company, which included a plant in North Birmingham that still operates today.

The name of the company was changed to United States Pipe and Foundry Company in 1929. U.S. Pipe also operates two other pipe plants, one in Burlington, New Jersey, and the other in Union City, California. These plants are located in the northern and western parts of the country to better serve our domestic market.

In 1952, the Sloss-Sheffield Steel and Iron Company was merged into U.S. Pipe, and the General Offices of U.S. Pipe moved from Burlington, New Jersey to Birmingham. The company quickly became a fully integrated producer of cast iron pipe and related products.

While the original plants produced pipe by the so called "pit cast" method, in which molten iron was poured into static, vertical molds lined and cored with sand, today's plants and production bear little resemblance to the old. In 1921, U.S. Pipe revolutionized the production of cast iron pipe when it purchased the rights for the centrifugal casting method, developed by Dimitri Sensaud Delavaud, a French engineer living in Brazil. In this process, the molten iron is poured into a rapidly spinning metal mold. The centrifugal force of the rotating mold distributes the molten iron uniformly around the inner surface of the mold. Upon cooling, extraction and heat treatment, high quality pipe with uniform thickness results.



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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Introduction (cont.)

In the early 1960's, U.S. Pipe perfected the production of Ductile Iron pipe, which is superior to gray iron in strength and durability. U.S. Pipe, since 1977, has used Ductile Iron exclusively for all its pressure pipe and fittings, making the company the first in the industry to do so.

Having produced pipe and fittings in imperial (inch) diameter sizes to ANSI/AWWA standards for a number of years, U.S. Pipe, in the 1970's, increased its production and marketing scope to include metric sized pipe and fittings to International Organization for Standardization (ISO) Standards.

Today U.S. Pipe and Foundry Company, a wholly owned subsidiary of Mueller Water Products, Inc., is the largest domestic producer of Ductile Iron pipe in sizes 4 inch through 64 inch. U.S. Pipe perfected the production of Ductile Iron pipe, which is superior in strength to cast iron, and was the first in the industry to use Ductile Iron exclusively for all its pressure pipe and fittings.

This U.S. Pipe International Sales catalog covers DN 100 - 1600 mm ISO Pipe and Fittings. For information on products of ANSI/AWWA imperial (inch) diameter sizes, please contact your U.S. Pipe Sales Representative.

Ductile Iron pipe and fittings of both ANSI/AWWA inch diameter and ISO metric sizes, and other U.S. Pipe products are sold worldwide. U.S. Pipe products have been shipped to Colombia, Ecuador, Egypt, El Salvador, Jamaica, Kuwait, Nigeria, Oman, Paraguay, The Philippines, Saudi Arabia, Canada, Mexico, Qatar, The United Arab Emirates and many, many other countries around the world. Both abroad and in the United States customers and specifiers alike have come to depend upon products and services from the "new ideas" company to keep their work flowing.

ISO 2531 Ductile iron pipes, fittings, accessories and their joints for water or gas applications

ISO 4179 Ductile iron pipes and fittings for pressure and non-pressure pipelines – Cement mortar lining

ISO 4633 Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for material

ISO 8179-1 Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer

ISO 8179-2 Ductile iron pipes – External zinc coating – Part 2: Zinc rich paint with finishing layer

ISO 8180 Ductile iron pipes – Polyethylene sleeving for site application

ANSI/AWWA C150/A21.50-02 American National Standard for Thickness Design of Ductile-Iron Pipe

ANSI/AWWA C151/A21.51-02 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

ANSI/AWWA C153/A21.53-06 American National Standard for Ductile-Iron Compact Fittings for Water Service

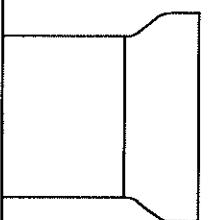
ANSI/AWWA C104/A21.4-03 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

ANSI/AWWA C105/A21.5-05 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems

ANSI/AWWA C111/A21.11-07 American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ANSI/AWWA C110/A21.10-03 American National Standard for Ductile-Iron and Gray-Iron Fittings for Water

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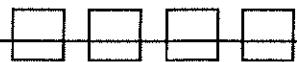
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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General Specifications: Dimensions

The following descriptions of dimensions are in accordance with the requirements of ISO 2531. Variations from the Standard are so noted.

- a. **Thickness** - The standard thicknesses of pipe and fittings are calculated as a function of their nominal diameter by the following formula:

$$e = k (0.5 + 0.001 DN)$$

where

e = Standard wall thickness (mm)

DN = Nominal Diameter (mm)

k = A coefficient selected from a series of whole numbers..8,9,10,11,12...

The external diameter of the pipe, expressed in millimeters is fixed as a function of the nominal diameter and independent of the pipe wall thickness. Increases or decreases in the pipe wall thickness result in change of the internal diameter.

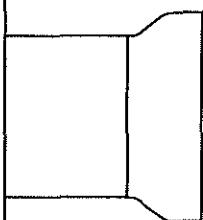
For fittings, both internal and external diameters may be varied to change wall thicknesses. Actual wall thicknesses may be adjusted to accommodate internal stresses for each point of the casting. In bends, for example, the wall thickness at the inner radius may be greater than that at the outer radius. The thickness "e" indicated in each table and on the drawings of the fittings is the mean thickness.

- b. **Thickness Tolerances** - The tolerances on wall thicknesses are as given in Table 1.

Table 1.

Type of Casting	Tolerance Dimensions in Millimeters
Pipe	-(1.3 + 0.001 DN) ¹
Fittings & Accessories	-(2.3 + 0.001 DN) ¹

¹ No Limit for the plus tolerance has been set



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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General Specifications: Dimensions (cont.)

- c. **Lengths and Tolerances: Spigot and Socket Pipe** - TR FLEX and HP LOK Pipe are produced to the manufacturing working lengths shown in Table 2.

In accordance with ISO 2531, of the total number of spigot and socket pipe to be supplied in each diameter, up to 10% may be supplied in shorter lengths than the working lengths stated in Table 2. The Standard allows a ± 30 mm tolerance on manufacturing working lengths to allow for variations due to shrinkage and growth, depending on the composition and heat treatment of the Ductile Iron.

- d. **Lengths and Tolerances: Fittings** - Fittings were designed using the performance requirements of ISO 2531 as the minimal requirements. At U.S. Pipe, fitting patterns have the capacity to accept interchangeable end pieces for different jointing systems. This affords a high degree of flexibility in the manufacture of the fittings at a minimal expense to the customer. Fittings constructed by this method may have lengths and masses which differ from those in the above mentioned standard. The lengths and masses for individual fittings are given in the appropriate table in this catalog. Many fittings, sizes and configurations are shown which are not in the ISO 2531 Standard.

Casting Tolerances on the laying lengths vary by fitting type and are given in the fitting tables.

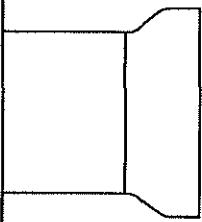
- e. **Tolerance on the Straightness of Centrifugally Cast Pipe** - When pipe are rolled along two gantries separated by approximately two-thirds of the length "L" of the pipe to be checked, the maximum deviation " f_m ", in millimeters, shall not be greater than 1.25 times the length "L", in meters of this pipe:

$$f_m < 1.25L$$

Table 2.

Nominal Diameters DN	Manufacturing Nominal Working Lengths m
100 to 1000	5,5
1200 to 1600	6,0

Dimensions in millimeters



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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General Specifications: Mechanical Testing

The following mechanical tests and acceptance values are in accordance with the requirements of ISO 2531. At the end of this section additional control tests used by U.S. Pipe during the production of centrifugally cast Ductile Iron pipe, the Ball Impression Test and Charpy Impact Test, are shown. These latter tests are not required by the International Standard.

a. Tensile Tests - Test Bars:

Pipe centrifugally cast in metal molds - The machined test bar for the tensile test is taken from the spigot end of the pipe, at approximately mid-thickness of the wall, with its axis parallel to the axis of the pipe.

The test bar includes a cylindrical part, with a gauge length at least five times its diameter: the latter given in Table 3, according to the thickness of the pipe, "e".

Table 3.

Thickness of Pipe	Diameter of Test Bar
$e < 6$	2,5
$6 < e < 8$	3,5
$8 < e < 12$	5
$12 > e$	6

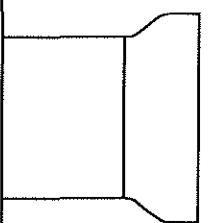
Dimensions in millimeters

Fittings cast in sand molds - The machined bar for the tensile test is taken from a sample attached to the casting or a sample cast separately from the same iron. Where heat treatment of the fitting or accessory is required, a separately cast sample shall be subjected to the same heat treatment. The thickness of the sample and the diameter of the test bar is given in Table 4 as a function of the mean thickness of the casting. The gauge length of the machined bar is at least five times its diameter.

Table 4.

Mean thickness of casting	Thickness of sample	Diameter of test bar
≤ 12	12,5	6
> 12	25,0	12

Dimensions in millimeters



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General Specifications: Mechanical Testing (cont.)

- b. Tensile Test: Methods and Results** - These mechanical tests are carried out during the manufacturing process on castings grouped in accordance with the following batch size limitations:

Pipe centrifugally cast in metal molds

DN 100 to 300 200 pipe

DN 350 to 600 100 pipe

DN 700 to 1000 50 pipe

DN 1200 to 1600 25 pipe

Fittings not centrifugally cast - Castings made from iron of substantially the same composition and, if necessary, having been subjected to the same heat treatment, shall be considered as one batch.

For one pipe, or from one sample of each batch of fittings, one test bar is taken which shall satisfy the requirements of Table 5.

If a result of this test is below the specified minimum values, two other test bars are taken from the same pipe, or from the same sample in the case of fittings and these must both satisfy the same requirements.

Table 5.

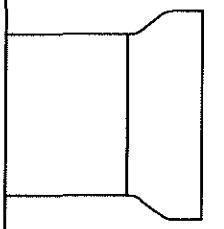
Type of Casting	Minimum tensile strength R_m N/mm ²	Minimum elongation after fracture A	
		DN 100 to 1600	DN 100 to 1000
Pipe centrifugally cast	420	10	7
Fittings	400	5	5

Dimensions in millimeters

NOTE: By agreement between manufacturer and purchaser, the 0.2% proof test may be used to determine the proof stress (yield strength). It shall not be less than:

-270 MPa when > 12% for DN 100 to 1000
or A > 10% for DN > 1000

*300 MPa in other cases.



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS**TR FLEX® - Anchor Gaskets - HP LOK®**

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General Specifications: Mechanical Testing (cont.)

- c. Internal Pressure Proof Test - Pipe are subjected to a works hydrostatic test for a minimum duration of 10 seconds and at a pressure based on the formulae and limitations given in Table 6.

Table 6.

Nominal size DN	Hydrostatic works test pressure for $K \geq 9$ pipe	
	Formulae (bar)	Minimum Test Pressure (bar)
100 < DN < 300	$0.5 (k + 1)^2$	50
350 < DN < 600	$0.5 k^2$	40
700 < DN < 1000	$0.5 (k-1)^2$	32
1200 < DN < 1600	$0.5 (k-2)^2$	25

k is the thickness coefficient of the pipe

Dimensions in millimeters

Fittings are subjected to a leak-tightness test carried out with water at the test pressures given in Table 7 or with air at a minimum pressure of 1 bar.

Table 7.

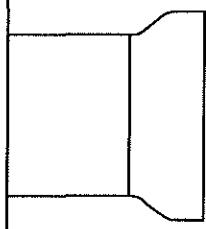
Nominal size DN	Hydrostatic leak-tightness test pressure for fittings (bar)
80 < DN < 300	25
350 < DN < 600	16
700 < DN < 1600	10

Dimensions in millimeters

For pipe and fittings, the acceptance criteria are that after completion of the test there shall be no visible leakage, sweating or other fault of any kind.

- d. Other Mechanical Tests - The following two tests, the Ball Impression Test and the Charpy Test, are quality and process control tests utilized by U.S. Pipe to assure consistent quality of centrifugally cast Ductile Iron pipe. Neither test is a requirement of International Standard. The Ball Impression test is a proprietary test developed by U.S. Pipe. The Charpy Impact Test is a requirement of *ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water*.

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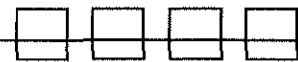
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®



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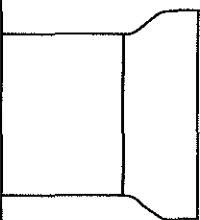
General Specifications: Mechanical Testing (cont.)

Ball Impression Test - Each processed Ductile Iron pipe is subjected to a proof test. The test consists of applying a concentrated load of the magnitude which would rupture the wall of a non-ductile pipe. An acceptable pipe will not split when tested at the designated loading for the applicable pipe wall thickness.

Charpy Impact Test - The Charpy Impact Test is a fracture toughness test used to measure the mechanical properties of centrifugally cast Ductile Iron pipe. A notched test specimen of full wall thickness is tested in accordance with the requirements of ASTM E 23. The pendulum type test equipment strikes the properly positioned test specimen and measures the energy required to fracture it.

Samples for Charpy testing are selected to represent production through the heat treating operation.

The acceptance value, corrected for actual thickness, is 7 ft-lbs (9.49 J) at 70° (21C). Pipe failing to meet this requirement are subjected to metallurgical evaluation and additional heat treatment or rejection as appropriate.



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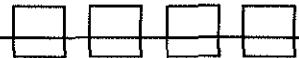
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General Specifications: Coatings, Linings, and Markings

COATINGS AND LININGS

Coatings and linings applied to pipe and fittings are as follows:

EXTERNAL - COATINGS

Pipe and fittings:

Bituminous paint.

When specified, metallic zinc with a bituminous finishing layer in accordance with ISO 8179-1 and/or ISO 8179-2 *Ductile Iron Pipes - External Zinc Coating*, can be furnished.

Polyethylene encasement as specified in ISO 8180, *Ductile Iron Pipes - Polyethylene Sleeving*, or ANSI/AWWA C105/A21.5, *Polyethylene Encasement for Ductile Iron Pipe*, is available when the soil is corrosive to Ductile Iron and protection against exterior corrosion should be provided.

INTERNAL LININGS

Pipe:

Cement mortar in accordance with ISO 4179, *ductile iron pipes for pressure and non-pressure pipelines - Centrifugal cement mortar lining - general requirements*.

Fittings:

Cement mortar in accordance with the applicable requirements of ISO 4179.

When specified, cement mortar linings can be furnished made with ASTM C150 Type V sulfate resisting Portland cement. Pipe and fittings can be furnished with or without a bitumen seal-coat on the cement mortar lining. Sealcoating furnished meets the health effects requirements of ANSI/NSF 61, *Drinking Water System Components-Health Effects*.

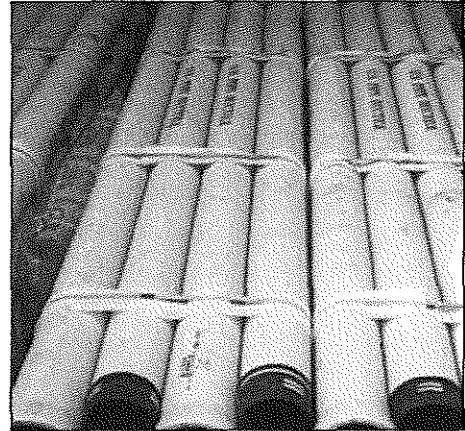
CAST-ON OR COLD STAMPED MARKINGS

All pipe and fittings shall be marked as follows:

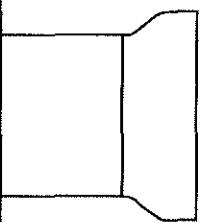
- identification of the manufacturer
- identification of the year of manufacture
- DN
- identification of Ductile Iron
- PN of flanges where applicable

Other markings, painted or attached via a label, as appropriate:

- length, etc.
- identification of third party certification
- special markings



NOTE: The above standard coatings and linings are suitable for the majority of soil conditions and raw or potable waters to be conveyed. Should supplementary protection be required for aggressive soils or waters carried by the pipeline, contact International Sales for additional methods of protection.



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Restrained Joint Pipe and Fittings

TR FLEX Restrained Joint Pipe and Fittings provide flexible restrained push-on joints for DN 100 mm through DN 1 600 mm Ductile Iron pipe and fittings.* The joints are suitable for 25 bars working pressures for pipe and fittings of sizes DN 100 mm through DN 600 mm and 17 bars for sizes DN 700 mm through DN 1200 mm. Pipe and fittings, sizes DN 1400 mm, 1500 mm, and 1600 mm, are rated for 24 bars working pressure.†

Ductile Iron locking segments, inserted through a slot (or slots) in the bell face, provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.

TR FLEX Pipe utilizes the conventional TYTON® Gasket for DN 400 mm through DN 900 mm sizes. TR FLEX® Gaskets are furnished for DN 1000 mm and 1200 mm TR FLEX Pipe and Fittings. Conventional TYTON Gaskets are used for 1400, 1500 and 1600 mm TR FLEX Pipe and Fittings. Gaskets are not interchangeable with gaskets used in TYTON JOINT® Pipe bells of these sizes.

TR FLEX Pipe and Fittings are furnished in Ductile Iron only and conform to applicable requirements of ISO 2531 "Ductile-iron pipes, fittings, accessories and their joints for water or gas applications."

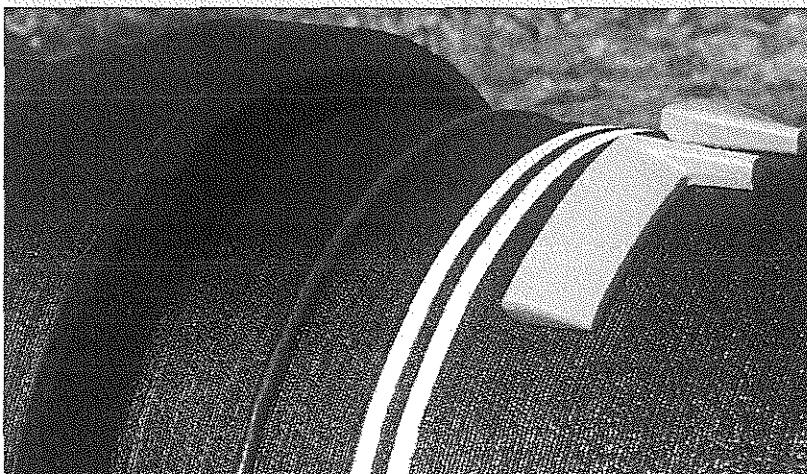
Cement lining in accordance with ISO 4179 "Ductile iron pipes for pressure and non-pressure pipelines - Centrifugal Cement Mortar Lining - General Requirements" or ANSI/AWWA C104/A21.4 "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water" is available. Asphaltic outside coating is in accordance with ANSI/AWWA C151/A21.51 "Ductile-Iron Pipe, Centrifugally Cast, for Water" for pipe and ANSI/AWWA C110/A21.10 "DUCTILE-IRON AND GRAY-IRON FITTINGS, 3 IN. THROUGH 48 IN. (75 mm THROUGH 1200 mm), FOR WATER" or ANSI/AWWA C153/A21.53 "DUCTILE-IRON COMPACT FITTINGS, 3 IN. THROUGH 24 IN. (76 mm THROUGH 610 mm) AND 54 IN. THROUGH 64 IN. (1,400 mm THROUGH 1,600 mm), FOR WATER SERVICE". Asphaltic seal-coat on cement mortar lining and special linings and/or coatings, including metallic zinc spray per ISO 8179, can be furnished for specific conditions.

NOTE: *Check with your U.S. Pipe Sales Representative for higher pressure ratings.

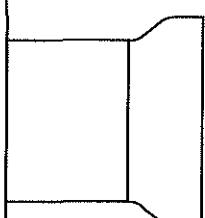
†For a suggested design procedure for the restraint of thrust forces in pressurized, buried Ductile Iron piping systems, the design engineer should refer to the current DIPRA publication "THRUST RESTRAINT DESIGN FOR DUCTILE IRON PIPE".

If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Ductile-Iron Pipe Systems" for proper protection procedures.

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Restrained Joint Ductile Iron Pipe and Fittings Assembly

CAUTION: Gasket-seat in the socket must be cleaned of all excess paint and foreign matter prior to installation of the gasket. Joints are only as watertight as they are clean. If the joint is somewhat difficult to assemble, inspect for proper gasket positioning, adequate lubrication, and removal of foreign matter in the joint.

Figure 1. Insertion Slot Orientation

Orientation of the segment insertion slots located in the face of the TR FLEX Pipe bell, is important for ease of assembly; therefore particular attention should be paid to that portion of the assembly instructions. Clean the sockets of all dirt, sand, gravel, or other foreign matter.

Figure 1.

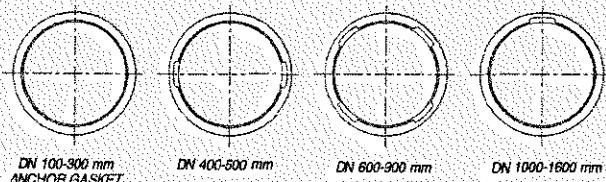


Figure 2. Gasket Installation

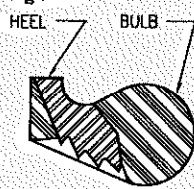
Clean the gasket. Loop it as shown in one of the two following illustrations and place it into the socket with the rounded bulb entering first.

Smaller sized gaskets (DN 100 through 500 mm) require only one loop. With larger sized gaskets (DN 600 - 1600 mm) it will be helpful to loop the gasket at two or more locations.

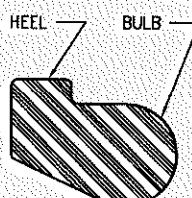
After the gasket has been inserted into the gasket seat, making sure the gasket is uniformly seated inside the socket, apply a thin film of TYTON® Lubricant to the exposed surface of the gasket.

In subfreezing weather the gaskets should be kept at temperatures above 4° C (39° F), to ensure resiliency during installation. Examples of suitable means of keeping the gaskets warm are: storing the gaskets in a heated area or keeping the gaskets immersed in a tank of warm water. If the gaskets are kept in warm water, they should be dried before they are installed into the socket.

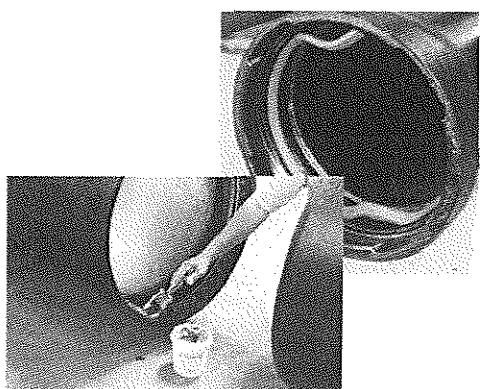
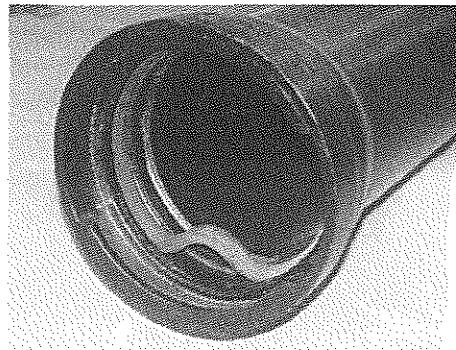
Figure 2.

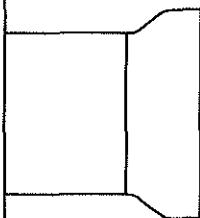


**DN 100 - 300 mm
Anchor Gasket**



**DN 400 - 1600 mm
Gasket**





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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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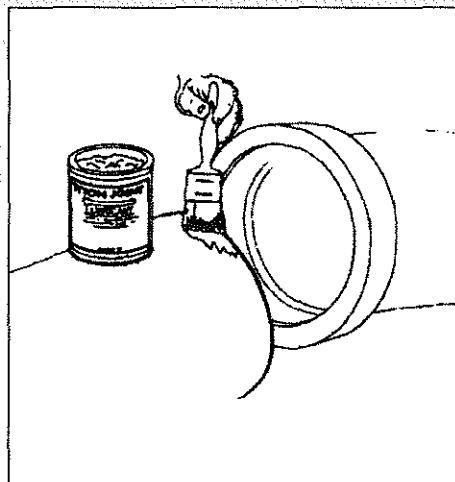
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TR FLEX Joint Ductile Iron Pipe Assembly (cont.)

Lubrication

Clean the spigot end of the pipe back to the assembly stripes. Apply a thin film of TYTON® Lubricant. Do not allow the lubricated plain end to touch the ground or trench sides. Lubricant other than that furnished with the pipe should not be used. For under-water installations, a special lubricant is available from U.S. Pipe.



Final Assembly

Keep the pipe in axial alignment during assembly. Insert the spigot end until the first assembly stripe is in the socket.

The locking segments should then be inserted. Both left hand and right locking segments are required for DN 400 through 900 mm sizes. The rubber locking segment retainer(s) should be wedged between the inserted locking segments. The pipe may then be retracted until the locking segments are seated. (See section of this brochure titled TR FLEX Pipe and Fitting Socket Pull Out, Page 21.) Lastly, deflection may be set observing the deflection limits in Table 8.

Table 8.

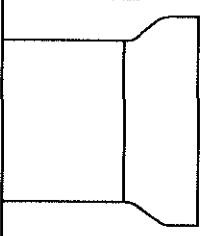
Maximum Deflection of TR FLEX Pipe and Fittings*

Size DN	Max. Deflection
100	5°
150	5°
200	5°
250	5°
300	5°
400	3 1/4°
450	3°
500	2 3/4°
600	2 1/4°
700	2 1/4°
800	1 3/4°
900	1 1/2°
1000	1/2"
1200	1/2"
1400	1/2"
1500	1/2"
1600	1/2"

Dimensions in millimeters

*NOTE: These deflections are based on nominal dimensions. Slightly higher or lesser deflections may be obtained in the field.

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Anchor Gaskets (100-300 mm)

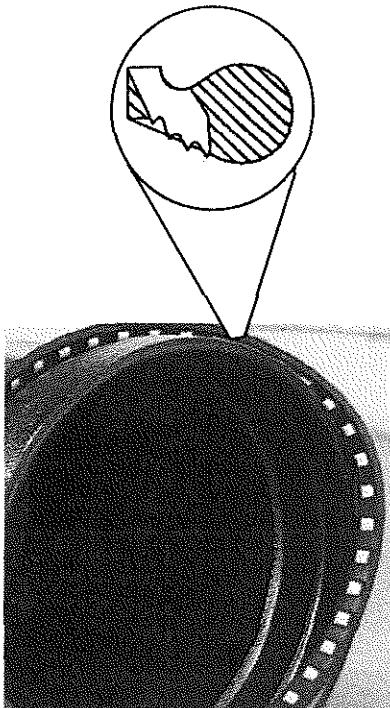
Restrained joint pipe and fittings are used in pressurized Ductile Iron pipelines to prevent the joints of the line from separating due to thrust forces. Thrust forces generally occur at changes of direction in the line. Usually, a calculated length of pipeline extending from the location of the thrust force is restrained in the joints so that this force can be transmitted to the soil surrounding the line. The entire pipeline is often restrained for installations in poor soil or for critical lines.

U.S. Pipe's Anchor Gasket has proven to be an extremely successful, trouble-free means of joint restraint for well over one million Ductile Iron pipe and fitting joint assemblies. By simply inserting a Anchor Gasket into the socket of a TYTON JOINT® Pipe, Fitting or Valve, restraint is instantly achieved when the joint is assembled. Stainless steel locking segments vulcanized into the Anchor Gasket grip the pipe to prevent joint separation.

Anchor Gaskets, utilizing patented improvements, are rated by U.S. Pipe for operating pressures up to 24 bars.

With the use of the Anchor Gasket, push-on joint Ductile Iron TYTON JOINT Pipe or Fittings can be quickly and securely restrained as the joint is assembled. Field cut pipe are no longer a problem to restrain. No pipe surface preparation* or grooving is required for field cut pipe other than the cut end needing to be beveled as required for any push-on joint spigot end. With the Anchor Gasket in place, the joints are restrained without thrust blocks, bolts, grooves, rods, clamps or retainer glands, resulting in savings of labor, material and time.

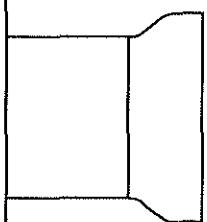
CAUTION: U.S. Pipe does not recommend Anchor Gaskets for use above ground. The long-term effect of cyclical movements can be gradual joint separation to the point that the seal on the gasket bulb is compromised. Sources of cyclical movements include vibration as may be found on bridge crossings, and thermal expansion and contraction resulting from atmospheric temperature changes. These conditions are not experienced with buried pipe lines.



NOTE: If specifiers and users believe that corrosive soils will be encountered where products are to be installed, please refer to ISO 8180 Ductile iron pipes - Polyethylene sleeving for site application.

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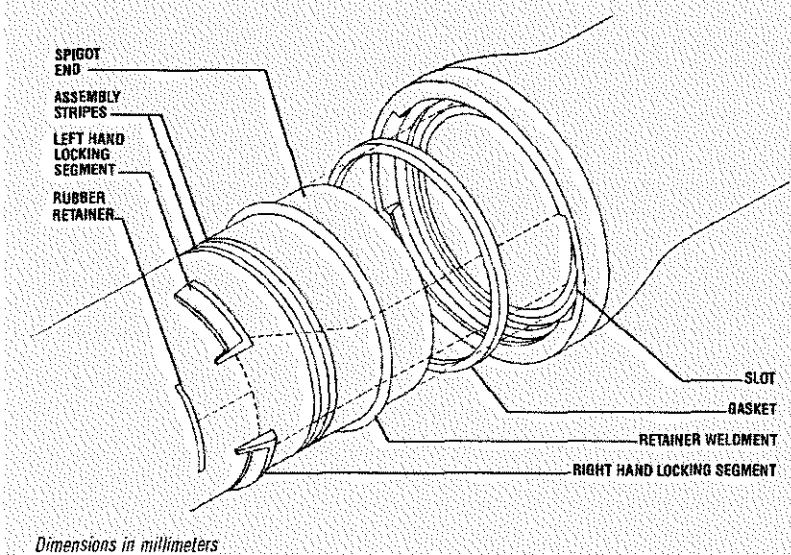


Instructions for DN 400 - 500 mm TR FLEX Pipe and Fittings - Two Bell Slots

1. Lay pipe or fitting such that both of the bell slots are accessible (in the horizontal position if possible).
2. Clean the socket and insert a TYTON® Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert lower locking segment into a bell slot and slide the segment around the pipe.
7. Insert upper locking segment into the same bell slot and rotate around the pipe.
8. Hold the upper segment in place and wedge the rubber retainer into the slot between the two locking segments.
9. Repeat steps 6-8 for other slot. Make sure that all 4 locking segments and 2 rubber retainers are securely in place.
10. Extend the joint to remove the slack in the locking segment cavity. Joint extension is necessary to attain the marked laying length of the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the section entitled TR FLEX Pipe and Fitting Socket Pullout, Page 21)
11. Set the joint deflection as required. (See Table 8, Page 14)

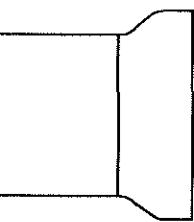
Components required for each joint:

- 2 right-hand locking segments (painted red, marked RH)
- 2 left-hand locking segments (painted black, marked LH)
- 2 rubber retainers
- 1 TYTON® Gasket
- TYTON® Lubricant



Dimensions in millimeters

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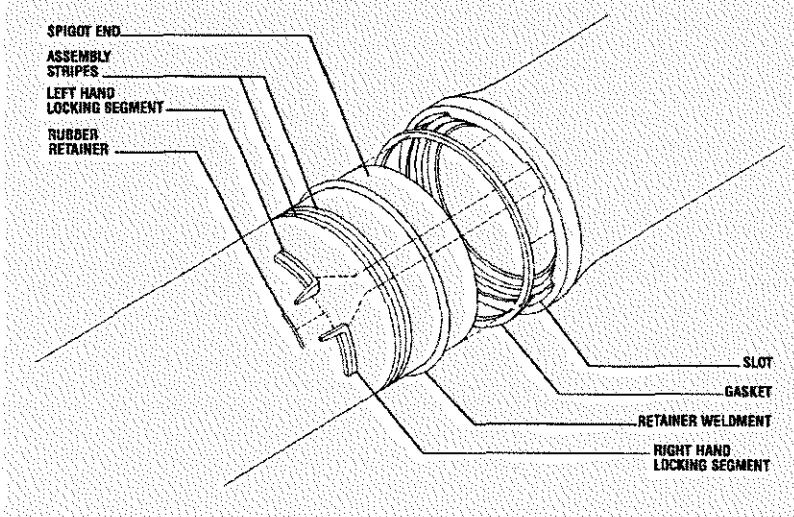
P 17

Instructions for DN 600 - 900 mm TR FLEX Pipe and Fittings - Four Bell Slots

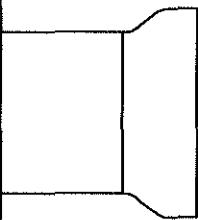
1. Lay pipe or fitting such that all four of the bell slots are accessible (in the diagonal position if possible).
2. Clean the socket and insert a TYTON® Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert lower locking segment into a bell slot and slide the segment around the pipe.
7. Insert upper locking segment into the same bell slot and rotate around the pipe.
8. Hold the upper segment in place and wedge the rubber retainer into the slot between the two locking segments.
9. Repeat steps 6-8 for other slots. Make sure that all 8 locking segments and 4 rubber retainers are securely in place.
10. Extend the joint to remove the slack in the locking segment cavity. Joint extension is necessary to attain the marked laying length of the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the section entitled TR FLEX Pipe and Fitting Socket Pullout, Page 21)
11. Set the joint deflection as required. (See Table 8, Page 14)

Components required for each joint:

- 4 right-hand locking segments (painted red, marked Rh)
- 4 left-hand locking segments (painted black, marked Lh)
- 4 rubber retainers
- 1 TYTON® Gasket
- TYTON® Lubricant



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Instructions for DN 1 000 - 1 200 mm TR FLEX Pipe and Fittings - One Bell Slot

1. Lay pipe or fitting such that the bell slot is accessible (in the 12 o'clock position if possible).
2. Clean the socket and insert a TR FLEX Gasket.
3. Clean the pipe spigot end back to the assembly stripes.
4. Lubricate the exposed surface of the gasket and the pipe spigot end back to the weld bead.
5. Make a conventional push-on joint assembly, fully homing the pipe until the first assembly stripe is in the bell socket. Keep the joint in straight alignment during assembly.
6. Insert 11 locking segments one at a time into the bell slot and slide the segments alternately to the left and to the right around the pipe.
7. Wedge the rubber retainer into the slot between the last two locking segments.
8. Make sure that all 11 locking segments and the rubber retainer are securely in place.
9. Extend the joint to remove the slack in the locking segment cavity. Make sure that the segments are evenly extended around the socket and are not over the weld bead. Joint extension is necessary to attain the marked laying length of the pipe and to minimize growth or extension of the line as it is pressurized. (Refer to the section entitled TR FLEX Pipe and Fitting Socket Pullout, Page 21)
11. Set the joint deflection as required. (See TABLE 8, Page 14)

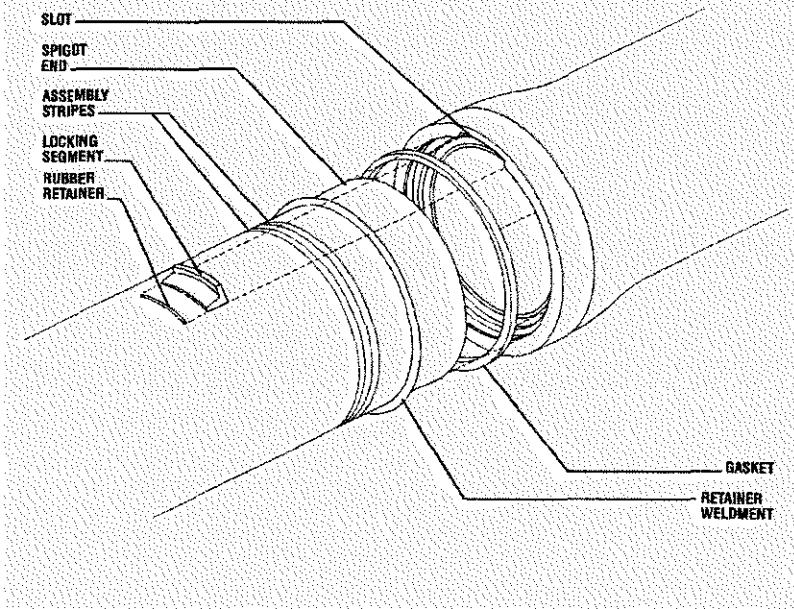
Components required for each joint:

11 locking segments

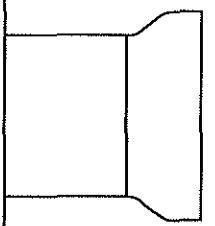
1 rubber retainer

1 gasket - Note: A TR FLEX® Gasket is used in these sizes.

TYTON® Lubricant



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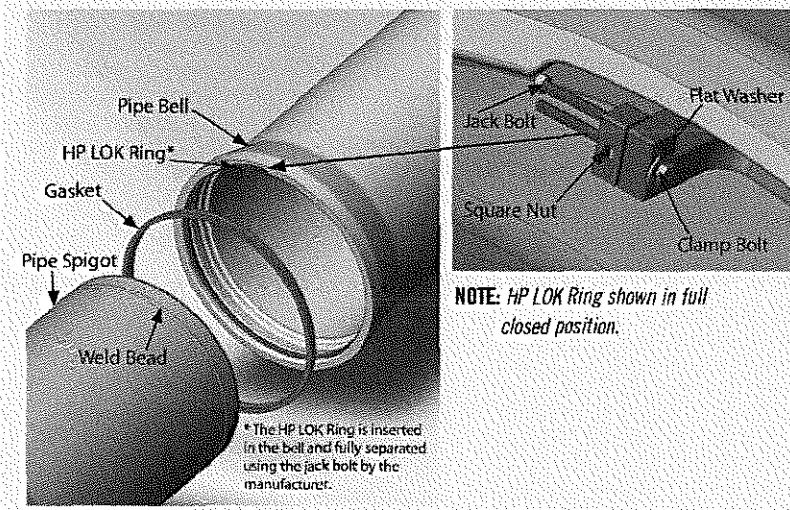


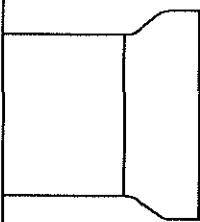
Instructions for Assembling HP LOK Pipe and Fittings (DN 1400 - 1600 mm)

1. The gasket seat must be clean and free of debris or any foreign matter.*
2. Install the gasket in the bell. Do not lubricate gasket prior to installing bell.*
3. Lubricate the gasket and spigot of the mating pipe with TYTON® Joint lubricant.*
4. The spigot of the mating pipe may now be inserted into the bell. The installer must make sure that the spigot is fully homed in the bell and not deflected. The HP LOK® Ring can be slid back and forth when the spigot is inserted correctly and not deflected.
5. The jack bolt should now be removed and discarded.
6. The clamp bolt can now be snugged down so that the HP LOK Ring contacts the pipe surface. Use only enough bolt torque to make sure the HP LOK Ring is in contact with the mating spigot and to prevent the HP LOK Ring from spreading.
7. Inspect the full circumference of the HP LOK Ring to make sure it is in contact with the spigot of the pipe and not resting on the weld bead. If the HP LOK Ring is sitting on the weld bead, the spigot is not fully homed in the bell or the joint is excessively deflected for installation.
8. When it is certain that the HP LOK Ring is fully contacting the spigot, extend the joint (remove slack in the joint) by pulling on the assembled pipe joints. Do not use excessive force. The spigot should slide easily under the HP LOK Ring.
9. Tighten the clamp bolt to approximately 10 to 20 ft-lb of torque. Do not over tighten.
10. Deflect the joint as desired, not to exceed 1/2 degree.
11. The joint is now completely assembled.

Components required for each joint:

- 1 HP LOK® Ring (factory installed)
- 1 TYTON® Gasket
- TYTON® Lubricant
- 1 jack bolt (factory installed)
- 1 clamp bolt (factory installed)





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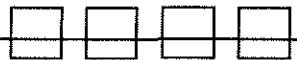
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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TR FLEX® Ductile Iron Pipe and Fittings Assembly

TR FLEX Pipe and Fittings

Socket Pull Out

(Linear Expansion Within the Socket)

In TR FLEX Pipe and Fitting sockets, a small amount of pull out is available at each joint (Refer to Table 9). This pull out or expansion capability is the result of clearance inside the socket required for the insertion of the locking segments. This expansion can be minimized by extending the joint after installing the locking segments and prior to setting the joint deflection. The expansion may be beneficial when utilized in underground installations. The movement of the pipe and fittings increases the passive resistance of the soil when thrust forces are encountered.

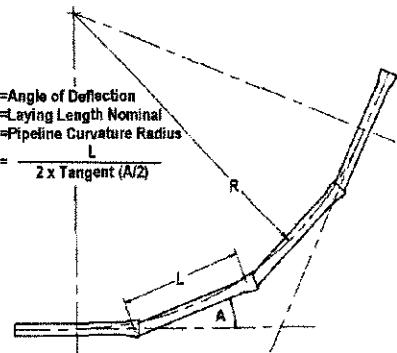
The expansion capability of the TR FLEX Pipe and Fitting socket must be considered, particularly in the following cases:

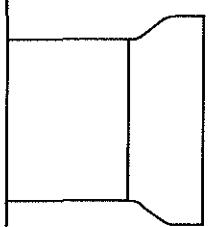
- a. When TR FLEX Pipe are used above ground (bridge crossings, on piers, etc.),
- b. When TR FLEX Pipe are used in poor soil conditions (swamps, marshes, etc.),
- c. When extremely long lengths of TR FLEX Pipe are required for restraint due to high operating pressures and/or unfavorable soil parameters, and
- d. Where TR FLEX Pipe are used inside casing pipe.
- e. When pipeline terminates in a building.
- f. Where TR FLEX Pipe and Fittings are in vertical alignment.

In cases, such as the above, the TR FLEX Joint should be fully extended after installation of the segments. When TR FLEX Pipe are used inside a casing pipe, it is recommended that the assembled pipe be pulled through the casing. Additional security may be required to ensure that the locking segments are adequately retained in the socket during such installations.

If the joint is not extended, during assembly, the expansion per joint will increase the length of a 300 Meter long bridge crossing installation between 0.6 to 1.5 Meters depending upon pipe size when the pipeline is pressurized (Table 9).

Pipeline Curve Geometry





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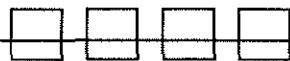
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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TR FLEX® Ductile Iron Pipe and Fittings Assembly (cont.)

Minimum Laying Lengths For TR FLEX Pipe

The following drawings and TABLE 9 define the minimum lengths for TR FLEX Pipe when furnished in either Plain End x Plain End, or Bell x Plain End. The minimum laying lengths are determined on the basis of the socket depth and the minimum space required in front of the pipe bell face to insert the locking segments. These minimum laying lengths must be considered when ordering factory cut lengths or field cutting TR FLEX Pipe. The longest pipe possible should be used in any installation to reduce large forces at the joint and also for ease of assembly.

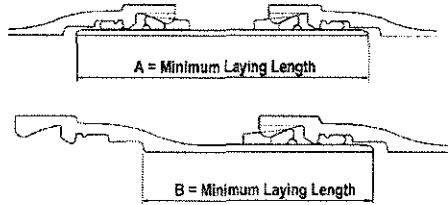
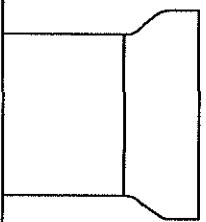


Table 9:
Minimum Laying Lengths and Pull Out For Restrained Joint Pipe

Size DN	A (mm)	B (mm)	Pull Out (M)
100	324	273	.01
150	356	298	.01
200	387	330	.01
250	400	343	.02
300	419	337	.02
400	514	387	.02
450	533	394	.02
500	546	406	.02
600	584	432	.02
700	641	470	.02
800	667	495	.02
900	711	527	.02
1000	572	438	.02
1200	591	464	.02
1400	641	514	.03
1500	711	540	.03
1600	743	559	.03

*Field Cut Pipe
Dimensions in millimeters
Pull Out in meters*

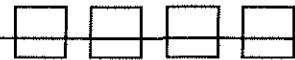
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Field Cut Pipe Preparation

Before making a field cut, measure the pipe diameter or circumference at the location to be cut. The diameter or circumference should fall within the range shown in TABLE 10. If the measurement is not within the prescribed range, another pipe should be selected and checked before cutting.

Making A Field Cut

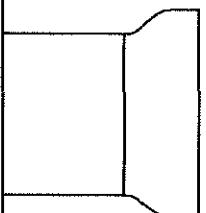
The pipe must be cut as square as is practical. A field cut end that is not square may leak, especially if the joint is fully deflected. Measure from the factory manufactured spigot end to the desired cut location. Mark the measured distance around the circumference of the pipe (a line perpendicular to the pipe axis). Cut the pipe. (Abrasive saws are commonly used). Bevel the field cut end (a disk grinder can be used). Refer to a shop manufactured bevel as a guide for proper shape. Additional grinding may be required to further bevel the pipe if difficulty in assembly is encountered.

Table 10

Size DN	Circumference		Diameter	
	Maximum	Minimum	Maximum	Minimum
100	374	362	119	115
150	537	525	171	167
200	701	688	223	219
250	864	851	275	271
300	1027	1013	327	323
350	1191	1180	379	376
400	1351	1341	430	427
450	1511	1501	481	478
500	1674	1664	533	530
600	1998	1988	636	633
700	2322	2311	739	736
800	2648	2637	843	839
900	2972	2960	946	942
1000	3296	3284	1049	1045
1200	3946	3935	1256	1252
1400	4596	4585	1463	1459
1500	4919	4908	1566	1562
1600	5243	5232	1669	1665

Dimensions in millimeters

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The Assembly Mark

Make an assembly mark on the pipe barrel at the location as shown in TABLE 11. Use this assembly mark to assure that the pipe is inserted the proper depth into the socket. If the pipe is "bottomed out" in the socket, the amount of joint deflection will be reduced. If the pipe is not inserted far enough into the socket, the gasket may not seal (particularly if the joint is deflected).

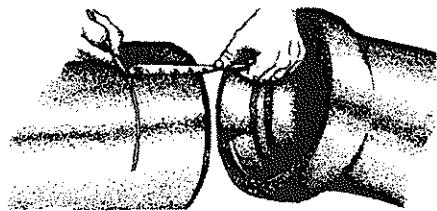
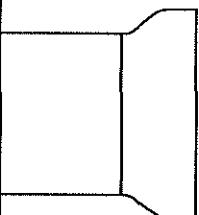


Table 11:

Size DN	Location of Assembly Mark
100	123
150	136
200	148
250	153
300	160
350	197
400	202
450	208
500	213
600	225
700	256
800	261
900	276
1000	193
1200	207
1400	221
1500	257
1600	271

Dimensions in millimeters

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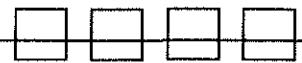
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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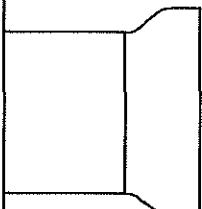
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Notes Regarding the Use of Restrained Joint Pipe

1. Large unbalanced thrust forces can be produced at dead ends, bends, tees or other changes in direction of high pressure and/or large diameter piping systems.
2. Concrete thrust blocks or restrained joint pipe and fittings can normally be used to resist the unbalanced thrust forces.
3. In underground piping systems, an unbalanced thrust force can normally be resisted by providing a designed length of restraint at a change in direction where thrust forces are anticipated. Restrained joint pipe normally must transfer the thrust forces to the soil surrounding the pipeline.
4. The Thrust Restraint Design For Ductile Iron Pipe published by the Ductile Iron Pipe Research Association (DIPRA) is one method used to calculate the required length of restraint at a change in direction. This publication is available through your U.S. Pipe representative.
5. Most restrained joints allow for the joint take-up after installation. The amount of take-up or slack can vary considerably with the type of joint and installation conditions. Thrust forces produced by internal pressure can result in removal of this joint take-up thereby increasing the length of the restrained section of the line. In any situation or configuration where increases in the line segment length could be detrimental to the pipeline or surrounding structures, the restrained joints should be fully extended during installation.
6. An increase in line segment length can also result in additional joint deflection. If increases in length or other line movements are anticipated, the deflection of the restrained joints should be limited to only a portion of the joint design deflection during the installation of the pipe.
7. In fully extended, totally restrained piping systems, the thrust forces are carried by the piping system, and the resistance to the thrust is not dependent upon the surrounding soil. In situations where there is insufficient space to provide the designed restrained length, or where there are poor soil conditions, the entire section of line should be restrained or other external means of stability or restraint provided.

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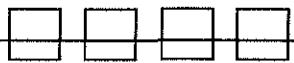
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®



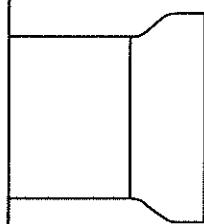
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Notes Regarding the Use of Restrained Joint Pipe (cont.)

8. If restrained joint pipe is used in a casing and is subjected to thrust, the joints should be fully extended to take up the joint slack prior to making end connections. The length of restraint in the casing should not be considered as part of the designed length of restraint required to provide the soil resistance to the thrust forces.
9. Above ground lines subject to thrust forces should be fully restrained and extended to remove any slack from the joint. The joint can be extended by pulling out on the pipe after the restrained joint assembly is made. The thrust forces can cause an unexpected increase in length of an above ground line if the slack is not first removed from the joint. When restrained joint pipe are used for bridge crossings or other above ground installations, each length of pipe must be supported in a manner to restrict both vertical and horizontal movement.
10. It is the responsibility of the Purchaser or Consulting Engineer to ensure that proper trench preparation, compaction, and pipe installation procedures are followed and that adequate restrained lengths or thrust block designs are provided to resist the unbalanced thrust loads generated by the installed piping systems.
11. In general, restrained joints are more electrically conductive than conventional push-on joints used for Ductile Iron pipe. This increased conductivity can make a restrained section of the line more susceptible to stray current corrosion caused by direct currents from sources such as electrical transit systems or cathodically protected steel structures (steel pipe, underground storage tanks, etc.) If exposure to stray currents is anticipated, contact your U.S. Pipe representative for the recommended method of protection.
12. If Anchor Gaskets are used in a vertical installation, provisions must be made to keep the joint extended and not allow the teeth to become disengaged from the pipe. Failure to keep vertical joints extended can result in joint separation.

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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

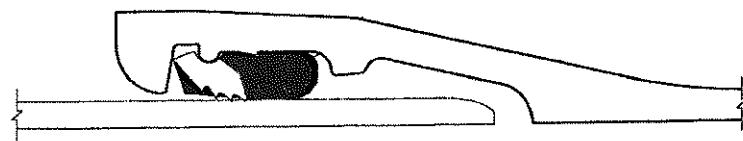
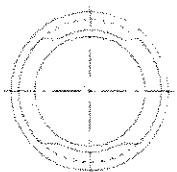


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Restrained Push On Joint Pipe and Fittings

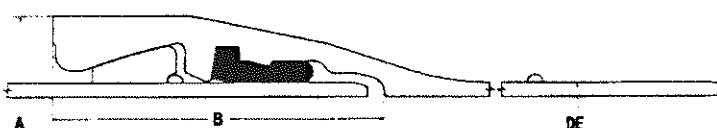
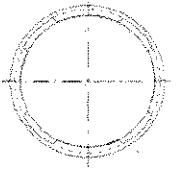
DN 100 - 300 mm



DN 400 - 500 mm



DN 600 - 900 mm



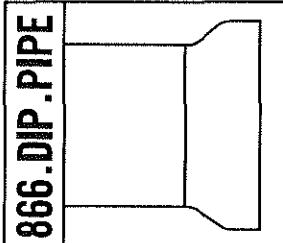
Size	O.D. Barrel	O. D. Bell Pipe	O.D. Bell Fitting	Socket Depth	Locking Segments	Rubber Retainers	Accessory Weights	Wall Thickness						
	DN	DE	A	A	B	Number	Number	*	K7	K8	K9	K10	K11	K12
100*	118	177	177	80	—	—	—	—	—	—	6,1	6,1	6,6	7,2
150*	170	232	233	88	—	—	—	—	—	—	6,3	6,5	7,2	7,8
200*	222	291	293	94	—	—	—	—	—	—	6,4	7,0	7,7	8,4
250*	274	351	351	95	—	—	—	—	—	—	6,8	7,5	8,3	9,0
300*	326	408	408	95	—	—	—	—	—	—	7,2	8,0	8,8	9,6
400	429	513	513	202	4	2	6,4	—	—	—	8,1	9,0	9,9	10,8
450*	480	569	582	208	4	2	7,7	—	—	—	8,6	9,5	10,5	11,4
500	532	625	637	213	4	2	9,1	—	8,0	9,0	10,0	11,0	12,0	—
600	635	748	738	225	8	4	14,5	—	8,8	9,9	11,0	12,1	13,2	—
700	738	845	860	256	8	4	22,7	8,4	9,6	10,8	12,0	13,2	14,4	—
800	842	953	974	261	8	4	22,7	9,1	10,4	11,7	13,0	14,3	15,6	—
900	945	1073	1086	276	8	4	30,8	9,8	11,2	12,6	14,0	15,4	16,8	—

Dimensions in millimeters
Masses in kilograms

NOTE: DN 100 - 900 mm 5.43 METERS IN LENGTH

*Contact your Sales Representative for availability.

*Accessory weights include segments, gaskets, and rubber retainers TR FLEX® is a Registered Trademark of United States Pipe and Foundry Company, LLC.



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS
TR FLEX® - Anchor Gaskets - HP LOK®

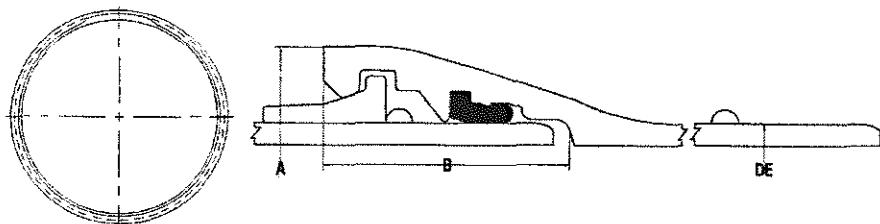


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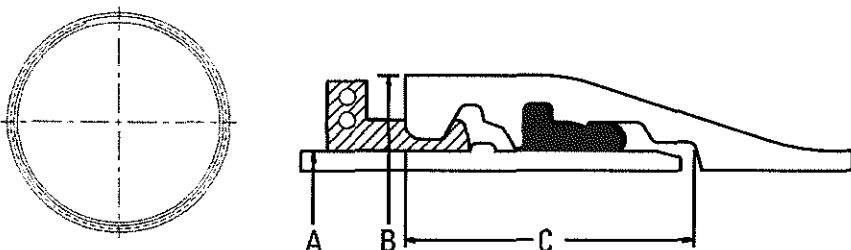
Restrained Push On Joint Pipe and Fittings

DN 1000 - 1200 mm



DN 1400 - 1600 mm

HP LOK® Assembly Cross Section



Size	O.D. Barrel	O. D. Bell Pipe	O. D. Bell Fitting	Socket Depth	Locking Segments	Rubber Retainers	Accessory Weights	Wall Thickness					
								*	K7	K8	K9	K10	K11
DN 1000	1048	1170	1179	193	11	1	39,5	10,5	12,0	13,5	15,0	16,5	18,0
1200	1255	1385	1382	207	11	1	60,3	11,9	13,6	15,3	17,0	18,7	20,4
1400**	1462	1610	1661	256	—	—	—	13,3	15,2	17,1	19,0	20,9	22,8
1500**	1565	1726	1669	256	—	—	—	14,0	16,0	18,0	20,0	22,0	24,0
1600**	1668	821	1877	256	—	—	—	14,7	16,8	18,9	21,0	—	25,2

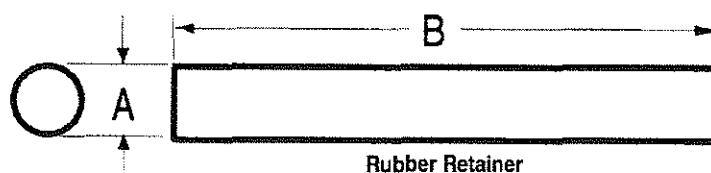
Dimensions in millimeters

Masses in kilograms

NOTE: DN 1000 - 1600 mm 6,0 METERS NOMINAL LENGTH

* Accessory weights include segments, gaskets, and rubber retainers

** HP LOK - 24 Bar only

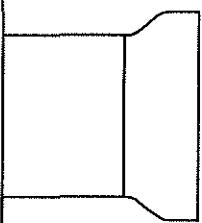


Size DN	400	450	500	600	700	800	900	1 000	1 200
(A) Diameter	25	25	25	25	32	32	32	32	32
(B) Length	216	241	267	184	241	241	267	343	400
Number Per Joint	2	2	2	4	4	4	4	1	1

Dimensions in millimeters

Masses in kilograms

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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

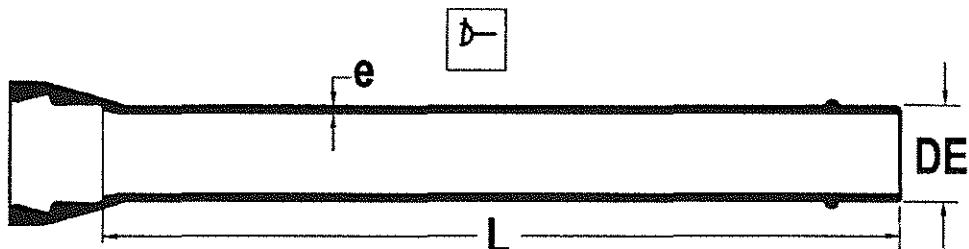


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Restrained Push On Joint Pipe and Fittings Dimensions and Masses K7 - K8



K7

Nominal Diameter DN	Barrel		Masses per Meter	Socket Mass	Total mass approximate for one working length "L" of	
	DE	e			5,43 Meters	5,93 Meters
600	635	7,7	107,0	95,3	680	—
700	738	8,4	135,7	133,4	875	—
800	842	9,1	167,9	164,7	1084	—
900	945	9,8	203,0	221,4	1331	—
1000	1048	10,5	241,3	146,1	1467	—
1200	1255	11,9	327,6	203,2	—	2193
1400	1462	13,3	426,8	430,9	—	3019
1500	1565	14,0	480,9	494,4	—	3411
1600	1668	14,7	538,3	575,6	—	3840

Dimensions in millimeters

Masses in kilograms

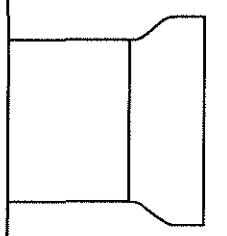
K8

Nominal Diameter DN	Barrel		Masses per Meter	Socket Mass	Total mass approximate for one working length "L" of	
	DE	e			5,43 Meters	5,93 Meters
600	635	8,8	122,1	95,3	762	—
700	738	9,6	154,9	133,4	980	—
800	842	10,4	191,6	164,7	1213	—
900	945	11,2	231,6	221,4	1488	—
1000	1048	12,0	275,3	146,1	1654	—
1200	1255	13,6	373,9	203,2	—	2474
1400	1462	15,2	487,1	430,9	—	3386
1500	1565	16,0	548,9	494,4	—	3824
1600	1668	16,8	614,4	575,6	—	4302

Dimensions in millimeters

Masses in kilograms

Contact your Sales Representative for availability.



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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

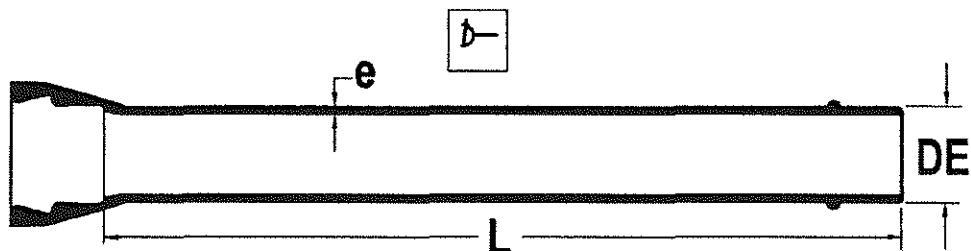
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Restrained Push On Joint Pipe and Fittings Dimensions and Masses K9



K9

Nominal Diameter DN	Barrel		Socket Mass		Total mass approximate for one working length "L" of	
	DE	e	Masses per Meter		5,43 Meters	5,93 Meters
100*	118	6,1	15,1	7,7	91	—
150*	170	6,3	22,8	11,8	136	—
200*	222	6,4	30,6	17,7	186	—
250*	274	6,8	40,2	24,0	245	—
300*	326	7,2	50,8	29,9	308	—
350*	378	7,7	63,2	43,5	390	—
400	429	8,1	75,5	49,0	463	—
450*	480	8,6	89,8	56,2	547	—
500	532	9,0	104,3	68,0	637	—
600	635	9,9	137,1	95,3	846	—
700	738	10,8	173,9	133,4	1084	—
800	842	11,7	215,2	164,7	1343	—
900	945	12,6	260,2	221,4	1644	—
1000	1048	13,5	309,3	146,1	1838	—
1200	1255	15,3	420,1	203,2	—	2753
1400	1462	17,1	547,2	430,9	—	3751
1500	1565	18,0	616,7	494,4	—	4234
1600	1668	18,9	690,3	575,6	—	4763

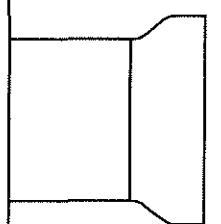
Dimensions in millimeters

Masses in kilograms

*Anchor Gasket Restraint

**Contact your Sales Representative for availability.

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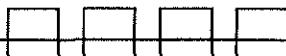
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

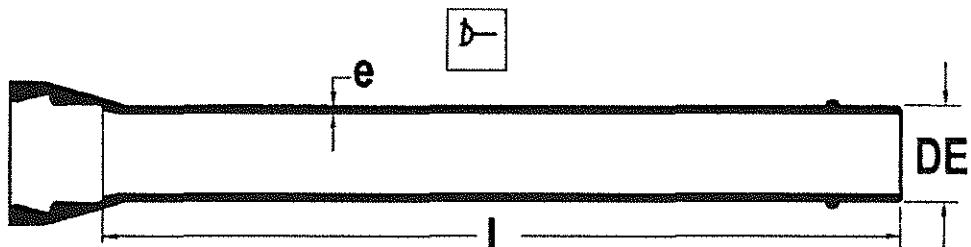


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Restrained Push On Joint Pipe and Fittings Dimensions and Masses K10



K10

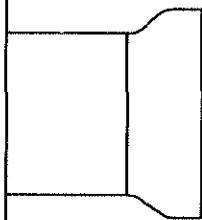
Nominal Diameter DN	Barrel			Socket Mass	Total mass approximate for one working length "L" of	
	DE	e	Masses per Meter		5,43 Meters	5,93 Meters
100*	118	6,1	15,1	7,7	91	—
150*	170	6,5	23,5	11,8	141	—
200*	222	7,0	33,3	17,7	200	—
250*	274	7,5	44,3	24,0	265	—
300*	326	8,0	56,3	29,9	338	—
350**	378	8,5	69,6	43,5	424	—
400	429	9,0	83,7	49,0	508	—
450**	480	9,5	99,0	56,2	599	—
500	532	10,0	115,6	68,0	701	—
600	635	11,0	152,0	95,3	928	—
700	738	12,0	193,0	133,4	1188	—
800	842	13,0	238,7	164,7	1470	—
900	945	14,0	288,7	221,4	1801	—
1000	1048	15,0	343,2	146,1	2023	—
1200	1255	17,0	466,1	203,2	—	3035
1400	1462	19,0	607,2	430,9	—	4114
1500	1565	20,0	684,4	494,4	—	4645
1600	1668	21,0	766,0	575,6	—	5223

Dimensions in millimeters

Masses in kilograms

*Anchor Gasket Restraint

**Contact your Sales Representative for availability.

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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

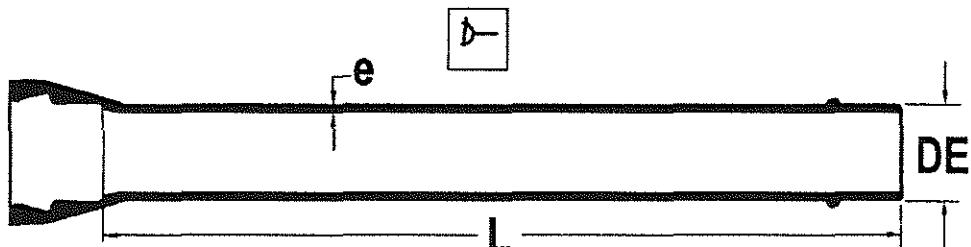


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Restrained Push On Joint Pipe and Fittings Dimensions and Masses K11



K11

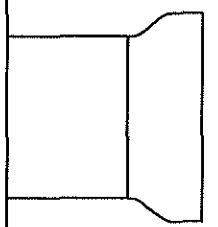
Nominal Diameter DN	Barrel			Socket Mass	Total mass approximate for one working length "L" of	
	DE	e	Masses per Meter		5,43 Meters	5,93 Meters
100*	118	6,6	16,3	7,7	98	—
150*	170	7,2	26,0	11,8	154	—
200*	222	7,7	36,5	17,7	218	—
250*	274	8,3	48,8	24,0	290	—
300*	326	8,8	61,8	29,9	367	—
350**	378	9,4	76,7	43,5	463	—
400	429	9,9	91,9	49,0	551	—
450**	480	10,5	109,2	56,2	653	—
500	532	11,0	126,9	68,0	762	—
600	635	12,1	166,9	95,3	1009	—
700	738	13,2	211,9	133,4	1293	—
800	842	14,3	262,2	164,7	1559	—
900	945	15,4	317,1	221,4	1955	—
1000	1048	16,5	377,0	146,1	2208	—
1200	1255	18,7	512,0	203,2	—	3311
1400	1462	20,9	667,1	430,9	—	4477
1500	1565	22,0	751,9	494,4	—	5055
1600	1668	23,1	841,6	575,6	—	5681

Dimensions in millimeters

Masses in kilograms

*Anchor Gasket Restraint

**Contact your Sales Representative for availability.



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

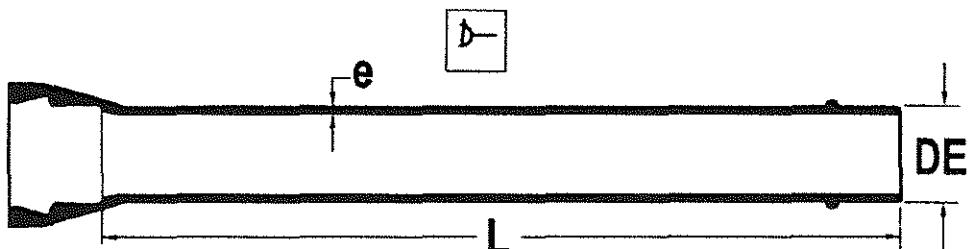


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P 32



Restrained Push On Joint Ductile Iron Pipe: Dimensions and Masses K12



K12

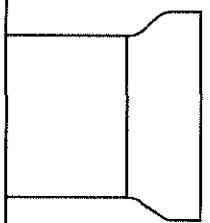
Nominal Diameter DN	Barrel			Socket Mass	Total mass approximate for one working length "L" of	
	DE	e	Masses per Meter		5,43 Meters	5,93 Meters
100*	118	7,2	17,7	7,7	104	—
150*	170	7,8	28,0	11,8	166	—
200*	222	8,4	39,7	17,7	236	—
250*	274	9,0	52,8	24,0	313	—
300*	326	9,6	67,3	29,9	397	—
350**	378	10,2	83,1	43,5	499	—
400	429	10,8	100,0	49,0	596	—
450**	480	11,4	118,3	56,2	703	—
500	532	12,0	138,2	68,0	823	—
600	635	13,2	181,8	95,3	1091	—
700	738	14,4	230,8	133,4	1726	—
800	842	15,6	285,5	164,7	2111	—
900	945	16,8	345,4	221,4	2392	—
1000	1048	18,0	410,6	146,1	—	—
1200	1255	20,4	557,8	203,2	—	3590
1400	1462	22,8	726,8	430,9	—	4840
1500	1565	24,0	819,1	494,4	—	5464
1600	1668	25,2	916,9	575,6	—	6137

Dimensions in millimeters

Masses in kilograms

*Anchor Gasket Restraint

**Contact your Sales Representative for availability.

866.DIP.PIPE

INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

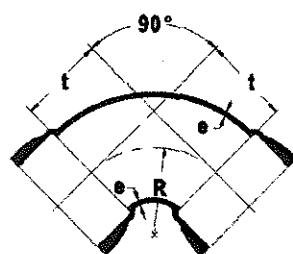
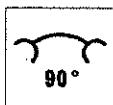


2008 EDITION

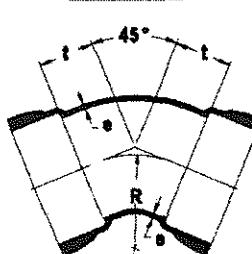
P 33



Restrained Joint Pipe and Fittings - 90°, and 45° Bends



90° Bend



45° Bend

Nominal Size DN	e	t	R	Mass Approx
100*	7,2	114	114	13,6
150*	7,8	152	152	24,9
200*	8,4	178	178	38,6
250*	9,0	229	229	56,7
300*	9,6	254	254	82
350***	10,2	356	292	141
400	10,8	381	318	159
450***	11,4	419	356	238
500	12,0	356	314	263
600	13,2	559	470	361
700*	14,4	640	572	601
800	15,6	739	671	798
900	16,8	660	610	964
1000	18,0	930	846	939
1200	20,4	864	711	1229
1400**	39,4	991	900	3238
1500**	38,1	1041	847	3539
1600**	38,1	1156	896	4111

Dimensions in millimeters

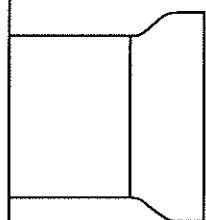
Masses in kilograms

*Anchor Gasket Restraint.

**HP LOK® - 24 Bar only

***Contact your Sales Representative for availability.

Nominal Size DN	e	t	R	Mass Approx
100*	7,2	51	122	13,6
150*	7,8	76	184	20,4
200*	8,4	89	214	34,0
250*	9,0	114	276	47,6
300*	9,6	140	337	73
350*	10,2	191	306	120
400	10,8	203	337	134
450*	11,4	216	368	206
500	12,0	241	429	247
600	13,2	279	356	290
700*	14,4	325	616	506
800	15,6	371	736	662
900	16,8	292	506	787
1000	18,0	460	930	685
1200	20,4	610	736	1093
1400**	39,4	521	1043	2438
1500**	38,1	546	1155	2675
1600**	38,1	572	1214	2949



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

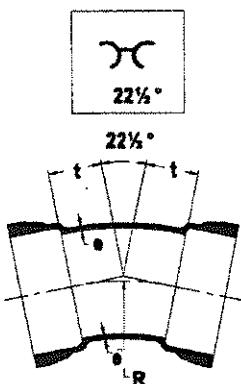
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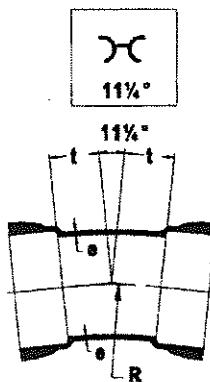
P 34

Restrained Joint Pipe and Fittings - 22½° and 11¼° Bends



22 1/2° Bend

Nominal Size DN	θ	t	R	Mass Approx
100*	7,2	51	256	13,6
150*	7,8	76	383	20,4
200*	8,4	89	448	34,0
250*	9,0	114	575	49,9
300*	9,6	140	702	75
350***	10,2	191	638	122
400	10,8	203	702	136
450***	11,4	216	767	206
500	12,0	241	894	249
600	13,2	279	367	293
700*	14,4	175	532	442
800	15,6	196	653	569
900	16,8	221	766	742
1000	18,0	241	826	519
1200	20,4	610	894	1109
1400**	39,4	356	823	2118
1500**	38,1	305	1001	2103
600**	38,1	279	1059	2202



11 1/4° Bend

Nominal Size DN	θ	t	R	Mass Approx
100*	7,2	51	516	13,6
150*	7,8	76	775	20,4
200*	8,4	89	902	34,0
250*	9,0	114	1161	49,9
300*	9,6	140	1418	75
350*	10,2	191	1289	122
400	10,8	203	1418	136
450*	11,4	216	1548	209
500	12,0	241	1805	249
600	13,2	279	355	293
700*	14,4	94	517	406
800	15,6	135	962	535
900	16,8	203	1547	671
1000	18,0	160	1163	454
1200	20,4	610	1805	1111
1400**	39,4	130	783	1553
1500**	38,1	216	1119	1877
1600**	38,1	178	1106	1926

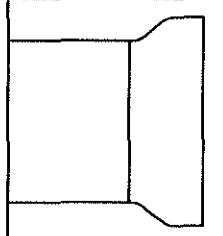
Dimensions in millimeters

Masses in kilograms

*Anchor Gasket Restraint.

**HP LOK® - 24 Bar only

***Contact your Sales Representative for availability.



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

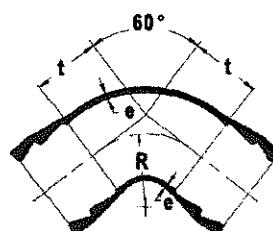
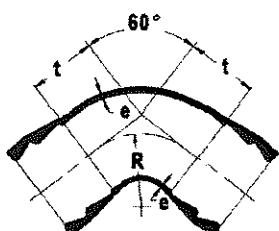


2008 EDITION

P 35



Restrained Joint Pipe and Fittings - 60°, 30° and 55/8° Bends



Nominal Size DN	e	t	R	Mass Approx.
1400*	39,4	610	876	2645

Dimensions in millimeters

Masses in kilograms

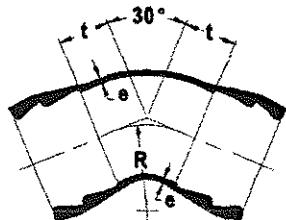
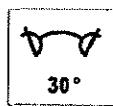
*HP LOK® - 24 Bar only

Nominal Size DN	e	t	R	Mass Approx.
500	12,0	127	1463	218
600	13,2	152	1876	245
900	16,8	203	2327	730
1200	20,4	254	3102	703
1400*	39,4	279	4131	1931
1500*	38,1	216	2244	1878
1600*	38,1	178	2218	1926

Dimensions in millimeters

Masses in kilograms

*HP LOK® - 24 Bar only

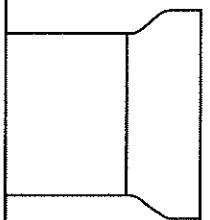


Nominal Size DN	e	t	R	Mass Approx.
1400*	39,4	406	1130	2234
1500*	38,1	483	1407	2552
1600*	38,1	470	1497	2714

Dimensions in millimeters

Masses in kilograms

*HP LOK® - 24 Bar only

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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

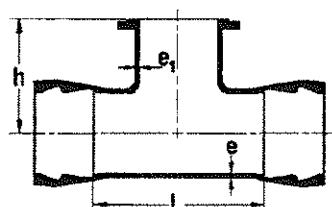


2008 EDITION

P 36



Restrained Joint Pipe and Fittings – All Socket Tee



DN x DN	e	L	e ₁	h	Mass
100 x 100*	8.4	229.0	8.4	114.0	20.4
150 x 100*	9.1	305.0	8.4	152.0	34.0
150 x 150*	9.1	305.0	9.1	152.0	36.3
200 x 100*	9.8	356.0	8.4	178.0	49.9
200 x 150*	9.8	356.0	9.1	178.0	52.2
200 x 200*	9.8	356.0	9.8	178.0	56.7
250 x 100*	10.5	457.0	8.4	229.0	72.6
250 x 150*	10.5	457.0	9.1	229.0	74.8
250 x 200*	10.5	457.0	9.8	229.0	81.6
250 x 250*	10.5	457.0	10.5	229.0	86.2
300 x 150*	11.2	508.0	9.1	254.0	107.0
300 x 200*	11.2	508.0	9.8	254.0	111.0
300 x 250*	11.2	508.0	10.5	254.0	116.0
300 x 300*	11.2	508.0	11.2	254.0	125.0
350 x 150*	11.9	711.0	9.1	356.0	172.0
250 x 200*	11.9	711.0	9.8	356.0	179.0
350** x 250**	11.9	711.0	10.5	356.0	186.0
350** x 300**	11.9	711.0	11.2	356.0	197.0
350** x 350**	11.9	711.0	11.9	356.0	213.0
400 x 150*	12.6	762.0	9.1	381.0	200.0
400 x 200*	12.6	762.0	9.8	381.0	204.0
400 x 250*	12.6	762.0	10.5	381.0	211.0
400 x 300*	12.6	762.0	11.2	381.0	222.0
400 x 350*	12.6	762.0	11.9	381.0	240.0
400 x 400*	12.6	762.0	12.6	381.0	243.0

DN x DN	e	L	e ₁	h	Mass
450 x 150*	13.3	660.0	9.1	394.0	261.0
450 x 200*	13.3	660.0	9.8	394.0	265.0
450 x 250*	13.3	660.0	10.5	394.0	272.0
450 x 300*	13.3	660.0	11.2	394.0	281.0
450 x 400	13.3	838.0	12.6	419.0	333.0
450 x 450**	13.3	838.0	13.3	419.0	361.0
500 x 150*	14.0	559.0	9.1	406.0	286.0
500 x 200*	14.0	559.0	9.8	406.0	290.0
500 x 250*	14.0	559.0	10.5	406.0	297.0
500 x 300*	14.0	559.0	11.2	406.0	306.0
500 x 350*	14.0	711.0	11.9	432.0	352.0
500 x 400	14.0	914.0	12.6	457.0	392.0
500 x 450**	14.0	914.0	13.3	457.0	424.0
500 x 500	14.0	914.0	14.0	457.0	435.0
600 x 150*	15.4	762.0	9.1	483.0	367.0
600 x 200*	15.4	762.0	9.8	483.0	374.0
600 x 250*	15.4	762.0	10.5	483.0	379.0
600 x 300*	15.4	762.0	11.2	483.0	390.0
600 x 350*	15.4	762.0	11.9	483.0	408.0
600 x 400	15.4	762.0	12.6	483.0	411.0
600 x 450**	15.4	864.0	13.3	533.0	472.0
600 x 500	15.4	864.0	14.0	533.0	485.0

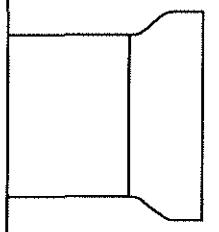
Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for restraint

**Contact your Sales Representative for availability

1400, 1500 and 1600 sizes are restrained by HP LOK®



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

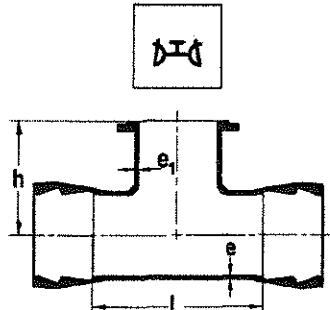
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P 37

Restrained Joint Pipe and Fittings – All Socket Tee (cont.)



DN x dn	e	L	e ₁	h	Mass
600 x 600	15.4	864.0	15.4	533.0	490.0
700 x 200*	16.8	424.0	9.8	495.0	492.0
700 x 400	19.6	630.0	12.6	495.0	581.0
700 x 700**	16.8	996.0	16.8	500.0	805.0
800 x 200*	18.2	424.0	9.8	541.0	615.0
800 x 400	18.2	635.0	12.6	551.0	719.0
800 x 450**	18.2	686.0	13.3	551.0	767.0
800 x 600	18.2	1044.0	15.4	526.0	896.0
800 x 700**	18.2	1044.0	16.8	521.0	980.0
800 x 800	18.2	1100.0	18.2	551.0	1043.0
900 x 200*	19.6	889.0	9.8	660.0	971.0
900 x 250*	19.6	889.0	10.5	660.0	975.0
900 x 300*	19.6	889.0	11.2	660.0	987.0
900 x 350*	19.6	889.0	11.9	660.0	1002.0
900 x 400	19.6	889.0	12.6	660.0	1005.0
900 x 450**	19.6	889.0	13.3	660.0	1034.0
900 x 500	19.6	889.0	14.0	660.0	1048.0
900 x 600	19.6	889.0	15.4	660.0	1052.0
900 x 900	19.6	1422.0	19.6	711.0	1479.0
1000 x 200*	21.0	450.0	9.8	650.0	553.0
1000 x 400	21.0	645.0	12.6	594.0	761.0
1000 x 500	21.0	780.0	14.0	650.0	782.0
1000 x 600	21.0	1306.0	15.4	625.0	1030.0
1000 x 800	21.0	1105.0	18.2	645.0	1066.0
1000 x 900	21.0	1306.0	19.6	655.0	1227.0
1000 x 1000	21.0	1316.0	21.0	655.0	1077.0

DN x dn	e	L	e ₁	h	Mass
1200 x 300*	23.8	1321.0	11.2	864.0	1331.0
1200 x 350*	23.8	1321.0	11.9	864.0	1347.0
1200 x 400	23.8	1321.0	12.6	864.0	1349.0
1200 x 450**	23.8	1321.0	13.3	864.0	1379.0
1200 x 500	23.8	1321.0	14.0	864.0	1393.0
1200 x 600	23.8	1321.0	15.4	864.0	1395.0
1200 x 800	23.8	1486.0	18.2	754.0	1583.0
1200 x 900	23.8	1727.0	19.6	864.0	1864.0
1200 x 1000	23.8	1544.0	21.0	655.0	1495.0
1200 x 1200	23.8	1727.0	23.8	864.0	1746.0
1400 x 600	26.6	965.0	15.4	991.0	1780.0
1400 x 900	26.6	1575.0	19.6	940.0	2481.0
1400 x 1200	26.6	1575.0	23.8	991.0	2420.0
1400 x 1400	26.6	1816.0	26.6	909.0	2724.0
1500 x 900	28.0	1575.0	19.6	1067.0	2558.0
1500 x 1200	28.0	2083.0	23.8	1092.0	2980.0
1500 x 1400	28.0	2083.0	26.6	1092.0	3205.0
1500 x 1500	28.0	2083.0	28.0	1041.0	3062.0
1600 x 900	29.4	1499.0	19.6	1118.0	2769.0
1600 x 1200	29.4	2311.0	23.8	1143.0	3570.0
1600 x 1400	29.4	2311.0	26.6	1168.0	3817.0
1600 x 1500	29.4	2311.0	28.0	1118.0	3731.0
1600 x 1600	29.4	2311.0	29.4	1156.0	3765.0

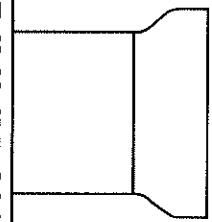
Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for restraint

**Contact your Sales Representative for availability

1400, 1500 and 1600 sizes are restrained by HP LOK®



INTERNATIONAL

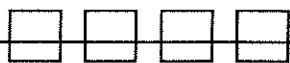
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

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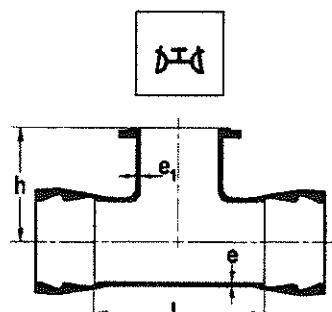


2008 EDITION

P 38



Restrained Joint Pipe and Fittings - Double Socket Body Tees with Flanged Branch



DN x DN	e	L	B ₁	h	Mass		
					PN10	PN16	PN25
100 x 100*	8.4	229.0	8.4	192.0	20.4	20.4	20.4
150 x 100*	9.1	305.0	8.4	230.0	34.0	34.0	34.0
150 x 150*	9.1	305.0	9.1	224.0	36.3	36.3	36.3
200 x 100*	9.8	356.0	8.4	256.0	49.9	49.9	49.9
200 x 150*	9.8	356.0	9.1	249.0	52.2	52.2	52.2
200 x 200*	9.8	365.0	9.8	254.0	54.4	54.4	54.4
250 x 100*	10.5	457.0	8.4	306.0	70.3	70.3	70.3
250 x 150*	10.5	457.0	9.1	300.0	74.8	74.8	74.8
250 x 200*	10.5	457.0	9.8	305.0	77.1	77.1	77.1
250 x 250*	10.5	457.0	10.5	290.0	79.4	79.4	83.9
300 x 100*	11.2	508.0	8.4	332.0	102.0	102.0	102
300 x 150*	11.2	508.0	9.1	325.0	104.0	104.0	104
300 x 200*	11.2	508.0	9.8	330.0	107.0	107.0	109
300 x 250*	11.2	508.0	10.5	315.0	111.0	111.0	113
300 x 300*	11.2	508.0	11.2	310.0	113.0	113.0	118
350** x 150**	11.9	711.0	9.1	375.0	170.0	170.0	172
350** x 200**	11.9	711.0	9.8	375.0	175.0	175.0	175
350** x 250**	11.9	711.0	10.5	375.0	177.0	177.0	181
350** x 300**	11.9	711.0	11.2	419.0	186.0	186.0	191
350** x 350**	11.9	711.0	11.9	445.0	191.0	193.0	200
400 x 150	12.6	762.0	9.1	400.0	195.0	195.0	197
400 x 200*	12.6	762.0	9.8	400.0	200.0	200.0	200
400 x 250*	12.6	762.0	10.5	400.0	202.0	202.0	206
400 x 300*	12.6	762.0	11.2	445.0	211.0	211.0	215
400 x 350*	12.6	762.0	11.9	470.0	218.0	220.0	227
400 x 400*	12.6	762.0	12.6	474.0	222.0	227.0	236

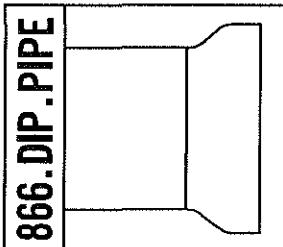
DN x DN	e	L	B ₁	h	Mass		
					PN10	PN16	PN25
450** x 150*	13.3	660.0	9.1	413.0	256.0	256.0	259
450** x 200*	13.3	660.0	9.8	413.0	261.0	261.0	261
450** x 250*	13.3	660.0	10.5	413.0	263.0	263.0	268
450** x 300*	13.3	660.0	11.2	413.0	268.0	268.0	272
450** x 350*	13.3	838.0	11.9	445.0	299.0	302.0	308
450** x 400	13.3	838.0	12.6	445.0	304.0	308.0	318
450** x 450	13.3	838.0	13.3	445.0	304.0	311.0	322
500 x 150*	14.0	559.0	9.1	451.0	283.0	283.0	283
500 x 200*	14.0	559.0	9.8	451.0	286.0	286.0	288
500 x 250*	14.0	559.0	10.5	451.0	290.0	290.0	293
500 x 300*	14.0	559.0	11.2	495.0	297.0	297.0	302
500 x 350*	14.0	711.0	11.9	521.0	329.0	331.0	338
500 x 400	14.0	914.0	12.6	483.0	363.0	363.0	379
500 x 450	14.0	914.0	13.3	483.0	367.0	374.0	383
500 x 500	14.0	914.0	14.0	489.0	370.0	383.0	392
600 x 150*	15.4	762.0	9.1	502.0	365.0	365.0	365
600 x 200*	15.4	762.0	9.8	502.0	367.0	367.0	370
600 x 250*	15.4	762.0	10.5	502.0	370.0	370.0	374
600 x 300*	15.4	762.0	11.2	546.0	379.0	376.0	383
600** x 350*	15.4	762.0	11.9	572.0	383.0	386.0	392
600 x 400	15.4	762.0	12.6	575.0	390.0	395.0	404
600** x 450	15.4	864.0	13.3	584.0	417.0	424.0	435
600 x 500	15.4	864.0	14.0	591.0	424.0	438.0	447

Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for restraint

**Contact your Sales Representative for availability.



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

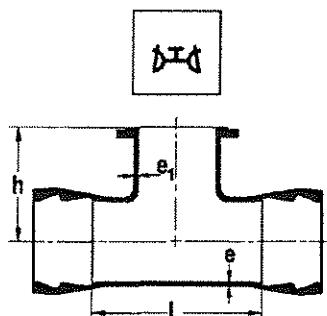
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P 39

Restrained Joint Pipe and Fittings - Double Socket Body Tees with Flanged Branch



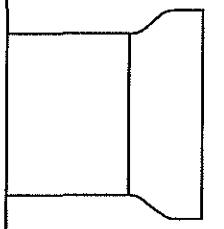
DN x DN	e	L	e ₁	h	Mass	PN10	PN16	PN25	DN x DN	e	L	e ₁	h	Mass	PN10	PN16	PN25
600 x 600	15.4	864.0	15.4	574.0	431.0	454.0	465		1200 x 300*	23.8	1321.0	11.2	883.0	1315.0	1315.0	1320	
700 x 200*	16.8	424.0	9.8	617.0	490.0	490.0	492		1200 x 350*	23.8	1321.0	11.9	889.0	1318.0	1320.0	1327	
700 x 400	16.8	630.0	12.6	638.0	565.0	569.0	581		1200 x 400	23.8	1321.0	12.6	889.0	1320.0	1324.0	1336	
700 x 700	16.8	996.0	16.8	657.0	705.0	717.0	746		1200 x 450*	23.8	1321.0	13.3	889.0	1322.0	1329.0	1340	
800 x 200*	18.2	242.0	9.8	686.0	615.0	615.0	717		1200 x 500	23.8	1321.0	14.0	895.0	1327.0	1340.0	1349	
800 x 400	18.2	635.0	12.6	689.0	703.0	708.0	719		1200 x 600	23.8	1321.0	15.4	879.0	1331.0	1354.0	1365	
800 x 450	18.2	686.0	13.3	690.0	723.0	733.0	742		1200 x 800	23.8	1486.0	18.2	915.0	1548.0	1474.0	1517	
800 x 600	18.2	1044.0	15.4	664.0	860.0	882.0	891		1200 x 900	23.8	1727.0	19.6	895.0	1644.0	1662.0	1712	
800 x 700	18.2	1044.0	16.8	678.0	878.0	891.0	921		1200 x 1000	23.8	1544.0	21.0	945.0	1549.0	1583.0	1649	
800 x 800	18.2	1100.0	18.2	709.0	919.0	932.0	975		1200 x 1200	23.8	1727.0	23.8	965.0	1721.0	1774.0	1851	
900 x 200*	19.6	889.0	9.8	679.0	964.0	964.0	966		1400 x 600	26.6	965.0	15.4	1006.0	1717.0	1742.0	1751	
900 x 250*	19.6	889.0	10.5	679.0	968.0	968.0	971		1400 x 900	26.6	1575.0	19.6	1035.0	2288.0	2304.0	2356	
900 x 300*	19.6	889.0	11.2	679.0	971.0	971.0	975		1400 x 1200	26.6	1575.0	23.8	1092.0	2393.0	2445.0	2522	
900 x 350*	19.6	889.0	11.9	686.0	973.0	975.0	982		1400 x 1400	26.6	1816.0	26.6	1137.0	2638.0	2688.0	2810	
900 x 400	19.6	889.0	12.6	686.0	975.0	980.0	991		1500 x 900	28.0	1575.0	19.6	1067.0	2327.0	2343.0	2395	
900 x 450	19.6	889.0	13.3	686.0	977.0	987.0	996		1500 x 1200	28.0	2083.0	23.8	1092.0	2887.0	2939.0	3016	
900 x 500	19.6	889.0	14.0	692.0	982.0	996.0	1005		1500 x 1400	28.0	2083.0	26.6	1092.0	2921.0	2973.0	3053	
900 x 600	19.6	889.0	15.4	676.0	989.0	1012.0	1023		1500 x 1500	28.0	2083.0	28.0	1092.0	2896.0	2978.0		
900 x 900	19.6	1422.0	19.6	743.0	1259.0	1277.0	1329		1600 x 900	29.4	1499.0	19.6	1118.0	2538.0	2556.0	2606	
1000 x 200*	21.0	450.0	9.8	768.0	551.0	551.0	553		1600 x 1200	29.4	2311.0	23.8	1143.0	3479.0	3529.0	3608	
1000 x 400	21.0	645.0	12.6	735.0	655.0	660.0	669		1600 x 1400	29.4	2311.0	26.6	1219.0	3579.0	3629.0	3751	
1000 x 500	21.0	780.0	14.0	790.0	735.0	748.0	758		1600 x 1500	29.4	2311.0	28.0	1168.0	3565.0	3645.0		
1000 x 600	21.0	1306.0	15.4	765.0	993.0	1016.0	1025		1600 x 1600	29.4	2311.0	29.4	1168.0	3540.0	3620.0	3758	
1000 x 800	21.0	1105.0	18.2	804.0	943.0	957.0	1000										
1000 x 900	21.0	1306.0	19.6	825.0	1064.0	1080.0	1132										
1000 x 1000	21.0	1316.0	21.0	829.0	1075.0	1109.0	1175										

Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for restraint

1400, 1500 and 1600 sizes are restrained by HP LOK®



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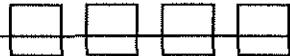
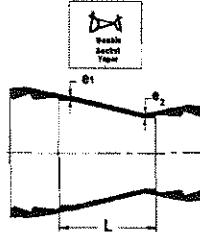
RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®



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Restrained Joint Pipe and Fittings -
Double Socket Taper

Large Diameter		Small Diameter		L	Mass Approx
Nominal Size DN	e ₁	Nominal Size DN	e ₂		
150*	7,8	100*	7,2	127	15,9
200*	8,4	100*	7,2	178	24,9
200*	8,4	150*	7,8	178	27,2
250*	9,0	100*	7,2	203	31,8
250*	9,0	150*	7,8	203	36,3
250*	9,0	200*	8,4	203	40,8
300*	9,6	100*	7,2	254	45
300*	9,6	150*	7,8	254	48
300*	9,6	200*	8,4	254	54
300*	9,6	250*	9,0	254	61
350*	10,2	150*	7,8	406	77
350*	10,2	200*	8,4	406	84
350*	10,2	250*	9,0	406	93
350*	10,2	300*	9,6	406	104
400	10,8	150*	7,8	457	86
400	10,8	200*	8,4	457	95
400	10,8	250*	9,0	457	102
400	10,8	300*	9,6	457	116
400	10,8	350*	10,2	457	136
450*	11,4	200*	8,4	483	132
450*	11,4	250*	9,0	483	138
450*	11,4	300*	9,6	483	152
450*	11,4	350*	10,2	483	172
450*	11,4	400	10,8	483	179
500	12,0	250*	9,0	508	161
500	12,0	300*	9,6	508	172
500	12,0	350*	10,2	508	193
500	12,0	400	10,8	508	200
500	12,0	450*	11,4	508	236

Large Diameter		Small Diameter		L	Mass Approx
Nominal Size DN	e ₁	Nominal Size DN	e ₂		
600	13,2	300*	9,6	610	202
600	13,2	350*	10,2	610	222
600	13,2	400	10,8	610	231
600	13,2	450*	11,4	610	258
600	13,2	500	12,0	610	286
700*	14,4	500	12,0	445	354
700*	14,4	600	13,2	295	336
800	15,6	600	13,2	470	433
800	15,6	700*	14,4	579	560
900	16,8	500	12,0	914	612
900	16,8	600	13,2	610	553
900	16,8	700*	14,4	480	615
900	16,8	800	15,6	310	621
1000	18,0	800	15,6	470	556
1000	18,0	900	16,8	574	671
1200	20,4	900	16,8	914	923
1200	20,4	1000	18,0	320	948
1400	39,4	600	22,6	965	1441
1400	39,4	900	29,2	711	1503
1400	39,4	1200	36,1	457	1606
1500	38,1	900	29,2	762	1605
1500	38,1	1200	36,1	457	1672
1500	38,1	1400	39,4	330	1693
1600	38,1	900	29,2	826	1754
1600	38,1	1200	36,1	572	1873
1600	38,1	1400	39,4	394	1848
1600	38,1	1500	38,1	318	1799

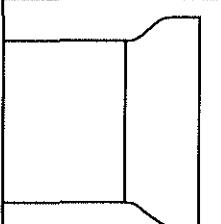
Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for Restraint.

**Contact your Sales Representative for availability.

866.DIP.PIPE



INTERNATIONAL

RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®

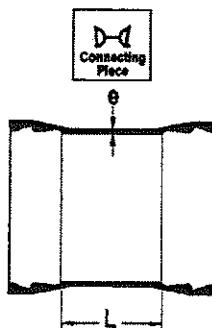


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Restrained Joint Pipe and Fittings - Connecting Piece



Nominal Size DN	e	L	Mass Approx.
100*	—	—	—
150*	—	—	—
200*	—	—	—
250*	—	—	—
300*	—	—	—
350	10,2	203	107
400	10,8	203	116
450	11,4	105	168
500	12,0	110	197
600	13,2	121	211
700*	—	—	—
800	15,6	150	503
900	16,8	203	658
1000*	—	—	—
1200	20,4	196	524
1400*	—	—	—
1500*	—	—	—
1600*	—	—	—

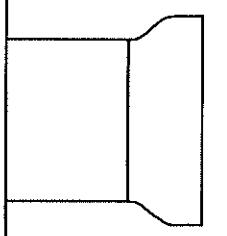
Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for Restraint.

**Contact your Sales Representative for availability.

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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

TR FLEX® - Anchor Gaskets - HP LOK®



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Restrained Joint Pipe and Fittings - Connecting Piece



Nominal Size DN	B	L	Mass Approx.
100*	8,4	133	6
150*	9,1	145	9
200*	9,9	160	16
250*	10,4	166	22
300*	11,2	174	33
350*	20,8	223	98
400	22,6	230	110
450*	24,4	237	164
500	26,2	245	154
600	29,5	260	227
700*	30,5	287	259
800	30,5	299	379
900	40,1	319	540
1000	45,2	240	567
1200	49,8	258	907
1400	56,6	278	1272
1500	63,5	320	1512
1600	69,9	340	1764

Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for Restraint.

**Contact your Sales Representative for availability.

Caps can be provided with bosses suitable for tapping.

1400, 1500 and 1600 sizes are restrained by HP LOK®

Nominal Size DN	DE	e	L	Mass Approx.
100*	118	8,4	165	5
150*	170	9,1	178	7
200*	222	9,9	191	14
250*	274	10,4	203	21
300*	326	11,2	210	23
350*	378	11,9	260	30
400	429	12,7	260	41
450*	480	19,1	267	70
500	532	20,3	273	84
600	635	22,6	286	138
700*	738	26,2	343	262
800	842	26,2	343	286
900	945	29,2	368	357
1000	1048	32,5	330	544
1200	1255	36,1	356	794
1400	1462	39,4	394	850
1500	1565	44,5	406	1361
1600	1668	44,5	406	1497

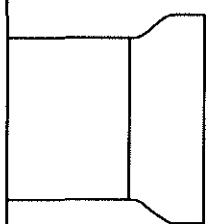
Dimensions in millimeters

Masses in kilograms

*Anchor Gaskets are used for Restraint.

**Contact your Sales Representative for availability.

Plugs can be provided with bosses suitable for tapping.

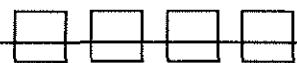


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RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS**TR FLEX® - Anchor Gaskets - HP LOK®**

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**Products for Water, Wastewater and Fire Protection**

Ductile Iron Pipe	SIZE RANGE (inches)	SIZE RANGE (metric)
TYTON JOINT® Pipe	4"-64" Ductile Iron	100-1600
Mechanical Joint Pipe	4"-12" Ductile Iron	
TR FLEX® Restrained Joint Pipe	4"-64" Ductile Iron	400-1600
HP LOK® Restrained Joint Pipe	30"-64"	1400-1600
Flanged Pipe	4"-64" Ductile Iron	100-1600
USIFLEX® Boltless Flexible Joint Pipe — for Subaqueous Installations	4"-48" Ductile Iron	
Restrained Joints		
TR FLEX® Restrained Joint Pipe	4"-64" Ductile Iron	400-1600
TYTON JOINT® Pipe with Anchor Gaskets		100-300
HP LOK® Restrained Joint	30"-64"	1400-1600
MJ FIELD LOK® Gaskets	4"-24"	
FIELD LOK 350® Gaskets	4"-24"	
FIELD LOK® Gaskets	30" & 36"	
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron	
TR TELE FLEX® Assemblies	4"-24" Ductile Iron	
Ductile Iron Fittings		
TYTON® Fittings (Push-On)	14"-64" Ductile Iron	100-1600
TRIM TYTON® Fittings	4"-12" Ductile Iron	
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-64" Ductile Iron	400-1600
Mechanical Joint Fittings	3"-48" Ductile Iron	
TRIM TYTE® MJ Fittings	3"-48" Ductile Iron	
Flanged Fittings	3"-64" Ductile Iron	100-1600
XTRA FLEX® Couplings	4"-24" Ductile Iron	
HP LOK™ (350 psi)		1400-1600
Miscellaneous Products		
PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron	100-1600
RING FLANGE-TYTE™ Gaskets	4"-36"	100-1600
FULL FACE FLANGE-TYTE™ Gaskets	4"-64"	1400-1600
Saddle Outlets	Various Ductile Iron	
Welded Outlets	Various Ductile Iron	
Polyethylene Encasement	4"-64"	100-1600
Anchor Gaskets		100-300

Our products are manufactured in conformance with National and International Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

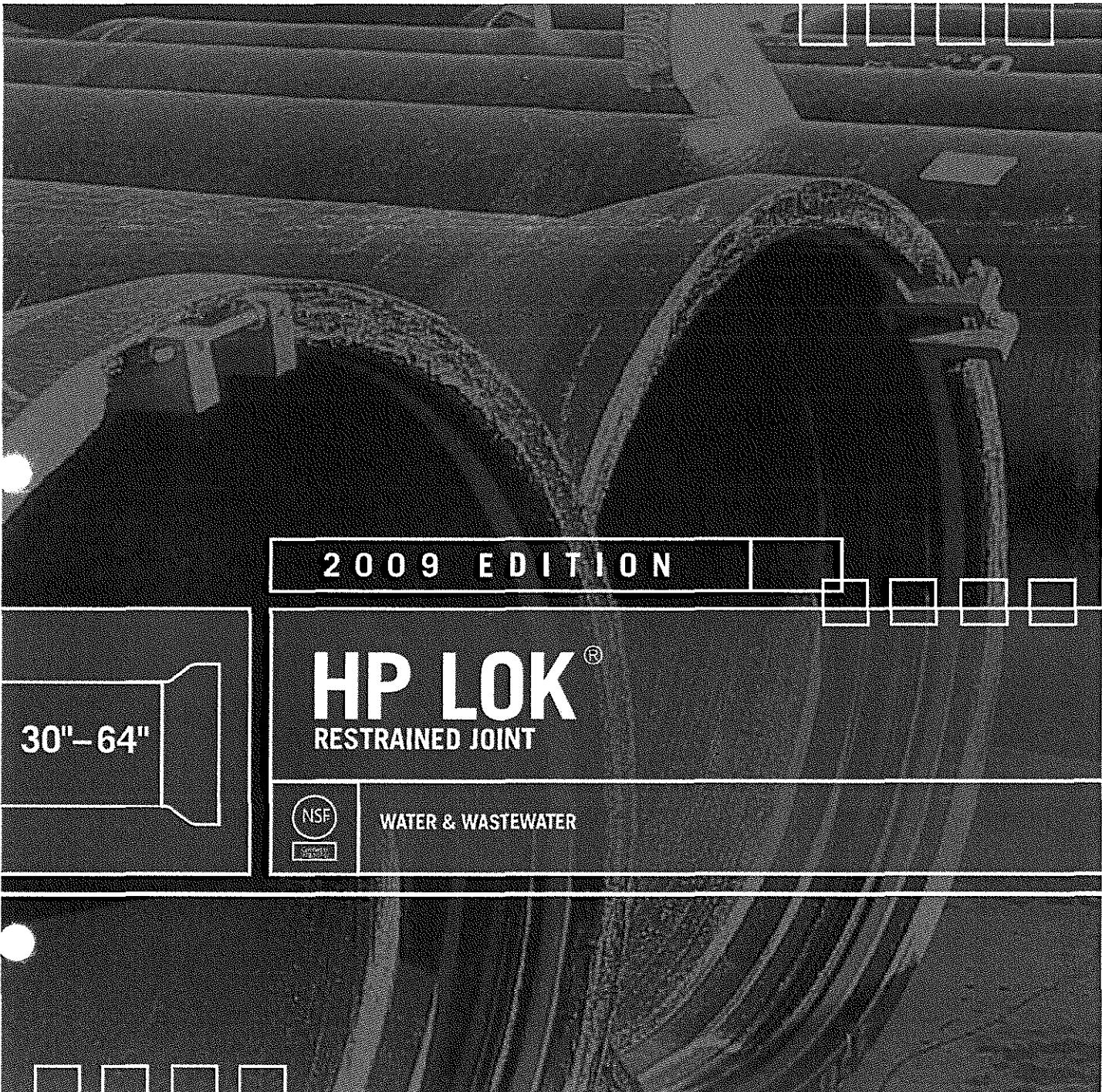
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*All U.S. Pipe brochures and/or products are
subject to change without further notice.*

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Birmingham, AL 35202
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Fax: 205.254.7174
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**MORE
THAN
JUST
PIPE.**





2009 EDITION

30"-64"

HP LOK®

RESTRAINED JOINT



WATER & WASTEWATER

STRONGER
THAN
JUST
PIPE



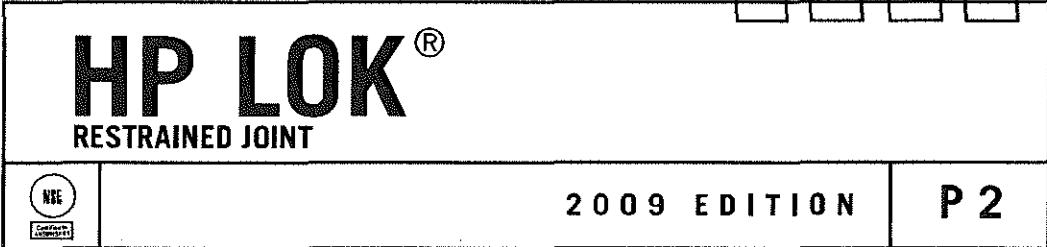
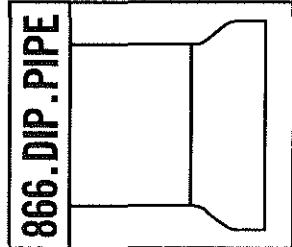
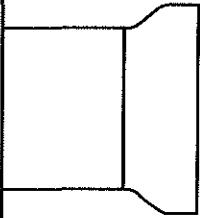


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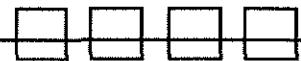


HP LOK® RESTRAINED JOINT



2009 EDITION

P 3



HP LOK Restrained Joint Pipe and Fittings 30"-64"

HP LOK Restrained Joint Pipe and Fittings provide flexible push-on joints for 30"-64" pipe sizes. The HP LOK Restrained Joint has a working pressure equivalent to the working pressure rating of the parent pipe with a maximum working pressure rating of 350 psi.

30"-36" HP LOK spigot ends are compatible with 30"-36" TR FLEX® Pipe and Fittings. The rating will be 250 psi when used with TR FLEX Fittings.

42"-64" HP LOK Pipe is not compatible with 42"-64" TR FLEX Pipe and Fittings.

Pipe for wastewater service may be furnished in accordance with **ASTM 746 Standard Specification for Ductile Iron Gravity Sewer Pipe**.

For certain wastewater applications, a ceramic quartz filled, amine cured, novolac epoxy lining is available — see PROTECTO 401™ Ceramic Epoxy Lined Pipe and Fittings brochure.

HP LOK Pipe and Fittings utilize the TYTON® Gasket.

An HP LOK Ring that is factory installed in the bell provides a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.

*For higher pressure ratings, consult your U.S. Pipe Sales Representative.

For a suggested design procedure for the restraint of thrust forces in pressurized, buried Ductile Iron piping systems, the design engineer should refer to the current DIPRA publication "Thrust Restraint Design for Ductile Iron Pipe" or the U.S. Pipe brochure "The Use And Application of Restrained Joints for Ductile Iron Pipelines."

ANSI/AWWA C151/A21.51 "Ductile-Iron Pipe, Centrifugally Cast, for Water."

Asphaltic outside coating and inside lining are in accordance with ANSI/AWWA C151/A21.51.

ANSI/AWWA C153/A21.53 "Ductile-Iron Compact Fittings For Water Service" or ANSI/AWWA C110/A21.10 "Ductile-Iron and Gray-Iron Fittings, For Water."

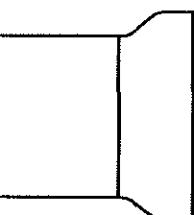
HP LOK® Fittings conform to applicable requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110/A21.10.

ANSI/AWWA C104/A21.4 "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water."

Cement lining, in accordance with ANSI/AWWA C104/A21.4, or special linings and/or coatings can be furnished for specific conditions.

NOTE: If specifiers or users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Ductile Iron Pipe Systems" for proper external protection procedures. TYTON®, HP LOK® and TYTON JOINT® are Registered Trademarks of U.S. Pipe and Foundry Co., LLC.

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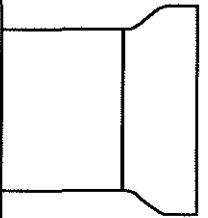
Suggested Specifications for HP LOK Restrained Push-On Joint Pipe and Fittings

30" – 64" restrained joints shall be HP LOK Pipe and Fittings or pre-approved equal.

Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi and shall conform to all applicable requirements of **ANSI/AWWA C110/A21.10** and **ANSI/AWWA C153/A21.53** with the exception of the manufacturer's proprietary design dimensions.

Restrained joint pipe shall be Ductile Iron manufactured in accordance with the requirements of **ANSI/AWWA C151/A21.51**. Push-on joints for such pipe shall be in accordance with **ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron Pipe and Fittings."** Pipe thickness shall be designed in accordance with **ANSI/AWWA C150/A21.50 "Thickness Design of Ductile-Iron Pressure Pipe,"** and shall be based on laying conditions and internal pressures as stated in the project plans and specifications.

NOTE: Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with **ANSI/AWWA C104/A21.4**. Asphaltic outside coating shall be in accordance with **ANSI/AWWA C151/A21.51** for pipe and **ANSI/AWWA C110/A21.10** or **ANSI/AWWA C153/A21.53** for fittings.



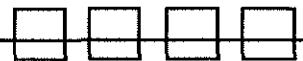
HP LOK®

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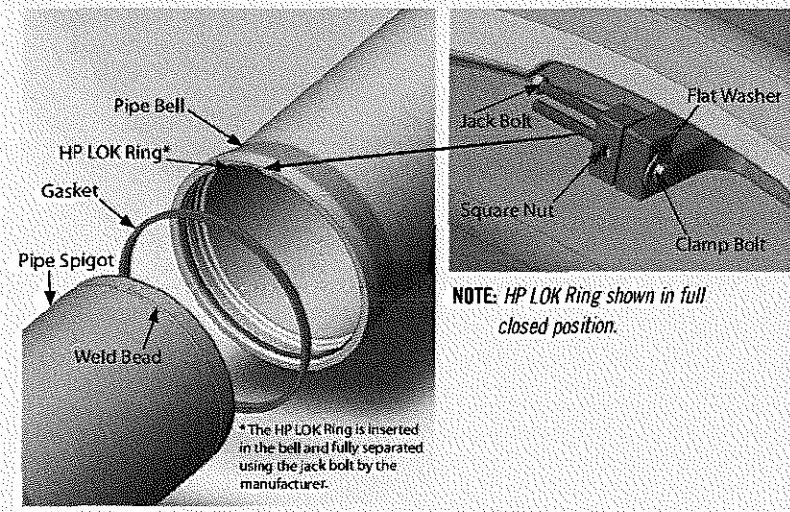
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Instructions for Assembling HP LOK Pipe and Fittings 30"-64"

1. The gasket seat must be clean and free of debris or any foreign matter.*
2. Install the gasket in the bell. Do not lubricate gasket prior to installing bell.*
3. Lubricate the gasket and spigot end of the mating pipe with TYTON JOINT® Lubricant.*
4. The spigot end of the mating pipe may now be inserted into the bell. The installer must make sure that the spigot end is fully homed in the bell and not deflected. The HP LOK® Ring can be slid back and forth when the spigot end is inserted correctly and not deflected.
5. The jack bolt should now be removed and discarded.
6. The clamp bolt can now be snugged down so that the HP LOK Ring contacts the pipe surface. Use only enough bolt torque to make sure the HP LOK Ring is in contact with the mating spigot end and to prevent the HP LOK Ring from spreading.
7. Inspect the full circumference of the HP LOK Ring to make sure it is in contact with the spigot end of the pipe and not resting on the weld bead. If the HP LOK Ring is sitting on the weld bead, the spigot end is not fully homed in the bell or the joint is excessively deflected for installation.
8. When it is certain that the HP LOK Ring is fully contacting the spigot end, extend the joint (remove slack in the joint) by pulling on the assembled pipe joints. Do not use excessive force. The spigot end should slide easily under the HP LOK Ring.
9. Tighten the clamp bolt to approximately 10 to 20 ft-lb of torque. Do not over tighten.
10. Deflect the joint as desired, not to exceed 1/2 degree.
11. The joint is now completely assembled.

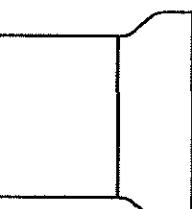


Components required for each joint:

- 1 HP LOK® Ring (factory installed)
- 1 TYTON® Gasket
- TYTON JOINT® Lubricant
- 1 jack bolt (factory installed)
- 1 clamp bolt (factory installed)

* Refer to page 6.

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HP LOK® RESTRAINED JOINT



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TYTON® Gasket Installation Instructions

Clean the gasket and the bell. Loop the gasket as shown in the illustrations. Place the gasket into the mating gasket seating area of the bell with the rounded bulb end of the gasket entering first. Seat the gasket heel firmly in the retainer seat of the bell.

It will be necessary to form equally spaced loops in the gasket for proper insertion. It is recommended to use two or three loops for 30" and 36" gaskets and four to six loops in 42"-64" gaskets.

Make sure the gasket is uniformly seated around the inside of the socket.

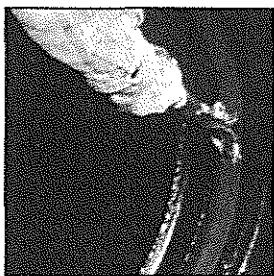
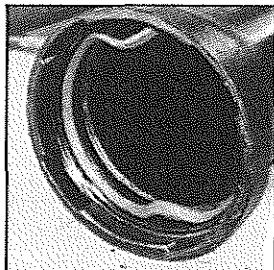
In colder weather, the gaskets should be kept at temperatures above 40°F to ensure the resiliency of the gasket during installation. In such conditions, the gaskets should be stored in a heated area or heated in drums of water prior to installation. If water is used, the gaskets should be dried before installation in the bell.

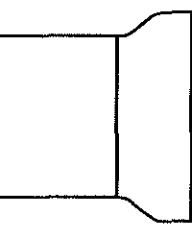
Lubrication

After the gasket has been installed into the bell, a thin film of TYTON JOINT® Lubricant should be applied to the inside surface of the gasket which will come in contact with the beveled end of the pipe. Only TYTON JOINT Lubricant should be used.

CAUTION: *The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.*

Clean the spigot end of the pipe back to the assembly stripes. Apply TYTON JOINT Lubricant to the cleaned spigot end. Do not allow the lubricated surface to touch the ground or trench sides prior to installation.





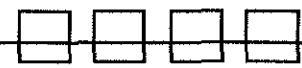
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Pipeline Expansion

HP LOK® Pipe and Fittings Socket Pull Out

(Linear Expansion Within The Assembled Socket)

In HP LOK Pipe and Fitting sockets, there is a small amount of slack or pullout available at each joint. This pullout, or expansion capability, is the result of clearance inside the socket required for joint assembly. The expansion can be minimized by extending the joint after assembly and prior to setting the joint deflection.

The expansion of the joint in both pipe and fitting sockets must be considered, especially in the following cases:

- a. When HP LOK Pipe are used above ground (bridge crossings, on piers, etc.),
- b. When HP LOK Pipe are used in poor soil conditions (swamps, marshes, etc.),
- c. When long lengths of HP LOK Pipe are required for restraint due to high operating pressures and/or unfavorable soil parameters,
- d. Where HP LOK Pipe are used inside casing pipe,
- e. Where HP LOK Pipe and Fittings are in vertical applications. If HP LOK joints are used in vertical installations, provisions must be made to keep the joint extended. Failure to keep vertical joints extended can result in movement of pipeline components.

When HP LOK Pipe are used inside a casing pipe, it is recommended that the assembled pipe be pulled through the casing.

Please note that if the joint is not extended during assembly, the expansion per joint during line pressurization will increase the length of a 1000 foot long installation up to 3 feet, depending upon the pipe size. (Refer to Table 1 for the Pullout at each joint.)

Minimum Laying Lengths For HP LOK Pipe

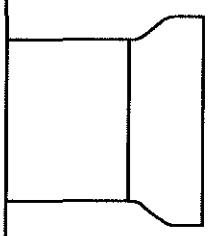
The following drawings and Table 1 define the minimum lengths for HP LOK Pipe when furnished in either Plain End x Plain End, or Bell x Plain End. The minimum laying lengths are determined on the basis of the socket depth and the minimum space required in front of the pipe bell face to clear the HP LOK® Ring and provide access to the jack and clamp bolts. These minimum laying lengths must be considered when ordering factory cut lengths or field cutting HP LOK Pipe.



Table 1. Minimum Laying Lengths & Average Pullout For Each HP LOK Pipe or Fittings Socket

SIZE Inches	DIMENSIONS Inches		PULLOUT Feet
	A	B	
30	24.00	18.00	.05
36	24.00	18.00	.04
42	27.00	20.00	.04
48	29.00	23.00	.05
54	29.00	23.00	.05
60	29.00	23.00	.05
64	29.00	23.00	.05

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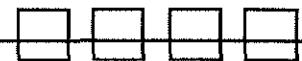
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HP LOK Field Cut Pipe Instructions

Making a Field Cut

Before making the field cut, measure the pipe diameter or circumference at the location to be cut. The diameter or circumference should fall within the range shown below in **Table 2**. If the measurement is not within the prescribed range, another pipe should be selected and checked before cutting.

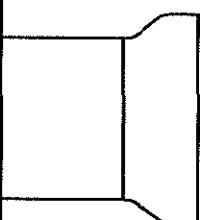
The pipe must be cut as square as is practical. A field cut end that is not square may leak, especially if the joint is fully deflected. Measure from the factory manufactured spigot end to the desired cut location. Mark the measured distance around the circumference of the pipe at sufficient intervals to determine a square cut-line (a line perpendicular to the axis of the pipe). Scribe the square cut-line around the outside surface of the pipe.

Cut the pipe. (Abrasive saws are commonly used.) Bevel the field cut end (a disk grinder can be used). Refer to a shop manufactured bevel as a guide for proper shape. Additional grinding may be required to further bevel the pipe if difficulty in assembly of the joint is encountered.

When Ductile Iron pipe 14" and larger is to be cut in the field, the material should be ordered as "GAUGED PIPE." A *Gauged Pipe* is a pipe whose barrel outside diameter is within the spigot diameter dimensional specifications as determined by diameter tape measurements over the pipe's length to within approximately two feet of the bell chime. Pipe that is "gauged" is specially marked to avoid confusion. **ANSI/AWWA C151/A21.51** Standard for Ductile Iron pipe requires factory gauging of the spigot end. Accordingly, pipe selected for field cutting should also be field gauged in the location of the cut and verified to be within the tolerances shown below in the table. In the field a mechanical joint gland can be used as a gauging device.

Table 2.

NOM. PIPE SIZE Inches	CIRCUMFERENCE		DIAMETER	
	MAXIMUM Inches	MINIMUM Inches	MAXIMUM Inches	MINIMUM Inches
30	100-25/32	100-11/32	32.08	31.94
36	120-9/16	120-1/8	38.38	38.24
42	140-1/16	139-5/8	44.58	44.44
48	159-27/32	159-13/32	50.88	50.74
54	180-31/32	180-1/2	57.60	57.46
60	193-11/16	193-1/4	61.65	61.51
64	206-7/16	206	65.71	65.57



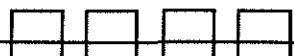
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HP LOK Field Cut Pipe Instructions (cont.)

Unrestrained Field Cut Pipe Installation Method

The following schematic illustrates the use of a field cut pipe in the unrestrained portions of the line, to eliminate the requirement for a field weldment.

Thrust Restraint Design For Ductile Iron Pipe

Published by the Ductile Iron Pipe Research Association (DIPRA).

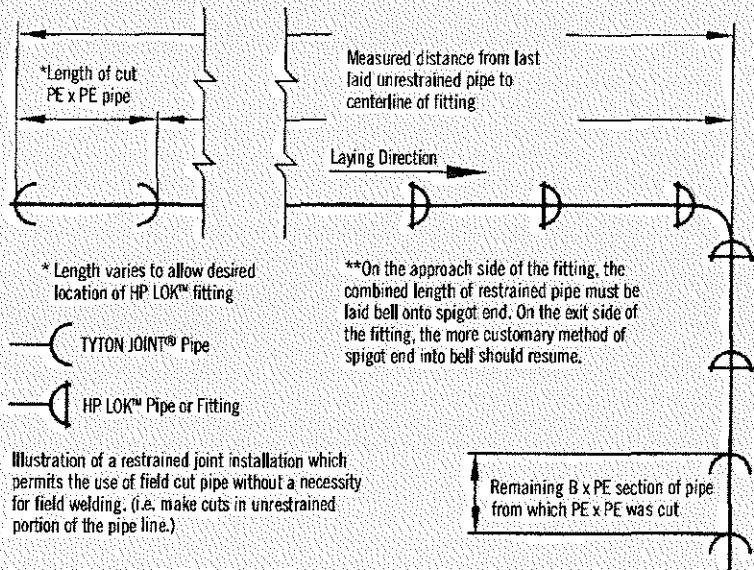


Illustration of a restrained joint installation which permits the use of field cut pipe without a necessity for field welding, (i.e. make cuts in unrestrained portion of the pipe line.)

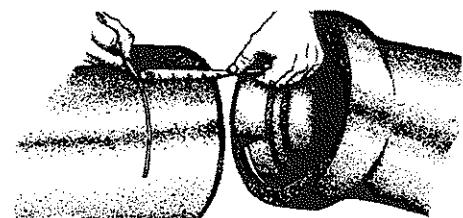
Pipe installations may require field cutting, particularly where fittings are used. By planning ahead, many field cuts can be made in the portion of the line involving standard TYTON JOINT® Pipe thus eliminating the need to field weld the TR FLEX Pipe.

TR FLEX GRIPPER® Rings may be used with field cut TR FLEX Pipe for sizes 4" through 36". Your U.S. Pipe Sales Representative can provide more information on TR FLEX GRIPPER Rings. For TR FLEX Pipe of sizes 42" through 64", field welded bars must be used.

In the event field cuts are required in the restrained portion of the line, the following recommended procedure may be used. This procedure describes how to weld a preformed round steel bar to the plain end of field cut TR FLEX Pipe to be used instead of the factory applied weld bead furnished on TR FLEX Pipe. Pittsburgh Testing Laboratory [now called Professional Service Industries, Inc. (PSI)] certified tests on TR FLEX Pipe which were welded following this procedure.

The Assembly Mark

Make an assembly mark on the pipe barrel at the location as shown in **Table 3**. Use this assembly mark to ensure that the pipe is inserted the proper depth into the socket. If the pipe is "bottomed out" in the socket, the amount of joint flexibility will be reduced. If the pipe is not inserted far enough into the socket, the gasket may not seal (particularly if the joint is deflected).

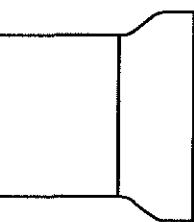


Marking Pipe for Assembly

Table 3. Assembly Mark Location

SIZE Inches	LOCATION OF ASSEMBLY MARK Inches
30	8-1/2
36	8-1/2
42	9
48	9-3/4
54	9-3/4
60	9-3/4
64	9-3/4

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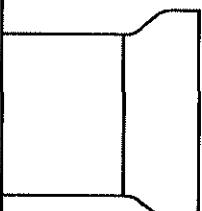
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Notes Regarding the Use of Restrained Joint Pipe

1. Large unbalanced thrust forces can be produced at dead ends, bends, tees or size changes of high pressure and/or large diameter piping systems.
2. Concrete thrust blocks or restrained joint pipe and fittings can normally be used to resist the unbalanced thrust forces.
3. In underground piping systems, an unbalanced thrust force can normally be resisted by providing a designed length of restraint at a change in direction or diameter where thrust forces are anticipated. Restrained joint pipe normally must transfer the thrust forces to the soil surrounding the pipeline.
4. The *Thrust Restraint Design For Ductile Iron Pipe* published by the Ductile Iron Pipe Research Association (DIPRA) is one method used to calculate the required length of restraint at a change in direction. This publication is available through your U.S. Pipe Sales Representative.
5. Most restrained joints allow for joint take-up after installation. The amount of take-up or slack can vary considerably with the type of joint and installation conditions. Thrust forces produced by internal pressures can result in removal of this joint take-up thereby increasing the length of the restrained section of the line. In any situation or configuration where increases in the line segment length could be detrimental to the pipeline or surrounding structures, the restrained joints should be fully extended during installation.
6. An increase in line segment length can also result in additional joint deflection. If an increase in length or other line movement are anticipated, the deflection of the restrained joints should be limited to only a portion of the joint design deflection during the installation of the pipe.
7. In fully extended, totally restrained piping systems, the thrust forces are carried by the piping system, and the resistance to the thrust is not dependent upon the surrounding soil. In situations where there is insufficient space to provide the designed restrained length, or where there are poor soil conditions, the entire section of line should be restrained or other external means of restraint provided.
8. If restrained joint pipe is used in a casing and is subjected to thrust, the joints should be fully extended to take up the joint slack prior to making end connections. The length of restraint in the casing should not be considered as part of the designed length of restraint required to provide the soil resistance to the thrust forces.

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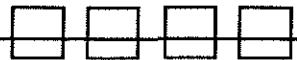
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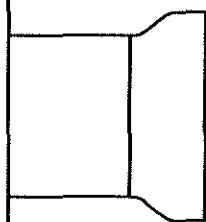
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Notes Regarding the Use of Restrained Joint Pipe (cont.)

9. Above ground lines subject to thrust forces should be fully restrained and extended to remove any slack from the joint. The joint can be extended by pulling out on the pipe after the restrained joint assembly is made. The thrust forces can cause an unexpected increase in length of an above ground line if the slack is not first removed from the joint. When restrained joint pipe are used for bridge crossings or other above ground installations, each length of pipe must be supported in a manner to restrict both vertical and horizontal movement.
10. It is the responsibility of the Purchaser or Consulting Engineer to ensure that proper trench preparation, compaction and pipe installation procedures are followed and that adequate restrained lengths or thrust block designs are provided to resist the unbalanced thrust loads generated by the installed piping systems.
11. In general, restrained joints are more electrically conductive than conventional push-on joints used for Ductile Iron pipe. This increased conductivity can make a restrained section of the line more susceptible to stray current corrosion caused by direct currents from sources such as electrical transit systems or cathodically protected steel structures (steel pipe, underground storage tanks, etc.). If exposure to stray current is anticipated, contact your U.S. Pipe Sales Representative for the recommended method of protection.
12. If HP LOK joints are used in vertical installations, provisions must be made to keep the joint extended. Failure to keep vertical joints extended can result in movement of pipeline components.

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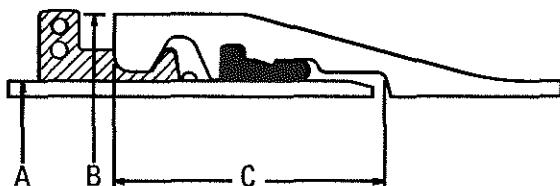


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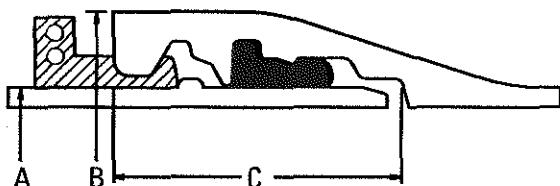
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HP LOK Restrained Joint Pipe and Fittings Basic Dimensions



30" - 36" HP LOK Assembly Cross Section

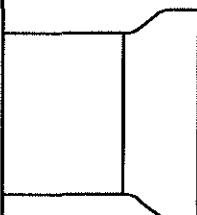


42" - 64" HP LOK Assembly Cross Section

SIZE Inches	WORKING PRESSURE* psi	A Inches	B PIPE Inches	B FITTINGS Inches	C PIPE Inches	C FITTINGS Inches	PULLOUT Feet
30	350	32.00	36.38	37.83	8.70	8.70	.05
36	350	38.30	42.68	44.73	8.70	8.70	.04
42	350	44.50	49.36	50.54	9.25	9.24	.04
48	350	50.80	56.25	58.05	10.06	9.91	.05
54	350	57.56	63.39	65.39	10.06	9.91	.05
60	350	61.61	67.95	69.65	10.06	9.91	.05
64	350	65.67	71.70	73.90	10.06	9.91	.05

Actual B and C Dimensions may be up to 0.50" greater than dimensions shown in this table.
The maximum deflection for HP LOK joints is 0.5 degree.

*The HP LOK Restrained Joint has a working pressure equivalent to the working pressure rating of the parent pipe with a maximum working pressure rating of 350 psi. For higher pressure ratings, contact your U.S. Pipe Sales Representative.



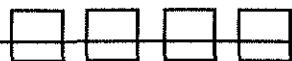
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Pressure Class – Thickness, Dimensions and Weight

SIZE Inches	PRESSURE CLASS psi	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	Avg. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	Avg. WEIGHT PER FOOT†† Pounds
30	150	0.34	32.00	2160	120.0	—	—
30	200	0.38	32.00	2375	131.9	—	—
30	250	0.42	32.00	2590	143.9	—	—
30	300	0.45	32.00	2755	155.1	—	—
30	350	0.49	32.00	2970	165.0	—	—
36	150	0.38	38.30	2935	163.1	—	—
36	200	0.42	38.30	3195	177.5	—	—
36	250	0.47	38.30	3520	195.6	—	—
36	300	0.51	38.30	3780	210.0	—	—
36	350	0.56	38.30	4100	227.8	—	—
42	150	0.41	44.50	3635	201.9	—	—
42	200	0.47	44.50	4090	227.2	—	—
42	250	0.52	44.50	4465	248.1	—	—
42	300	0.57	44.50	4840	268.9	—	—
42	350	0.63	44.50	5290	293.9	—	—
48	150	0.46	50.80	—	—	4915	245.8
48	200	0.52	50.80	—	—	5490	274.5
48	250	0.58	50.80	—	—	6060	303.0
48	300	0.64	50.80	—	—	6635	331.8
48	350	0.70	50.80	—	—	7205	360.3
54	150	0.51	57.56	—	—	6380	319.0
54	200	0.58	57.56	—	—	7140	357.0
54	250	0.65	57.56	—	—	7900	395.0
54	300	0.72	57.56	—	—	8655	432.8
54	350	0.79	57.56	—	—	9410	470.5

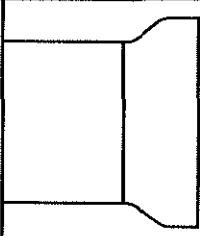
NOTE: Thicknesses and dimensions of 30" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51.
Weights may vary from the standard because of differences in bell weights.

*Tolerance of O.D. of spigot end: 30-48 in., +0.08 in., -0.06 in.; 54-64 in., +0.04 in., -0.10 in.

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.

Table continued on next page.

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Pressure Class – Thicknesses, Dimensions and Weight (cont.)

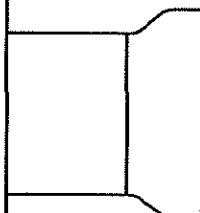
SIZE Inches	PRESSURE CLASS psi	THICKNESS Inches	OUTSIDE DIAMETER*Inches	18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
				WEIGHT PER LENGTH† Pounds	Avg. WEIGHT PER FOOT†† Pounds	WEIGHT PER LENGTH† Pounds	Avg. WEIGHT PER FOOT†† Pounds
60	150	0.54	61.61	—	—	7235	361.8
60	200	0.61	61.61	—	—	8050	402.5
60	250	0.68	61.61	—	—	8860	443.0
60	300	0.76	61.61	—	—	9785	489.3
60	350	0.83	61.61	—	—	10,595	529.8
64	150	0.56	65.67	—	—	8045	402.3
64	200	0.64	65.67	—	—	9035	451.8
64	250	0.72	65.67	—	—	10,025	501.3
64	300	0.80	65.67	—	—	11,010	550.5
64	350	0.87	65.67	—	—	11,870	593.5

NOTE: Thicknesses and dimensions of 30" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51.
Weights may vary from the standard because of differences in bell weights.

*Tolerance of O.D. of spigot end: 30-48 in., +0.08 in., -0.06 in.; 54-64 in., +0.04 in., -0.10 in.

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell; average weight, per foot, based on calculated weight of pipe before rounding.



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Thickness Class - Thicknesses, Dimensions and Weight

Size Inches	Thickness Class	Thickness Inches	Outside Diameter* Inches	18-Foot Laying Length		20-Foot Laying Length	
				Avg. Weight Length† Pounds	Weight Per Foot†† Pounds	Avg. Weight Length† Pounds	Weight Per Foot†† Pounds
30	50	0.39	32	2466	137	—	—
30	51	0.43	32	2682	149	—	—
30	52	0.47	32	2897	161	—	—
30	53	0.51	32	3112	173	—	—
30	54	0.55	32	3326	185	—	—
30	55	0.59	32	3540	197	—	—
30	56	0.63	32	3753	209	—	—
36	50	0.43	38.3	3331	185	—	—
36	51	0.48	38.3	3654	203	—	—
36	52	0.53	38.3	3977	221	—	—
36	53	0.58	38.3	4299	239	—	—
36	54	0.63	38.3	4620	257	—	—
36	55	0.68	38.3	4940	274	—	—
36	56	0.73	38.3	5259	292	—	—
42	50	0.47	44.5	4113	229	—	—
42	51	0.53	44.5	4565	254	—	—
42	52	0.59	44.5	5015	279	—	—
42	53	0.65	44.5	5464	304	—	—
42	54	0.71	44.5	5912	328	—	—
42	55	0.77	44.5	6359	353	—	—
42	56	0.83	44.5	6804	378	—	—

NOTE: Thicknesses and dimensions of 30" through 64" Ductile Iron Pipe conform to ANSI/AWWA C151/A21.51.

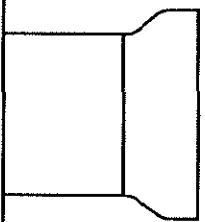
Weights may vary from the standard because of differences in bell weights.

60" and 64" classified as pressure class only.

*Tolerance of O.D. of spigot end: 30" - 48", +0.08", -0.06 in., 54"-64", +0.04, -0.10".

†Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

††Including bell; average weight, per foot, based on calculated weight of pipe before rounding.



Thickness Class - Thicknesses, Dimensions and Weight (cont.)

Size Inches	Thickness Class	Thickness Inches	Outside Diameter* Inches	18-Foot Laying Length		20-Foot Laying Length	
				Avg. Weight Length† Pounds	Weight Per Foot†† Pounds	Avg. Weight Length† Pounds	Weight Per Foot†† Pounds
48	50	0.51	50.8	5210	289	7275	364
48	51	0.58	50.8	5812	323	8141	407
48	52	0.65	50.8	6413	356	9005	450
48	53	0.72	50.8	7011	390	9867	493
48	54	0.79	50.8	7608	423	10726	536
48	55	0.86	50.8	8204	456	11583	579
48	56	0.93	50.8	8797	489	12437	622
54	50	0.57	57.56	6650	369	5703	285
54	51	0.65	57.56	7403	411	6372	319
54	52	0.73	57.56	8208	456	7039	352
54	53	0.81	57.56	8983	499	7705	385
54	54	0.89	57.56	9756	542	8368	418
54	55	0.97	57.56	10528	585	9029	451
54	56	1.05	57.56	11296	628	9689	484

NOTE: Thicknesses and dimensions of 30" through 64" Ductile Iron Pipe conform to ANSI/AWWA C151/A21.51.

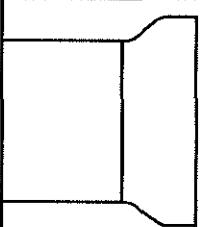
Weights may vary from the standard because of differences in bell weights.

60" and 64" classified as pressure class only.

*Tolerance of O.D. of spigot end: 30" - 48", +0.08", -0.06 in., 54"-64", +0.04, -0.10".

†Including bell; calculated weight of pipe rounded off to nearest 5 lbs.

††Including bell; average weight, per foot, based on calculated weight of pipe before rounding.

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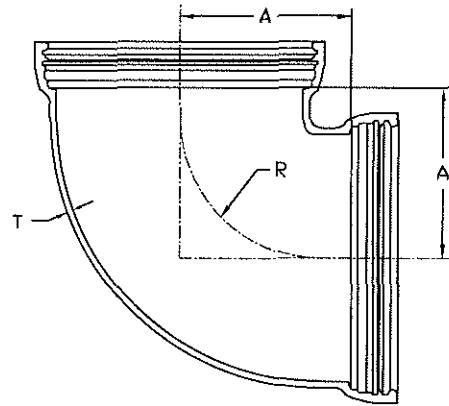
Sanitary Fittings

2009 EDITION

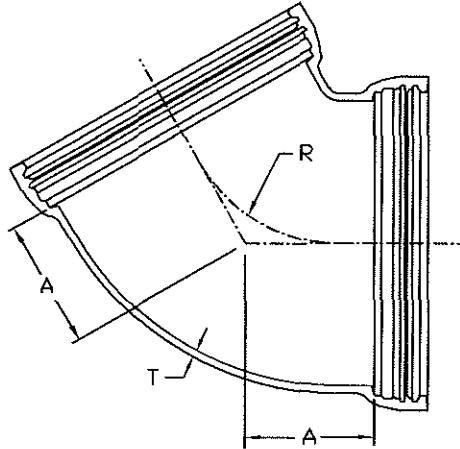
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**HP LOK 90° Bend**

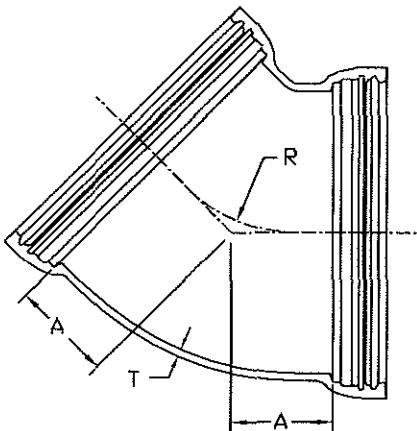
SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	23.00	21.00	1770
36	350	1.15	26.00	24.00	2565
42	350	1.28	27.50	24.50	3526
48	350	1.42	31.00	28.00	4952
54/1400	350	1.55	39.00	35.28	7138
60/1500	350	1.50	41.00	33.34	7846
64/1600	350	1.50	45.50	35.29	9063

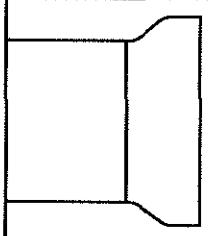
**HP LOK 60° Bend**

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	15.00	20.19	1545
36	350	1.15	17.00	23.38	2216
42	350	1.28	19.00	25.98	3112
48	350	1.42	21.00	29.44	4327
54/1400	350	1.55	24.00	34.50	5831

**HP LOK 45° Bend**

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	10.50	20.52	1352
36	350	1.15	8.50	19.92	1692
42	350	1.28	14.00	26.56	2743
48	350	1.42	15.00	28.97	3761
54/1400	350	1.55	20.50	41.05	5474
60/1500	350	1.50	21.50	45.48	5898
64/1600	350	1.50	22.50	47.78	6501





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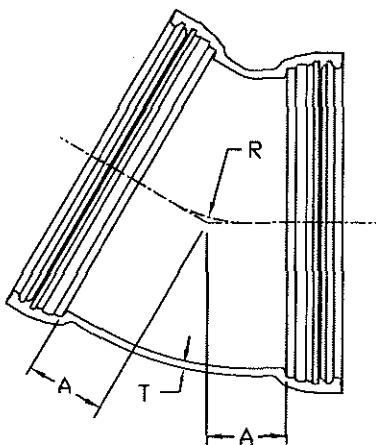


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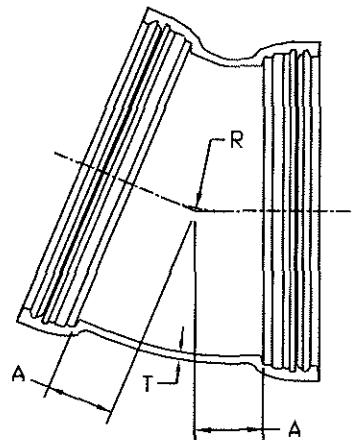
HP LOK 30° Bend

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	9.50	22.97	1319
36	350	1.15	11.00	27.99	1880
42	350	1.28	12.00	29.86	2600
48	350	1.42	14.00	37.32	3693
54/1400	350	1.55	16.00	44.50	4925
60/1500	350	1.50	19.00	55.38	5626
64/1600	350	1.50	18.50	58.93	5982



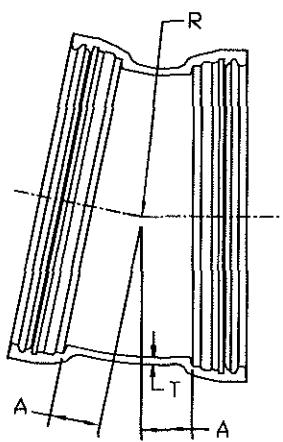
HP LOK 22.5° Bend

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	7.00	25.14	1197
36	350	1.15	8.00	30.16	1681
42	350	1.28	9.00	30.16	2344
48	350	1.42	10.00	35.19	3260
54/1400	350	1.55	14.00	34.24	4670
60/1500	350	1.50	12.00	39.41	4637
64/1600	350	1.50	11.00	41.68	4854

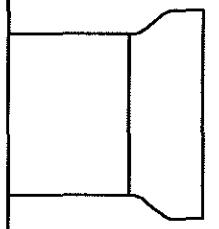


HP LOK 11.25° Bend

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	7.00	50.77	1199
36	350	1.15	8.00	60.92	1685
42	350	1.28	9.00	60.92	2349
48	350	1.42	10.00	71.07	3267
54/1400	350	1.55	5.10	30.81	3424
60/1500	350	1.50	8.50	44.07	4138
64/1600	350	1.50	7.00	43.56	4245



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NSE

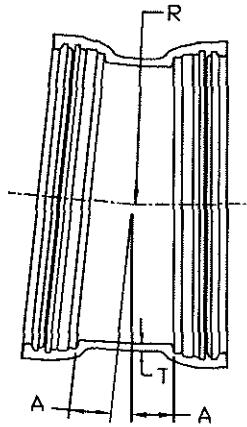
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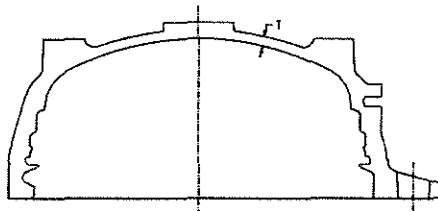
HP LOK 5.625° Bend

SIZE Inches	PRESSURE RATING psi	DIMENSIONS Inches			WEIGHT Pounds
		T	A	R	
30	350	1.03	7.00	74.38	1202
36	350	1.15	8.00	91.60	1686
42	350	1.28	9.00	101.78	2350
48	350	1.42	10.00	122.13	3269
54/1400	350	1.55	11.00	161.29	4256
60/1500	350	1.50	8.50	88.34	4140
64/1600	350	1.50	7.00	87.33	4247



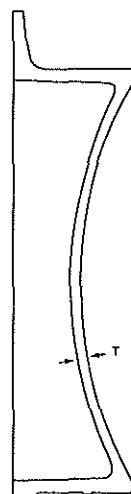
HP LOK® Caps

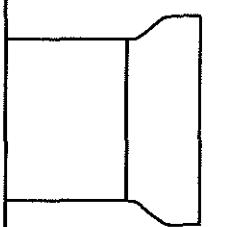
SIZE Inches	PRESSURE RATING psi	T	WEIGHT Pounds	
30	350	1.00	960	
36	350	1.00	1288	
42	350	1.00	1700	
48	350	1.30	2051	
54/1400	350	1.50	2804	
60/1500	350	1.60	3334	
64/1600	350	1.70	3889	



HP LOK® Plugs

SIZE Inches	T	WEIGHT Pounds
30	1.03	838
36	1.15	1172
42	1.28	1439
48	1.42	1941
54	1.54	2522
60	1.75	2785
64	1.75	3125





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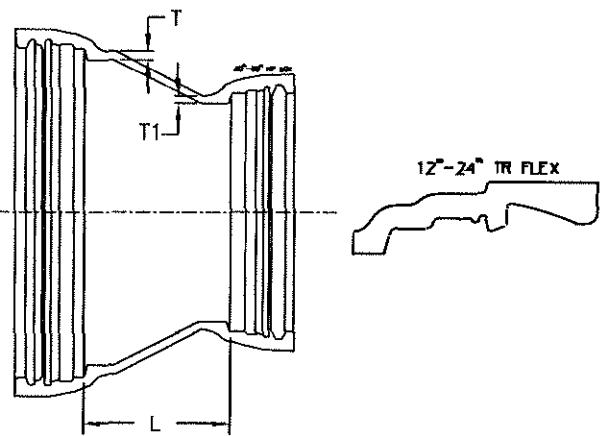


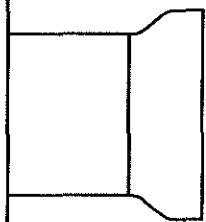
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HP LOK® Reducer

SIZE Inches	L	T	T1	WEIGHT Pounds
LEB	SEB			
30	12 TR FLEX	30.00	1.03	0.44
30	14 TR FLEX	30.00	1.03	0.66
30	16 TR FLEX	30.00	1.03	0.70
30	18 TR FLEX	30.00	1.03	0.75
30	20 TR FLEX	24.00	1.03	0.80
30	24 TR FLEX	24.00	1.03	0.89
36	18 TR FLEX	36.00	1.15	0.75
36	20 TR FLEX	36.00	1.15	0.80
36	24 TR FLEX	22.00	1.15	0.89
36	30 HP LOK	22.00	1.15	1.03
42	20 TR FLEX	42.00	1.28	0.80
42	24 TR FLEX	42.00	1.28	0.89
42	30 HP LOK	20.00	1.28	1.03
42	36 HP LOK	20.00	1.28	1.15
48	24 TR FLEX	48.00	1.42	0.89
48	30 HP LOK	48.00	1.42	1.03
48	36 HP LOK	36.00	1.42	1.15
48	42 HP LOK	36.00	1.42	1.28
54	24 TR FLEX	38.00	1.55	0.89
54	30 HP LOK	32.00	1.55	1.03
54	36 HP LOK	28.00	1.55	1.15
54	42 HP LOK	25.00	1.55	1.28
54	48 HP LOK	18.00	1.55	1.42
60	30 HP LOK	35.40	1.50	1.03
60	36 HP LOK	30.00	1.50	1.15
60	42 HP LOK	24.00	1.50	1.28
60	48 HP LOK	18.00	1.50	1.42
60	54 HP LOK	13.00	1.50	1.55
64	36 HP LOK	32.50	1.50	1.15
64	42 HP LOK	27.50	1.50	1.28
64	48 HP LOK	22.50	1.50	1.42
64	54 HP LOK	15.50	1.50	1.55
64	60 HP LOK	12.50	1.50	1.50
				3965





HP LOK®

RESTRAINED JOINT

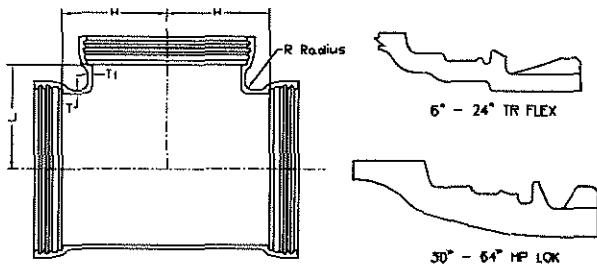
NSE
Ductile Iron
Restrained Joint

2009 EDITION

P 21



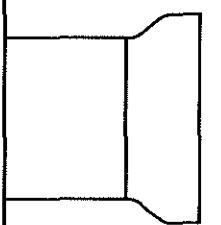
HP LOK® Tee



RUN	BRANCH	SIZE Inches			WEIGHT Pounds
		H	J	R	
30	6 TR FLEX®	11.00	23.00	1.50	1434
30	8 TR FLEX	11.00	23.00	1.50	1456
30	10 TR FLEX	11.00	23.00	1.50	1476
30	12 TR FLEX	11.00	23.00	1.50	1504
30	14 TR FLEX	13.50	23.00	2.00	1671
30	16 TR FLEX	13.50	23.00	2.00	1702
30	18 TR FLEX	18.00	23.00	2.00	1957
30	20 TR FLEX	18.00	23.00	2.00	2002
30	24 TR FLEX	21.00	25.00	2.00	2286
30	30 HP LOK	21.00	25.00	2.00	2553
36	6 TR FLEX	17.50	26.00	2.00	2372
36	8 TR FLEX	17.50	26.00	2.00	2393
36	10 TR FLEX	17.50	26.00	2.00	2412
36	12 TR FLEX	17.50	26.00	2.00	2437
36	14 TR FLEX	17.50	26.00	2.00	2478
36	16 TR FLEX	17.50	26.00	2.00	2507
36	18 TR FLEX	17.50	26.00	2.00	2535
36	20 TR FLEX	17.50	26.00	2.00	2575
36	24 TR FLEX	17.50	26.00	2.00	2660
36	30 HP LOK	20.00	26.00	2.00	2995
36	36 HP LOK	20.00	26.00	2.00	3331
42	12 TR FLEX	20.00	30.00	3.00	3427
42	14 TR FLEX	20.00	30.00	3.00	3467
42	16 TR FLEX	20.00	30.00	3.00	3495
42	18 TR FLEX	20.00	30.00	3.00	3522
42	20 TR FLEX	20.00	30.00	3.00	3561
42	24 TR FLEX	20.00	30.00	3.00	3641
42	30 HP LOK	31.00	31.00	4.00	4786
42	36 HP LOK	31.00	31.00	4.00	5011
42	42 HP LOK	31.00	31.00	4.00	5491

RUN	BRANCH	SIZE Inches			WEIGHT Pounds
		H	J	R	
48	12 TR FLEX	26.00	34.00	4.00	5170
48	14 TR FLEX	26.00	34.00	4.00	5208
48	16 TR FLEX	26.00	34.00	4.00	5235
48	18 TR FLEX	26.00	34.00	4.00	5261
48	20 TR FLEX	26.00	34.00	4.00	5299
48	24 TR FLEX	26.00	34.00	4.00	5375
48	30 HP LOK	26.00	34.00	4.00	5510
48	36 HP LOK	34.00	34.00	4.00	6596
48	42 HP LOK	34.00	34.00	4.00	6897
48	48 HP LOK	34.00	34.00	4.00	7559
54	30 HP LOK	31.00	37.00	2.50	7469
54	36 HP LOK	31.00	37.00	2.50	7623
54	42 HP LOK	31.00	39.00	2.50	7954
54	48 HP LOK	31.00	39.00	2.50	8380
54	54 HP LOK	35.80	35.80	2.50	9615
60	30 HP LOK	31.00	42.00	2.50	7899
60	36 HP LOK	31.00	42.00	2.50	8080
60	42 HP LOK	41.00	43.00	2.50	9854
60	48 HP LOK	41.00	43.00	2.50	10284
60	54 HP LOK	41.00	43.00	2.50	10849
60	60 HP LOK	41.00	41.00	2.50	11112
64	36 HP LOK	29.50	44.00	2.50	8394
64	42 HP LOK	45.50	45.00	2.50	11205
64	48 HP LOK	45.50	45.00	2.50	11601
64	54 HP LOK	45.50	46.00	2.50	12172
64	60 HP LOK	45.50	44.00	2.50	12198
64	64 HP LOK	45.50	48.00	2.50	12840

BELL SIZE/TYPE	T OR T1	BELL SIZE/TYPE	T OR T1
6" TR FLEX	0.36	24" TR FLEX	0.89
8" TR FLEX	0.39	30" HP LOK	1.03
10" TR FLEX	0.41	36" HP LOK	1.15
12" TR FLEX	0.44	42" HP LOK	1.28
14" TR FLEX	0.66	48" HP LOK	1.42
16" TR FLEX	0.70	54" HP LOK	1.55
18" TR FLEX	0.75	60" HP LOK	1.50
20" TR FLEX	0.80	64" HP LOK	1.50



HP LOK®

RESTRAINED JOINT

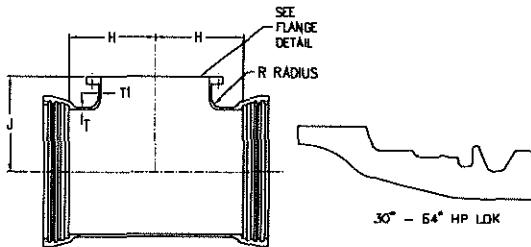


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HP LOK® x Flange Tee

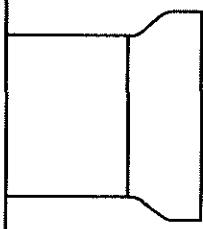


RUN	SIZE Inches	DIMENSIONS Inches			WEIGHT Pounds
		BRANCH	H	J	
30	6" FLANGE	11.00	23.00	1.50	1427
30	8" FLANGE	11.00	23.00	1.50	1441
30	10" FLANGE	11.00	23.00	1.50	1454
30	12" FLANGE	11.00	23.00	1.50	1479
30	14" FLANGE	13.50	23.00	2.00	1608
30	16" FLANGE	13.50	23.00	2.00	1628
30	18" FLANGE	18.00	23.00	2.00	1862
30	20" FLANGE	18.00	23.00	2.00	1893
30	24" FLANGE	21.00	25.00	2.00	2143
30	30" FLANGE	21.00	25.00	2.00	2353
36	6" FLANGE	17.50	26.00	2.00	2365
36	8" FLANGE	17.50	26.00	2.00	2378
36	10" FLANGE	17.50	26.00	2.00	2390
36	12" FLANGE	17.50	26.00	2.00	2412
36	14" FLANGE	17.50	26.00	2.00	2415
36	16" FLANGE	17.50	26.00	2.00	2433
36	18" FLANGE	17.50	26.00	2.00	2440
36	20" FLANGE	17.50	26.00	2.00	2466
36	24" FLANGE	17.50	26.00	2.00	2517
36	30" FLANGE	28.00	28.00	2.00	3392
36	36" FLANGE	28.00	28.00	2.00	3718
42	12" FLANGE	20.00	30.00	3.00	3402
42	14" FLANGE	20.00	30.00	3.00	3404
42	16" FLANGE	20.00	30.00	3.00	3421
42	18" FLANGE	20.00	30.00	3.00	3427
42	20" FLANGE	20.00	30.00	3.00	3452
42	24" FLANGE	20.00	30.00	3.00	3498
42	30" FLANGE	31.00	31.00	4.00	4586
42	36" FLANGE	31.00	31.00	4.00	4784
42	42" FLANGE	31.00	31.00	4.00	5190

RUN	SIZE Inches	DIMENSIONS Inches			WEIGHT Pounds
		BRANCH	H	J	
48	12" FLANGE	26.00	34.00	4.00	5145
48	14" FLANGE	26.00	34.00	4.00	5145
48	16" FLANGE	26.00	34.00	4.00	5161
48	18" FLANGE	26.00	34.00	4.00	5166
48	20" FLANGE	26.00	34.00	4.00	5190
48	24" FLANGE	26.00	34.00	4.00	5232
48	30" FLANGE	26.00	34.00	4.00	5310
48	36" FLANGE	34.00	34.00	4.00	6368
48	42" FLANGE	34.00	34.00	4.00	6596
48	48" FLANGE	34.00	34.00	4.00	7061
54	30" FLANGE	31.00	37.00	2.50	7261
54	36" FLANGE	31.00	37.00	2.50	7383
54	42" FLANGE	31.00	39.00	2.50	7634
54	48" FLANGE	31.00	39.00	2.50	7856
54	54" FLANGE	35.80	39.00	2.50	9092
60	30" FLANGE	31.00	42.00	2.50	7691
60	36" FLANGE	31.00	43.00	2.50	7874
60	42" FLANGE	41.00	43.00	2.50	9534
60	48" FLANGE	41.00	43.00	2.50	9760
60	54" FLANGE	41.00	43.00	2.50	10096
60	60" FLANGE	41.00	43.00	2.50	10749
64	36" FLANGE	29.50	44.00	2.50	8154
64	42" FLANGE	45.50	45.00	2.50	10885
64	48" FLANGE	45.50	45.00	2.50	11077
64	54" FLANGE	45.50	46.00	2.50	11419
64	60" FLANGE	45.50	46.00	2.50	11835
64	64" FLANGE	45.50	48.50	2.50	12875

BELL SIZE/TYPE	T OR T1	BELL SIZE/TYPE	T OR T1
6" FLANGE	0.36	24" FLANGE	0.89
8" FLANGE	0.39	30" HP LOK/FLG.	1.03
10" FLANGE	0.41	36" HP LOK/FLG.	1.15
12" FLANGE	0.44	42" HP LOK/FLG.	1.28
14" FLANGE	0.66	48" HP LOK/FLG.	1.42
16" FLANGE	0.70	54" HP LOK/FLG.	1.55
18" FLANGE	0.75	60" HP LOK/FLG.	1.50
20" FLANGE	0.80	64" HP LOK/FLG.	1.50

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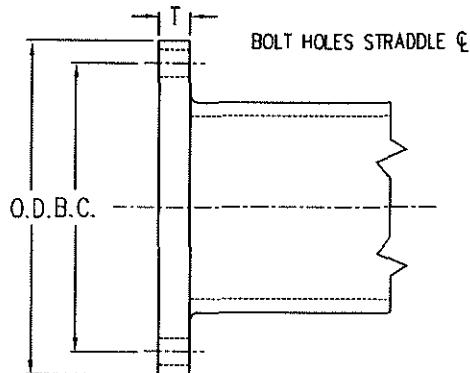
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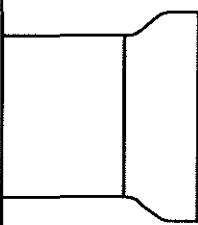
P 23



FLANGE DETAIL

SIZE Inches	DIMENSIONS Inches				NO. OF BOLTS
	OD	BC	T	BOLT HOLE Dia.	
6	11.00	9.50	1.00	7/8	8
8	13.50	11.75	1.12	7/8	8
10	16.00	14.25	1.19	1	12
12	19.00	17.00	1.25	1	12
14	21.00	18.75	1.38	1-1/8	12
16	23.50	21.25	1.44	1-1/8	16
18	25.00	22.75	1.56	1-1/4	16
20	27.50	25.00	1.69	1-1/4	20
24	32.00	29.50	1.88	1-3/8	20
30	38.75	36.00	2.12	1-3/8	28
36	46.00	42.75	2.38	1-5/8	32
42	53.00	49.50	2.62	1-5/8	36
48	59.50	56.00	2.75	1-5/8	44
54	66.25	62.75	3.00	2	44
60	73.00	69.25	3.12	2	52
64	80.00	76.00	3.38	2	52





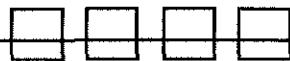
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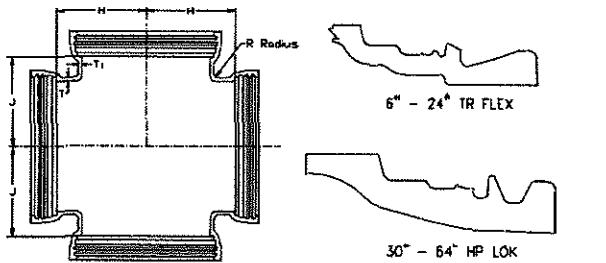


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HP LOK® Crosses



SIZE Inches		H	J	R	WEIGHT Pounds
RUN	BRANCH				
30	6 TR FLEX®	11.00	23.00	1.50	1472
30	8 TR FLEX	11.00	23.00	1.50	1516
30	10 TR FLEX	11.00	23.00	1.50	1557
30	12 TR FLEX	11.00	23.00	1.50	1611
30	14 TR FLEX	18.00	23.00	2.00	2045
30	16 TR FLEX	18.00	23.00	2.00	2107
30	18 TR FLEX	18.00	23.00	2.00	2171
30	20 TR FLEX	18.00	23.00	2.00	2261
30	24 TR FLEX	25.00	25.00	2.00	2878
30	30 HP LOK	25.00	25.00	2.00	3412
36	6 TR FLEX	20.00	26.00	2.00	2579
36	8 TR FLEX	20.00	26.00	2.00	2621
36	10 TR FLEX	20.00	26.00	2.00	2659
36	12 TR FLEX	20.00	26.00	2.00	2709
36	14 TR FLEX	20.00	26.00	2.00	2791
36	16 TR FLEX	20.00	26.00	2.00	2848
36	18 TR FLEX	20.00	26.00	2.00	2904
36	20 TR FLEX	20.00	26.00	2.00	2985
36	24 TR FLEX	20.00	26.00	2.00	3156
36	30 HP LOK	28.00	28.00	2.00	4130
36	36 HP LOK	28.00	28.00	2.00	4838
42	12 TR FLEX	23.00	30.00	3.00	3796
42	14 TR FLEX	23.00	30.00	3.00	3875
42	16 TR FLEX	23.00	30.00	3.00	3931
42	18 TR FLEX	23.00	30.00	3.00	3985
42	20 TR FLEX	23.00	30.00	3.00	4063
42	24 TR FLEX	23.00	30.00	3.00	4224
42	30 HP LOK	31.00	31.00	4.00	5275
42	36 HP LOK	31.00	31.00	4.00	5725
42	42 HP LOK	31.00	31.00	4.00	6683

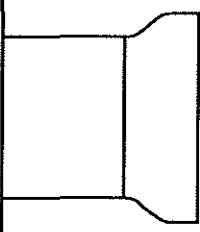
SIZE Inches	H	J	R	WEIGHT Pounds	
RUN	BRANCH				
48	12 TR FLEX	26.00	34.00	4.00	5275
48	14 TR FLEX	26.00	34.00	4.00	5351
48	16 TR FLEX	26.00	34.00	4.00	5405
48	18 TR FLEX	26.00	34.00	4.00	5457
48	20 TR FLEX	26.00	34.00	4.00	5532
48	24 TR FLEX	26.00	34.00	4.00	5685
48	30 HP LOK	26.00	34.00	4.00	5955
48	36 HP LOK	34.00	34.00	4.00	7229
48	42 HP LOK	34.00	34.00	4.00	7830
48	48 HP LOK	34.00	34.00	4.00	9156
54	30 HP LOK	31.00	37.00	4.00	7857
54	36 HP LOK	31.00	37.00	4.00	8164
54	42 HP LOK	31.00	39.00	4.00	8827
54	48 HP LOK	31.00	39.00	4.00	9579
54	54 HP LOK	35.80	35.80	3.75	11479
60	30 HP LOK	31.00	42.00	4.00	8367
60	36 HP LOK	31.00	42.00	4.00	8730
60	42 HP LOK	41.00	43.00	4.00	10815
60	48 HP LOK	41.00	43.00	4.00	11676
60	54 HP LOK	41.00	43.00	4.00	12805
60	60 HP LOK	41.00	41.00	4.00	13331
64	36 HP LOK	29.50	44.00	—	8994
64	42 HP LOK	45.50	45.00	—	12157
64	48 HP LOK	45.50	45.00	—	12960
64	54 HP LOK	45.50	46.00	—	14100
64	60 HP LOK	45.50	44.00	—	14153
64	64 HP LOK	45.50	45.50	—	15436

BELL SIZE/TYPE	T OR T1	BELL SIZE/TYPE	T OR T1
6" TR FLEX	0.55	24" TR FLEX	0.89
8" TR FLEX	0.60	30" HP LOK	1.03
10" TR FLEX	0.68	36" HP LOK	1.15
12" TR FLEX	0.75	42" HP LOK	1.28
14" TR FLEX	0.66	48" HP LOK	1.42
16" TR FLEX	0.70	54" HP LOK	1.55
18" TR FLEX	0.75	60" HP LOK	1.50
20" TR FLEX	0.80	64" HP LOK	1.50

6"-48" Based on C 110 thickness.

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RESTRAINED JOINT



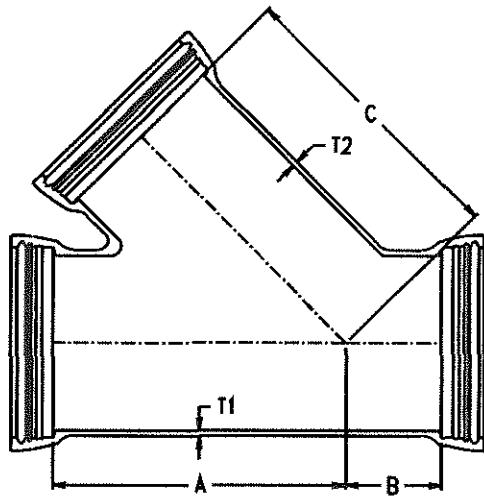
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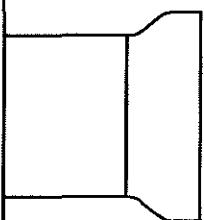
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HP LOK® Wye

Run	SIZE Branch	A	B	C	T1	T2	WEIGHT Pounds
30	16" TR FLEX®	49.00	10.00	49.00	1.37	0.89	3311
30	18" TR FLEX	49.00	10.00	49.00	1.37	0.96	3389
30	20" TR FLEX	49.00	10.00	49.00	1.37	1.03	3483
30	24" TR FLEX	49.00	10.00	49.00	1.37	1.16	3678
30	30" HP LOK	49.00	10.00	49.00	1.37	1.37	4022
36	16" TR FLEX	58.00	21.50	58.00	1.58	0.89	5393
36	18" TR FLEX	59.00	20.50	59.00	1.58	0.96	5494
36	20" TR FLEX	60.00	19.50	60.00	1.58	1.03	5617
36	24" TR FLEX	60.00	19.50	60.00	1.58	1.16	5843
36	30" HP LOK	60.00	19.50	60.00	1.58	1.37	6244
36	36" HP LOK	60.00	19.50	60.00	1.58	1.58	6710
42	24" TR FLEX	69.00	19.50	69.00	1.78	1.16	8075
42	30" HP LOK	69.00	19.50	69.00	1.78	1.37	8512
42	36" HP LOK	69.00	19.50	69.00	1.78	1.58	9020
42	42" HP LOK	69.00	19.50	69.00	1.78	1.78	9628
48	24" TR FLEX	77.50	21.50	77.50	1.96	1.16	10985
48	30" HP LOK	77.50	21.50	77.50	1.96	1.37	11453
48	36" HP LOK	77.50	21.50	77.50	1.96	1.58	11998
48	42" HP LOK	77.50	21.50	77.50	1.96	1.78	12647
48	48" HP LOK	77.50	21.50	77.50	1.96	1.96	13407





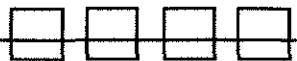
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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Restrained Joint Pipe	30"-64"
Flanged Pipe	4"-64" Ductile Iron
USIFLEX® Boltless Flexible Joint Pipe — for Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64"
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gaskets	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Ductile Iron Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
Mechanical Joint Fittings	3"-48" Ductile Iron
TRIM TYTE® MJ Fittings	3"-48" Ductile Iron
Flanged Fittings	3"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
RING FLANGE-TYTE™ Gaskets	4"-36"
FULL FACE FLANGE-TYTE™ Gaskets	4"-64"
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

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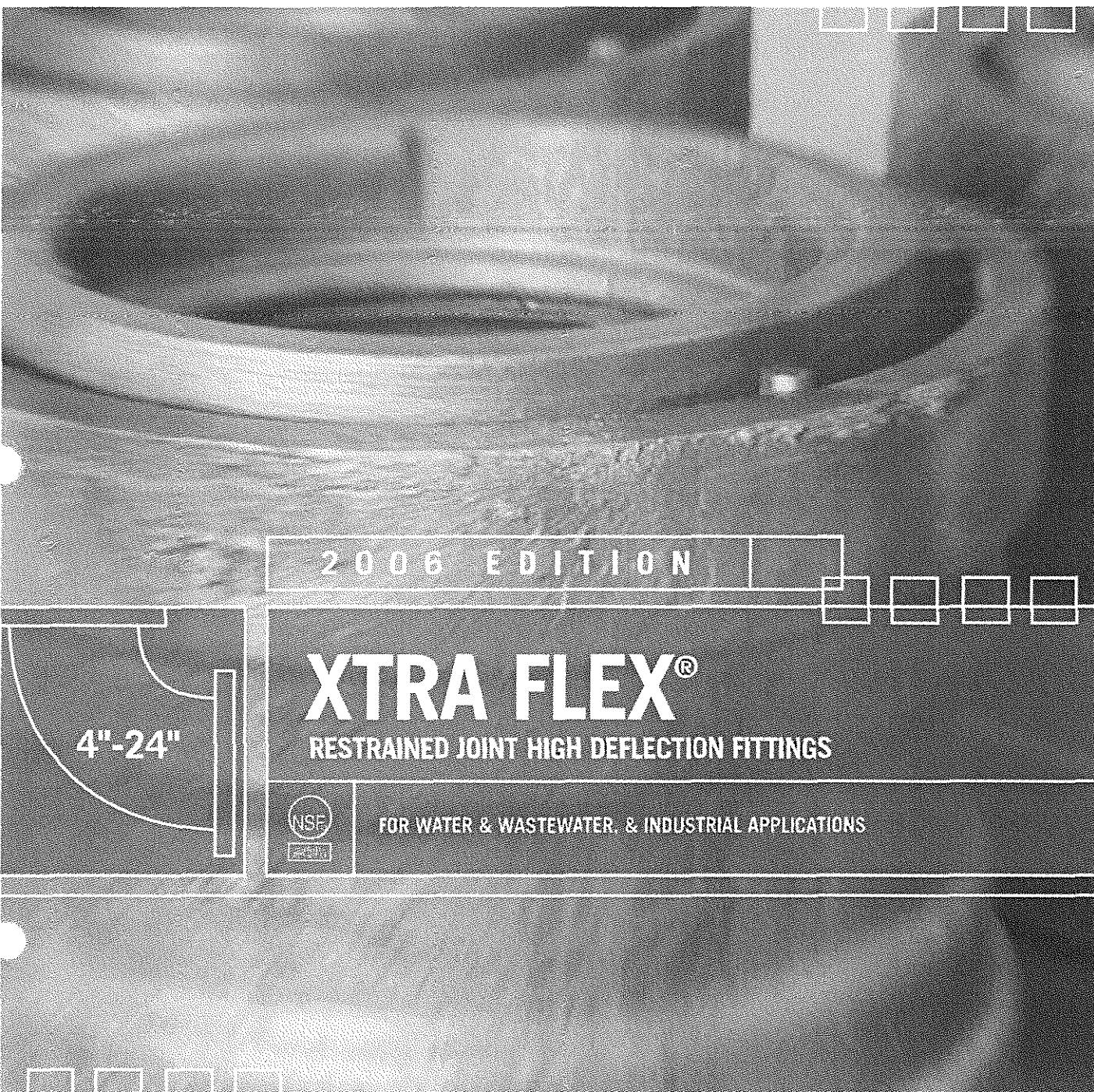
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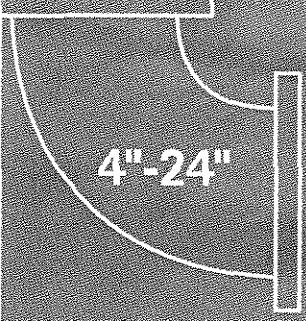
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XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS



FOR WATER & WASTEWATER, & INDUSTRIAL APPLICATIONS

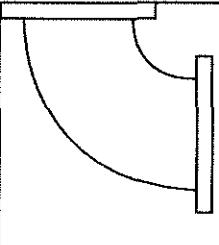


4"-24"

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RESTRAINED JOINT HIGH DEFLECTION FITTINGS



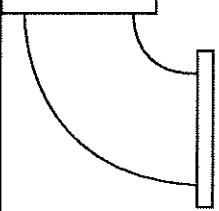
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XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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XTRA FLEX® Coupling

Utilizing the proven thrust restraint features of the TR FLEX® Pipe and Fittings product line, the XTRA FLEX Coupling provides an exceptionally strong joint with a high degree of deflection. Deflections up to four (4) times that of a single TR FLEX Pipe or Fitting joint are possible. U.S. Pipe's XTRA FLEX Coupling can be used as a high deflection reducer if one of the inserts is removed.

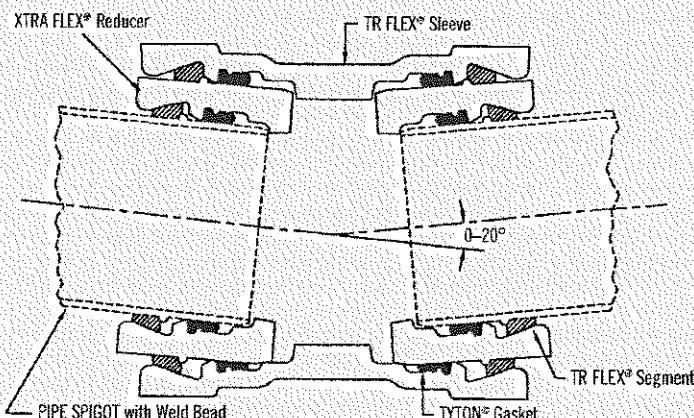
Currently produced in sizes 4"-24", the XTRA FLEX Coupling uses standard TYTON JOINT® Gaskets and is compatible with all TR FLEX Pipe and Fittings products.

All XTRA FLEX Fittings have a rated working pressure of 350 psi, except 24", which is 250 psi. The standard lining and coating is a petroleum asphaltic material.

Joint assembly follows the same procedure as that for all TR FLEX Pipe and Fittings. For detailed instructions concerning joint preparation, assembly and other information, refer to U.S. Pipe publication BRO-009, TR FLEX® Restrained Joint Pipe and Fittings, and BRO-051, The Use and Application of Restrained Joints for Ductile Iron Pipelines.

Cast components are made of Ductile Iron conforming to all applicable requirements of ANSI/AWWA C11C/A21.10 American National Standard for Ductile Iron and Gray Iron Fittings for Water.

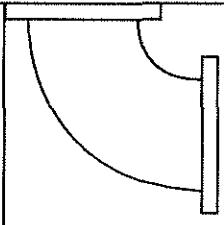
ASTM A536 "Standard Specification for Ductile Iron Castings."



NOTE: For suggested design procedures for the restraint of thrust forces in pressurized, buried Ductile Iron piping systems, design engineers should refer to the current DIPRA publication "Thrust Restraint Design for Ductile Iron Pipe".

If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile Iron Pipe Systems for proper external protection procedures.

XTRA FLEX® is a Registered Trademark of U.S. Pipe and Foundry Company.



XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS

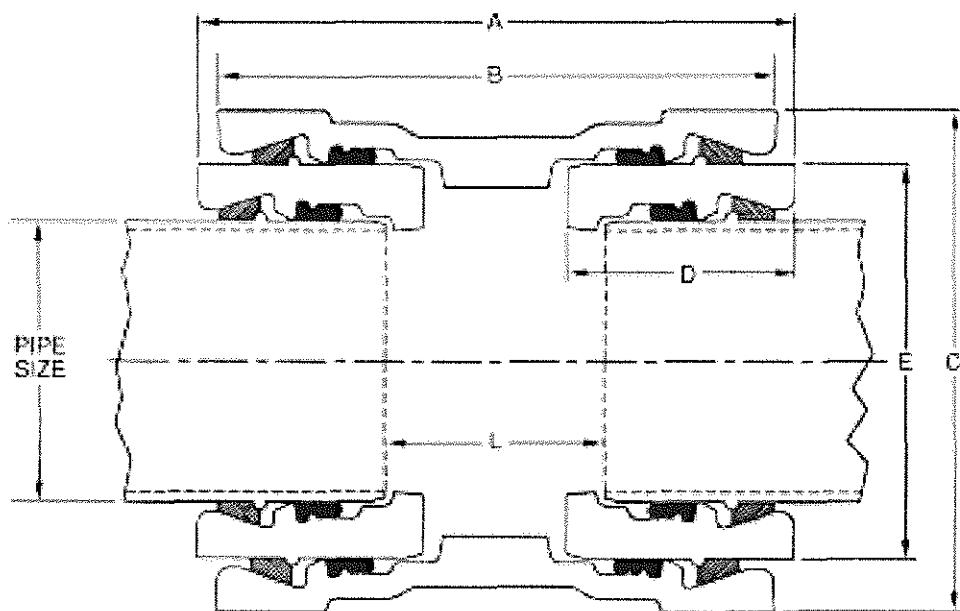


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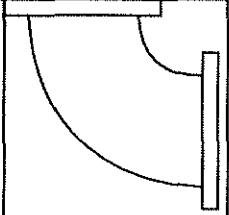


Coupling Diagram



PIPE SIZE Inches	DIMENSIONS Inches						WEIGHT Pounds	REDUCER*	TOTAL	MAXIMUM DEFLECTION Degrees
	A	B	C	D	E	L				
4	13.76	11.54	9.39	5.83	6.90	4.08	55	20	95	20.0
6	14.12	12.64	11.84	6.20	9.05	3.58	90	30	150	20.0
8	15.90	14.10	16.45	7.15	13.20	4.26	175	100	375	20.0
10	18.60	17.00	19.12	8.45	15.30	6.54	285	125	535	16.5
12	19.00	17.40	21.32	8.65	17.40	6.40	325	200	725	16.5
14	20.38	22.50	23.52	9.20	19.50	4.88	430	220	870	12.5
16	22.76	21.16	25.74	9.10	21.60	8.18	510	215	940	12.0
18	24.04	22.46	30.14	9.55	25.80	7.24	695	370	1435	10.5
20	24.04	22.46	30.14	9.55	25.80	7.24	695	300	1295	10.0
24	29.20	27.56	37.18	10.00	32.00	11.48	1125	520	2165	8.0

*Two reducers included in total weight.



XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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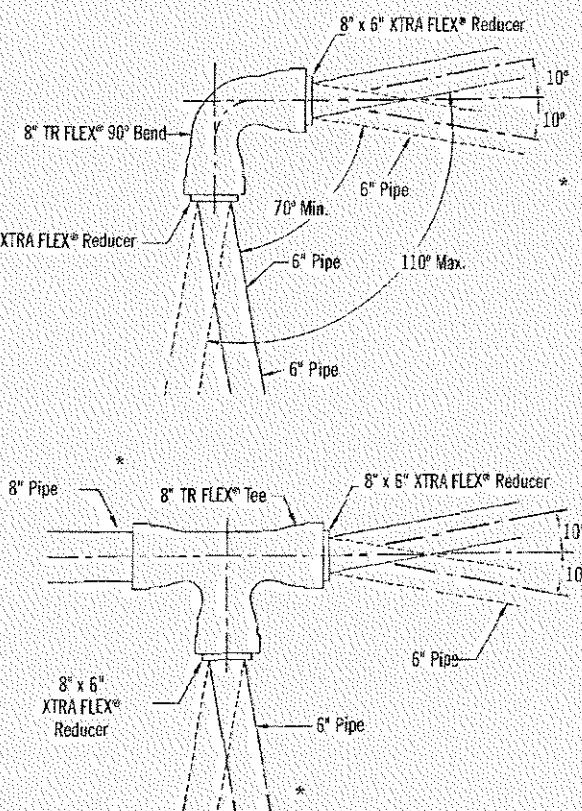
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XTRA FLEX® Reducers

With the use of XTRA FLEX Reducers, TR FLEX® Bends and Tees can be adapted to provide additional flexibility to accommodate earth movement and unstable soil conditions, giving design engineers greater flexibility. For example, by installing an XTRA FLEX Reducer inside each bell of a TR FLEX Fitting, the deflection capabilities of two joints are available.

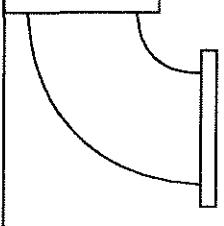
XTRA FLEX Reducers, which are small end bell reducers, are available in 6"x4"-30"x24" sizes.

XTRA FLEX Tees are available in sizes 4"x4"-24"x24" sizes.



Please note that 20° range of deflection comes from +10° and -10°.

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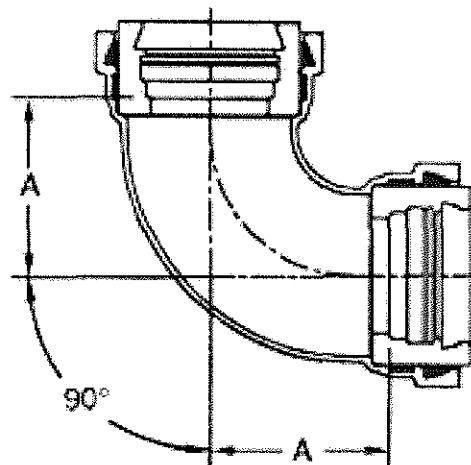
RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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350 psi Working Pressure — 90° Bends

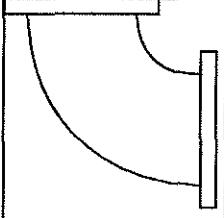


SIZE Inches	TR FLEX® BEND	XTRA FLEX® REDUCER	A Inches	WEIGHT Pounds	DEFLECTION† Degrees	MAXIMUM Degrees	MINIMUM Degrees
4	6	6x4	7.77	110	20.0	110.0	70.0
6	8	8x6	9.76	185	20.0	110.0	70.0
8	12	12x8	13.93	455	20.0	110.0	70.0
10	14	14x10	16.42	685	16.5	106.5	73.5
12	16	16x12	17.35	920	16.5	106.5	73.5
14	18	18x14	17.95	1110	12.5	102.5	77.5
16	20	20x16	15.23	1175	12.0	102.0	78.0
18	24	24x18	18.46	1970	10.5	100.5	79.5
20	24	24x20	18.15	1830	10.0	100.0	80.0
24*	30	30x24	25.24	2935	8.0	98.0	82.0

*24" bends use a component limited to 250 psi.

† Total Available Deflection

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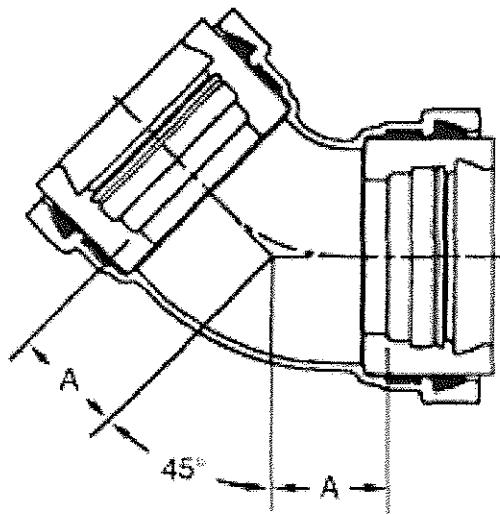
RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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350 psi Working Pressure — 45° Bends

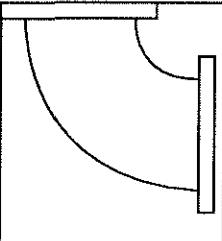


SIZE Inches	TR FLEX® BEND	XTRA FLEX® REDUCER	A Inches	WEIGHT Pounds	DEFLECTION† Degrees	MAXIMUM Degrees	MINIMUM Degrees
4	6	6x4	4.85	105	20.0	65.0	25.0
6	8	8x6	5.67	170	20.0	65.0	25.0
8	12	12x8	7.24	410	20.0	65.0	25.0
10	14	14x10	9.94	620	16.5	61.5	28.5
12	16	16x12	10.35	830	16.5	61.5	28.5
14	18	18x14	9.95	990	12.5	57.5	32.5
16	20	20x16	10.73	1115	12.0	57.0	33.0
18	24	24x18	7.46	1535	10.5	55.5	34.5
20	24	24x20	7.15	1395	10.0	55.0	35.0
24*	30	30x24	12.74	2605	8.0	53.0	37.0

*24" bends use a component limited to 250 psi.

† Total Available Deflection

866.DIP.PIPE



XTRA FLEX®

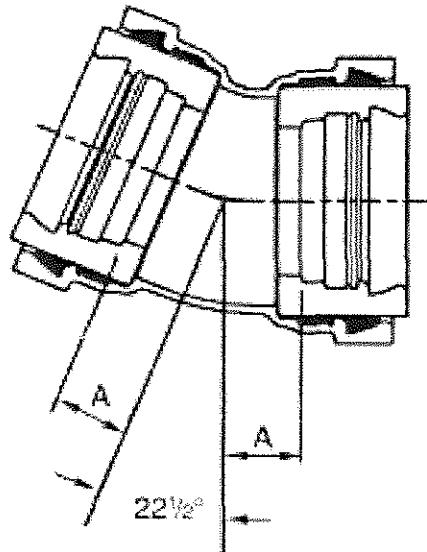
RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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P 8

350 psi Working Pressure — 22½° bends

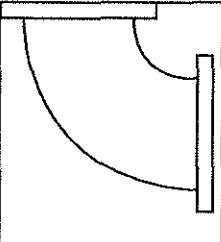


SIZE Inches	TR FLEX® BEND	XTRA FLEX® REDUCER	A Inches	WEIGHT Pounds	DEFLECTION† Degrees	MAXIMUM Degrees	MINIMUM Degrees
4	6	6x4	4.06	100	20.0	42.5	2.5
6	8	8x6	4.17	160	20.0	42.5	2.5
8	12	12x8	5.09	390	20.0	42.5	2.5
10	14	14x10	9.94	625	16.5	39.0	6.0
12	16	16x12	10.35	835	16.5	39.0	6.0
14	18	18x14	9.95	1000	12.5	35.0	10.0
16	20	20x16	10.73	1125	12.0	34.5	10.5
18	24	24x18	5.96	1490	10.5	33.0	12.0
20	24	24x20	5.65	1350	10.0	32.5	12.5
24*	30	30x24	9.24	2345	8.0	30.5	14.5

*24" bends use a component limited to 250 psi.

† Total Available Deflection

866.DIP.PIPE



XTRA FLEX®

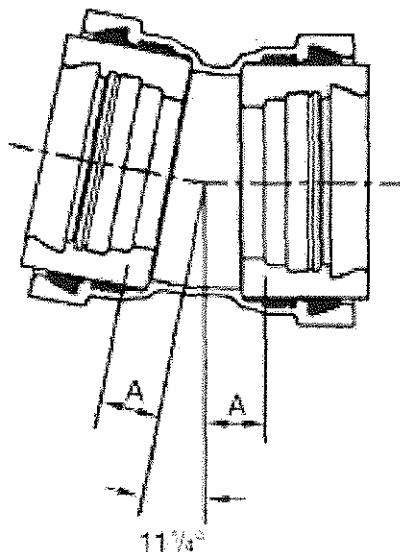
RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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P 9

350 psi Working Pressure — 11 1/4° Bends

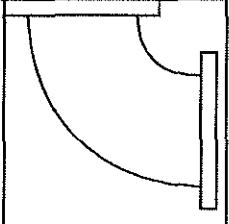


SIZE Inches	TR FLEX® BEND	XTRA FLEX® REDUCER	A Inches	WEIGHT Pounds	DEFLECTION Degrees	MAXIMUM Degrees	MINIMUM Degrees
4	6	6x4	3.41	100	20.0	31.25	-8.75
6	8	8x6	3.48	155	20.0	31.25	-8.75
8	12	12x8	4.20	385	20.0	31.25	-8.75
10	14	14x10	9.94	625	16.5	27.75	-5.25
12	16	16x12	10.35	840	16.5	27.75	-5.25
14	18	18x14	9.95	1000	12.5	23.75	-1.25
16	20	20x16	10.73	1125	12.0	23.25	-0.75
18	24	24x18	4.46	1440	10.5	21.75	0.75
20	24	24x20	4.15	1300	10.0	21.25	1.25
24*	30	30x24	9.24	2345	8.0	19.25	3.25

* 24" bends use a component limited to 250 psi.

† Total Available Deflection

866.DIP.PIPE



XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS

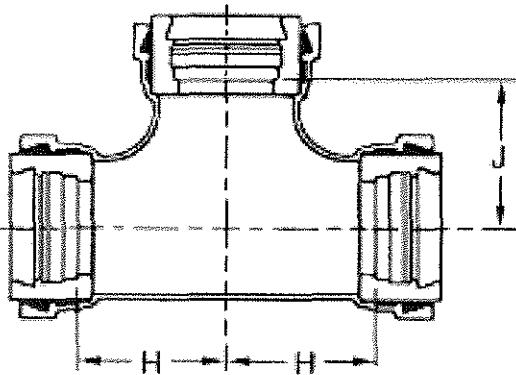


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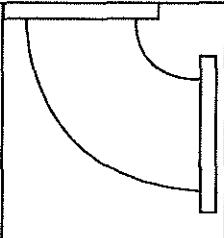
P 10



350 psi Working Pressure — Tees



SIZE	DIMENSIONS Inches		WEIGHT Pounds
	H	J	
4	7.15	7.15	150
6	8.53	8.53	230
8	11.00	11.00	570
10	16.44	16.44	1005
12	14.59	15.59	1275
14	17.95	17.95	1560
16	16.23	16.23	1830
18	18.46	22.46	2655
20	18.15	22.15	2445
24*	23.24	27.24	4125



XTRA FLEX®

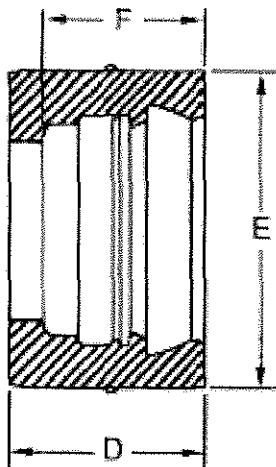
RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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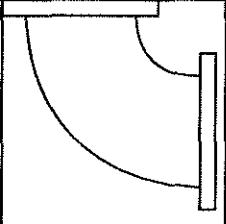
350 psi Working Pressure — Reducers



SIZE	DIMENSIONS Inches			WEIGHT Pounds
	D	E	F	
4	5.83	6.90	4.84	20
6	6.20	9.05	5.27	30
8	7.15	13.20	5.82	100
10	8.45	15.30	6.03	125
12	8.65	17.40	6.30	200
14	9.20	19.50	7.75	220
16	9.10	21.60	7.95	215
18	9.55	25.80	8.19	370
20	9.55	25.80	8.40	300
24*	10.00	32.00	8.86	520

*24" bends use a component limited to 250 psi.

866.DIP.PIPE



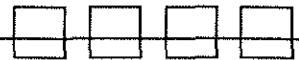
XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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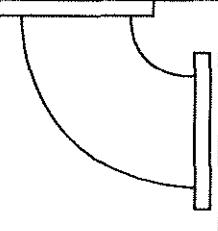


Ordering Instructions

When ordering XTRA FLEX Fittings, only the fitting configuration and line size need be specified. For example, if an XTRA FLEX Fitting for a 6" line is to be ordered, specify a 6" XTRA FLEX Sleeve. The unit will be supplied with the proper size TR FLEX® Couplings and XTRA FLEX Reducers. Equal opening tees and bends will be supplied in the same manner, with reducers in all fitting ends. In special conditions where reducers are not required in all ends or where tees other than equal opening are required, please contact your U. S. Pipe Sales Representative for the proper opening size.

The XTRA FLEX Reducers may be used to provide a reduced diameter, high deflection joint at most outlets of 6"-24" TR FLEX® Fittings. The table on page 12 shows the XTRA FLEX Reducers which are available.

XTRA FLEX Fittings will be shipped assembled with all components in place. To prevent loss of components in shipping and handling, each fittings assembly will be polyethylene encased. The assembled fittings should be inspected to make certain that all components are in place and then rewound in polyethylene to prevent soil from entering the joint opening, thereby reducing flexibility.



XTRA FLEX®

RESTRAINED JOINT HIGH DEFLECTION FITTINGS



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
USIFLEX® Boltless Flexible Joint Pipe --- for Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Pipe	4"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350° Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron
HP LOK™ Restrained Joint	30"-42"

Ductile Iron Fittings

TYTON® Fittings	14"-64" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-64" Ductile Iron
Mechanical Joint Fittings	3"-48" Ductile Iron
TRIM TYTE® MJ Fittings	3"-48" Ductile Iron
Flanged Fittings	3"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401® Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
FLANGE-TYTE® Gaskets	4"-64"
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.



*All U.S. Pipe brochures and/or products are
subject to change without further notice.*

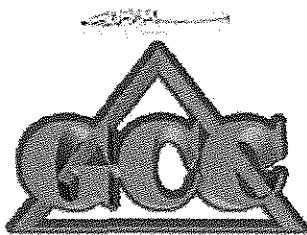
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PIPE**

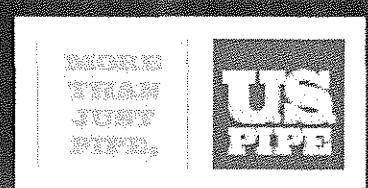


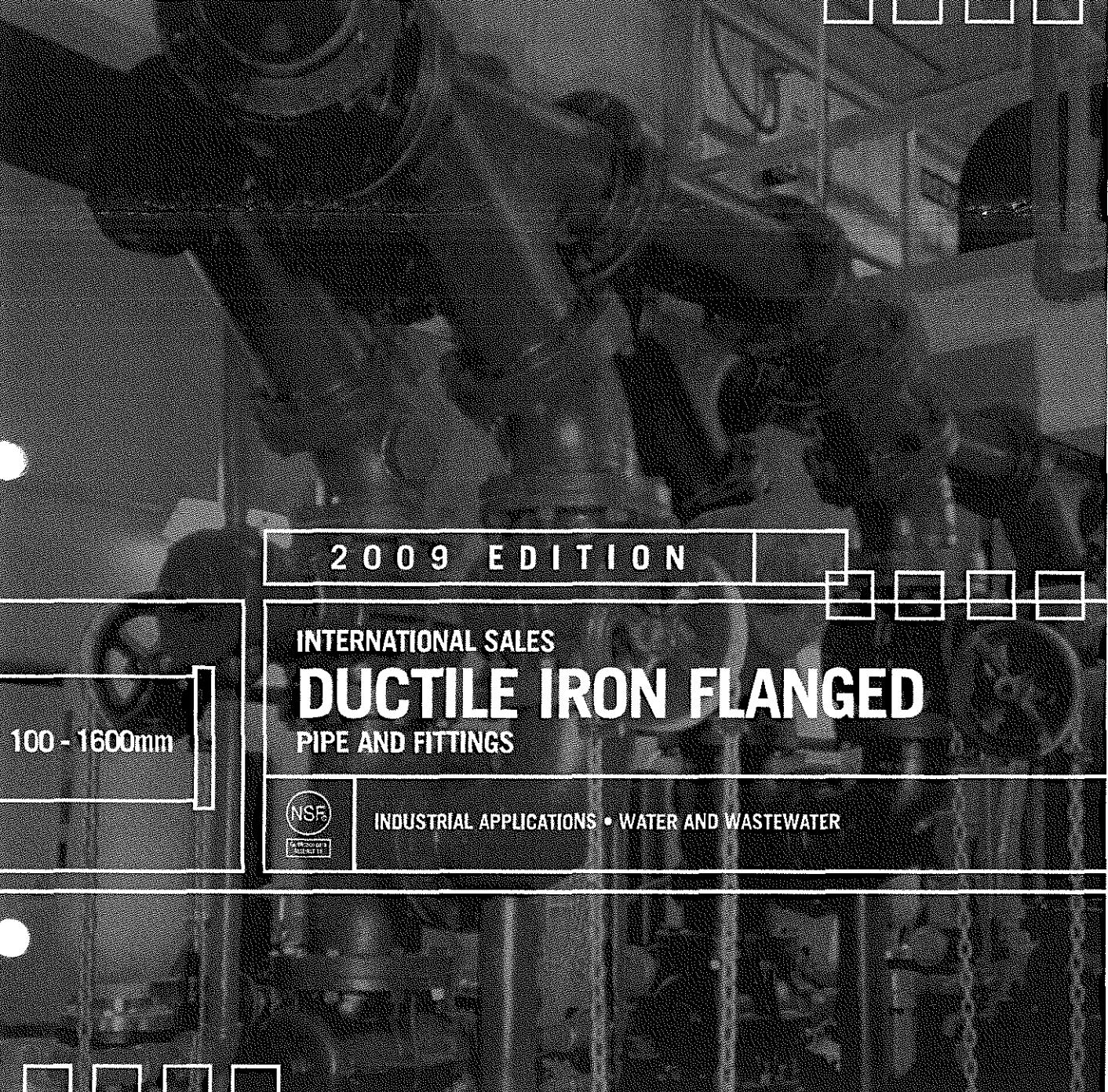
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FLANGED PIPE AND FITTINGS





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INTERNATIONAL SALES

DUCTILE IRON FLANGED PIPE AND FITTINGS

100 - 1600mm



INDUSTRIAL APPLICATIONS • WATER AND WASTEWATER

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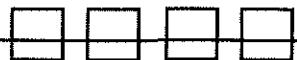


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NOTE: If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 Polyethelene Encasement for Ductile Iron Pipe Systems for proper external protection procedures.

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DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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Introduction

Based in Birmingham, Alabama, U.S. Pipe and Foundry Company, Inc. is America's leading manufacturer of Ductile Iron pipe. U.S. Pipe produces Ductile Iron pipe and fittings, joint restraint products, valves and hydrants and other products for the water and wastewater industry.

U.S. Pipe operates six manufacturing plants and sales offices across the country. These domestic sales offices combined with the International Sales office and their worldwide network of sales associates gives U.S. Pipe one of the broadest domestic and international marketing coverages in the industry.

From its beginning in 1899, U.S. Pipe has consistently lead the industry with innovations and product developments.

Centrifugal casting, pioneered by U.S. Pipe, revolutionized the industry. TYTON JOINT® Pipe, using a single rubber gasket, patented by U.S. Pipe and licensed throughout the world, is the most widely used joint for Ductile Iron pipe today.

Boltless USIFLEX® Pipe, for underwater installations, TR FLEX® Pipe and Fittings - a boltless method of joint restraint, the FIELD LOK 350® Gasket, the METROPOLITAN® Fire Hydrant, the METROSEAL® 250 Resilient Seated Gate Valve, along with numerous patents in the production of pipe, fittings, valves, and hydrants testify to the fact that U.S. Pipe is the leader and truly a company of "new ideas".

The company lineage dates back to 1882, when Colonel James Withers Sloss founded Sloss Furnace Company in Birmingham, Sloss Furnace Company became Sloss Iron and Steel Company. After acquiring Sheffield Iron Company, the Sloss-Sheffield Steel and Iron Company was incorporated in 1899.

In that same year U.S. Cast Iron Pipe and Foundry Company was incorporated with the consolidation of eleven small cast iron pipe companies located in eight states. Prominent among these was the Bessemer, Alabama plant, one of the three original plants still in operation today.

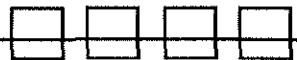
In 1911, U.S. Pipe purchased the Dimmick Pipe Company, which included a plant in North Birmingham that still operates today.

The name of the company was changed to United States Pipe and Foundry Company in 1929. U.S. Pipe also operates two other pipe plants, one in Burlington, New Jersey, and the other in Union City, California. These plants are located in the northern and western parts of the country to better serve our domestic market. Chattanooga, Tennessee is home to the plant which produces fittings, valve and hydrant products. A general casting facility, U.S. Castings, is located in Anniston, Alabama.

**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

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Introduction (cont.)

In 1952, the Sloss-Sheffield Steel and Iron Company was merged into U.S. Pipe, and the General Offices of U.S. Pipe moved from Burlington, New Jersey to Birmingham. The company quickly became a fully integrated producer of cast iron pipe and related products.

While the original plants produced pipe by the so called "pit cast" method, in which molten iron was poured into static, vertical molds lined and cored with sand, today's plants and production bear little resemblance to the old. In 1921, U.S. Pipe revolutionized the production of cast iron pipe when it purchased the rights for the centrifugal casting method, developed by Dimitri Sensaud Delavaud, a French engineer living in Brazil. In this process, the molten iron is poured into a rapidly spinning metal mold. The centrifugal force of the rotating mold distributes the molten iron uniformly around the inner surface of the mold. Upon cooling, extraction and heat treatment, high quality pipe with uniform thickness results.

In the early 1960's, U.S. Pipe perfected the production of Ductile Iron pipe, which is superior to cast iron in strength and durability. U.S. Pipe, since 1977, has used Ductile Iron exclusively for all its pressure pipe and fittings, making the company the first in the industry to do so.

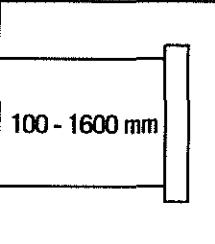
Having produced pipe and fittings in imperial (inch) diameter sizes to ANSI/AWWA standards for a number of years, U.S. Pipe, in the 1970's, increased its production and marketing scope to include metric sized pipe and fittings to International Organization for Standardization (ISO) Standards.

This U.S. Pipe International Sales catalog covers DN 100-1600 mm ISO Pipe and Fittings.

For information on products of ANSI/AWWA Imperial (inch) diameter sizes, please contact your U.S. Pipe representative or agent.

Today, Ductile Iron pipe and fittings of both ANSI/AWWA inch diameter and ISO metric sizes, and other U.S. Pipe products are sold worldwide. U.S. Pipe products have been shipped to Colombia, Ecuador, Egypt, El Salvador, Jamaica, Kuwait, Nigeria, Oman, Paraguay, The Philippines, Saudi Arabia, Syria, The United Arab Emirates and many, many other countries around the world. Both abroad and in the United States customers and specifiers alike have come to depend upon products and services from the "new ideas" company to keep their work flowing.

TYTON®, TYTON JOINT®, USIFLEX®, TR FLEX®
and FIELD LOK 350® are Registered Trademarks of
United States Pipe and Foundry Company.

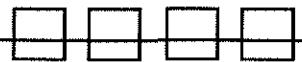


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PIPE AND FITTINGS**



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General Specifications: Dimensions and Masses

The following descriptions of dimensions are in accordance with the requirements of ISO 2531.
Variations from the Standard are so noted.

a. Thickness

The standard thicknesses of pipe and fittings are calculated as a function of their nominal diameter by the following formula:

$$e = k (0,5 + 0,001 DN)$$

where

e = Standard wall thickness (mm)

DN = Nominal Diameter (mm)

k = A coefficient selected from a series of whole numbers...8,9,10,11,12...

The external diameter of the pipe, expressed in millimeters is fixed as a function of the nominal diameter and independent of the pipe wall thickness. Increases or decreases in the pipe wall thickness result in a change of the internal diameter.

For fittings, both internal and external diameters may be varied to change wall thicknesses. Actual wall thicknesses may be adjusted to accommodate internal stresses for each point of the casting. In bends, for example, the wall thickness at the inner radius may be greater than that at the outer radius. The thickness, "e" indicated in each table and on the drawings of the fittings is the mean thickness.

b. Thickness Tolerances

The tolerances on wall thicknesses are as given in TABLE 1.

c. Lengths and Tolerances: Spigot and Socket Pipe

Spigot and Socket Pipe - TYTON JOINT® Pipe are produced to the manufacturing working lengths shown in TABLE 2.

In accordance with ISO 2531, of the total number of spigot and socket pipe to be supplied in each diameter, up to 10% may be supplied in shorter lengths than the working lengths stated in TABLE 2. The Standard allows a ± 30 mm tolerance on manufacturing working lengths to allow for variations due to shrinkage and growth, depending on the composition and heat treatment of the Ductile Iron.

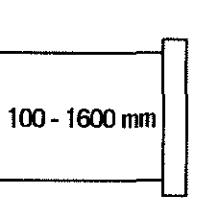
Table 1.

Type of Casting	Tolerance in Millimeters
Pipe	-(1,3 + 0,001 DN) ¹
Fittings & Accessories	-(2,3 + 0,001 DN) ¹

¹No limit for the plus tolerance has been set.

Table 2.

Nominal Diameters DN	Manufacturing Working Lengths m
100 - 900	5,5
1000	5,5 y 6,0
1200 - 1600	6,0

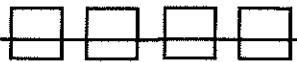


INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS



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General Specifications: Dimensions and Masses (cont.)

d. Lengths and Tolerances: Fittings

Fittings – Fittings were designed using the performance requirements of ISO 2531 as the minimal requirements. At U.S. Pipe, fitting patterns have the capacity to accept interchangeable end pieces for different jointing systems. This affords a high degree of flexibility in the manufacture of the fittings at a minimal expense to the customer. Fittings constructed by this method may have lengths and masses which differ from those in the above mentioned standard. The lengths and masses for individual fittings are given in the appropriate table in this catalog. Many fittings, sizes and configurations are shown which are not in the ISO 2531 Standard.

Casting Tolerances on the laying lengths vary by fitting type and are given in the fitting tables.

e. Tolerance on the Straightness of Centrifugally Cast Pipe

When pipe are rolled along two gantries separated by approximately two-thirds of the length "L" of the pipe to be checked, the maximum deviation "fm", in millimeters, shall not be greater than 1,25 times the length "L", in meters of this pipe. $fm < 1,25L$



General Specifications: Mechanical Testing

The following mechanical tests and acceptance values are in accordance with the requirements ISO 2531. At the end of this section additional control tests used by U.S. Pipe during the production of centrifugally cast Ductile Iron pipe, the Ball Impression Test and Charpy Impact Test, are shown. These latter tests are not required by the International Standard.

a. Tensile Tests - Test Bars

Pipe centrifugally cast in metal molds - The machined test bar for the tensile test is taken from the spigot end of the pipe, at approximately mid-thickness of the wall, with its axis parallel to the axis of the pipe.

The test bar includes a cylindrical part, with a gauge length at least five times its diameter: the latter given in TABLE 3, according to the thickness of the pipe, "e".

Fittings and accessories cast in sand molds - The machined bar for the tensile test is taken from a sample attached to the casting or a sample cast separately from the same iron. Where heat treatment of the fitting or accessory is required, a separately cast sample shall be subjected to the same heat treatment. The thickness of the sample and the diameter of the test bar is given in TABLE 4 as a function of the mean thickness of the casting. The gauge length of the machined bar is at least five times its diameter.

b. Tensile Test: methods and Results

These mechanical tests are carried out during the manufacturing process on castings grouped in accordance with the following batch size limitations:

Pipe centrifugally cast in metal molds

- DN 100 - 300.....200 pipe
- DN 350 - 600.....100 pipe
- DN 700 - 1000.....50 pipe
- DN 1200 - 1600....25 pipe

Pipe, fittings and accessories not centrifugally cast - Castings made from iron of substantially the same composition and, if necessary, having been subjected to the same heat treatment, shall be considered as one batch. The size of such batches shall be limited to 4 tons of castings, excluding the mass of the risers.

For one pipe, or from one sample of each batch of fittings and accessories, one test bar is taken which shall satisfy the requirements of TABLE 5.

If a result of this test is below the specified minimum values, two other test bars are taken from the same pipe, or from the same sample in the case of fittings and accessories and these must both satisfy the same requirements.

Table 3.

Thickness of Pipe	Diameter of Test Bar
e<6	2,5
6<e<8	3,5
8<e<12	5
12>e	6

Dimensions in millimeters.

Table 4.

Mean Thickness of Casting	Thickness of Test Bar	Diameter of Test Bar
≤12	12,5	6
>12	25,0	12

Dimensions in millimeters.

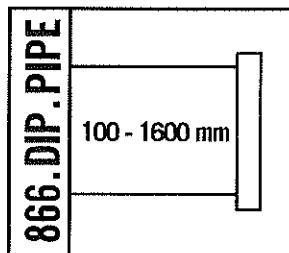
Table 5.

Type of Casting	Minimum Tensile Strength Rm N/mm ²	Minimum Elongation after Fracture, A %	
		DN 100 - 1000	DN>1000
Pipe centrifugally cast	420	10	7
Fittings	400	4	5

NOTE: By agreement between manufacturer and purchaser, the 0.2% proof test may be used to determine the proof stress (yield strength). It shall not be less than:

-270 MPa when A > 12% for DN 100 to 1000 or A > 10% for DN > 1000.

*300 MPa in other cases.



INTERNATIONAL SALES DUCTILE IRON FLANGED PIPE AND FITTINGS



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General Specifications: Mechanical Testing (cont.)

c. Internal Pressure Proof Test

Pipe are subjected to a works hydrostatic test for a minimum duration of 10 seconds and at a pressure based on the formulae and limitations given in TABLE 6.

Fittings are subjected to a leak-tightness test carried out with water at the test pressures given in TABLE 7 or with air at a minimum pressure of 1 bar. For pipe and fittings, the acceptance criteria are that after completion of the test there shall be no visible leakage, sweating or other fault of any kind.

d. Brinell Hardness Test

The hardness of the metal shall be such that the pipe can be cut, drilled or machined. In case of dispute, the products shall be considered as acceptable provided the superficial hardness does not exceed 230 HB for pipe and 250 HB for fittings and accessories. The hardness is checked on the outer surface of the castings after slight grinding. Where pipe and fittings have welded elements, a higher hardness is permitted locally at the welds.

e. Other Mechanical Tests

The following two tests, the Ball Impression Test and the Charpy Test, are quality and process control tests utilized by U.S. Pipe to assure consistent quality of centrifugally cast Ductile Iron pipe. Neither test is a requirement of International Standard. The Ball Impression Test is a proprietary test developed by U.S. Pipe. The Charpy Impact Test is a requirement of ANSI/AWWA C151/A21.51 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

Ball Impression Test

Each processed Ductile Iron pipe is subjected to a proof test. The test consists of applying a concentrated load of the magnitude which would rupture the wall of a non-ductile pipe. An acceptable pipe will not split when tested at the designated loading for the applicable pipe wall thickness.

Charpy Impact Test

The Charpy Impact Test is a fracture toughness test used to measure the mechanical properties of centrifugally cast Ductile Iron pipe. A notched test specimen of full wall thickness is tested in accordance with the requirements of ASTM E 23. The pendulum type test equipment strikes the properly positioned test specimen and measures the energy required to fracture it.

Samples for Charpy testing are selected to represent production through the heat treating operation.

The acceptance value, corrected for actual thickness, is 7 ft-lbs (9.49 J) at 70° (21C). Pipe failing to meet this requirement are subjected to metallurgical evaluation and additional heat treatment or rejection as appropriate.

Table 6.

Nominal Size DN (mm)	Hydrostatic Works Test for Pressure for $K \geq 9$ Pipe	
	Formula (bar)	Minimum Test Pressure (bar)
100 < DN < 300	$0.5 (k+1)^2$	50
350 < DN < 600	$0.5 k^2$	40
700 < DN < 1000	$0.5 (k-1)^2$	32
1200 < DN < 1600	$0.5 (k-2)^2$	25

k is the thickness coefficient of the pipe.

Table 7.

Nominal Size DN (mm)	Hydrostatic Leak-Tightness Test for Fittings (bar)
80 < DN < 300	25
350 < DN < 600	16
700 < DN < 1600	10



General Specifications: Coatings, Linings and Markings

Coatings and linings applied to pipe and fittings are as follows:

External - Coatings - Pipe and fittings

Bituminous paint

When specified, metallic zinc with a bituminous finishing layer in accordance with ISO 8179, Ductile Iron Pipes - External Zinc Coating, can be furnished.

Polyethylene encasement as specified in ISO 8180, Ductile Iron Pipes - Polyethylene Sleeving, or ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe, is available when the soil is corrosive to Ductile Iron and protection against exterior corrosion should be provided.

Internal - Linings

Pipe:

Cement mortar in accordance with ISO 4179, ductile iron pipes for pressure and non-pressure pipelines - centrifugal cement mortar lining - general requirements and ISO 6600, Ductile iron pipes - Centrifugal cement mortar lining - composition controls of freshly applied mortar.

Fittings:

Cement mortar in accordance with the applicable requirements of ISO 4179 and ISO 6600. When specified, cement mortar linings can be furnished made with ASTM C150 Type V sulfate resisting Portland cement. Pipe and fittings can be furnished with or without a bitumen sealcoat on the cement mortar lining. Sealcoating furnished meets the health effects requirements of ANSI/NSF 61, Drinking Water System Components-Health Effects.

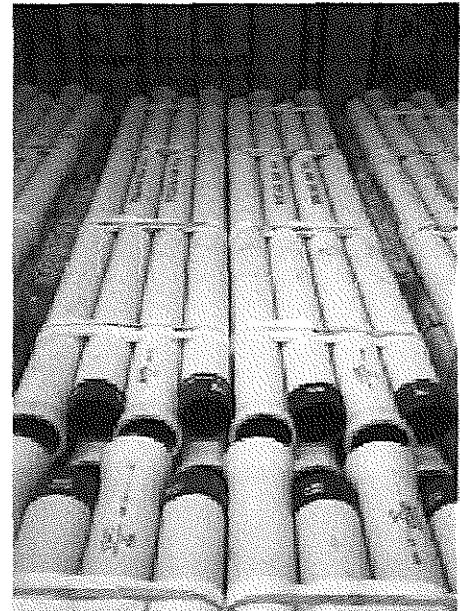
Cast-Iron or Cold Stamp Markings

All pipe and fittings shall be marked as follows:

- identification of the manufacturer
- identification of the year of manufacture
- DN
- identification of Ductile Iron
- PN of flanges where applicable

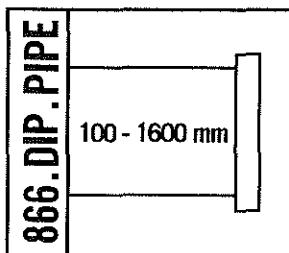
Other markings, painted or attached, as appropriate:

- length
- identification of third party certification
- special markings



NOTE: The above standard coatings and linings are suitable for the majority of soil conditions and raw or potable waters to be conveyed. Should supplementary protection be required for aggressive soils or waters carried by the pipeline, special coatings and linings may be required (see the Special Coatings and Linings section of this catalog).

See separate section for additional information on Polyethylene Encasement and special internal and/or external linings and coatings of Epoxy and Polyurethane.



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Thickness Design of Ductile Iron Pipe

Until such time as an ISO Standard covering the subject is adopted, we recommend the use of ANSI/AWWA C150/A21.50, Thickness Design of Ductile Iron Pipe. This Standard deals with internal pressure, trench loads, and exterior wheel loads.

Rated Working Pressure

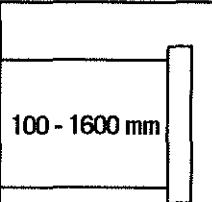
Rated working pressure and maximum allowable depths of earth cover indicated were calculated according to this Standard and on the following basis:

- $P = \text{design pressure} = 2 (\text{working pressure} + \text{surge pressure})$,
where 2 is the safety coefficient $P = 2eRp/DE$;
- surge pressure = 7 bar;
- $e = \text{net thickness} = \text{standard thickness} - \text{casting tolerance} - \text{service allowance}$;
- casting tolerance = $-(1,3 + 0,001 \text{ DN})$, where DN is the nominal diameter in millimeters;
- service allowance = 2 mm;
- $Rp = \text{minimum } 0,2\% \text{ proof stress} = 300 \text{ N/mm}^2$;
- truck superload of 7,3 t per rear wheel;
- $DE = \text{outside diameter}$

Allowable Depths of Cover (k9 thickness)

Based on a density of 1922,2 kg/m³, a wheel load of 7257,5 kg and an impact factor of 1,5

DN (mm)	Maximum Depth of Cover (M) - Standard Laying Conditions				
	1	2	3	4	5
100	13,6	15,5	17,8	22,1	28,7
150	7,5	9,8	10,6	13,8	19,0
200	4,8	6,1	7,5	10,2	15,3
250	4,0	5,3	6,6	9,3	14,4
300	3,5	4,8	6,2	8,8	13,9
350	3,3	4,6	5,9	8,6	13,7
400	3,0	4,4	5,7	8,3	12,5
450	2,9	4,2	5,6	8,2	11,8
500	2,7	4,1	5,4	8,0	10,8
600	2,6	3,9	5,2	7,1	9,7
700	2,4	3,8	5,1	6,6	9,1
800	*	3,7	4,9	6,2	8,6
900	*	3,6	4,8	5,9	8,3
1000	*	3,5	4,6	5,7	8,0
1200	*	3,4	4,3	5,4	7,7
1400	*	3,3	4,1	5,2	7,5
1500	*	3,2	4,0	5,1	7,4
1600	*	3,1	3,6	5,0	7,3



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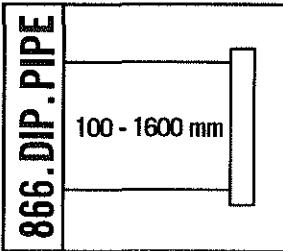
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Thickness Design of Ductile Iron Pipe (cont.)

Working Pressures (based on 7 bar surge)

DN (mm)	Working Pressure (K9 thickness) Bar
100	61,2
150	42,9
200	31,9
250	28,3
300	25,9
350	24,9
400	23,6
450	23,1
500	22,1
600	21,2
700	20,5
800	19,9
900	19,5
1000	19,2
1200	18,7
1400	18,3
1500	18,2
1600	18,1



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Thickness Design of Ductile Iron Pipe (cont.)

Type 1*:

Flat bottom trench† loose backfill.

Type 2:

Flat bottom trench† backfill lightly to centerline of pipe.

Type 3:

Pipe bedded in 10.2 cm minimum loose soil††. Backfill lightly consolidated to top of pipe.

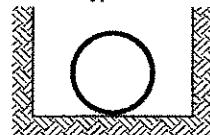
Type 4:

Pipe bedded in sand, gravel, or crushed stone to depth of 1/8 pipe diameter, 10.2 cm minimum. Backfill compacted to top of pipe. (Approximately 80% Standard Proctor, AASHTO T-99.)

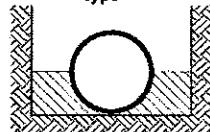
Type 5:

Pipe bedded in compacted granular material to centerline of pipe. Compacted granular material or select†† material to top of pipe. (Approximately 80% Standard Proctor, AASHTO T-99.)

Type 1*



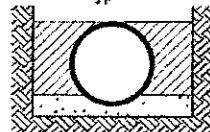
Type 2



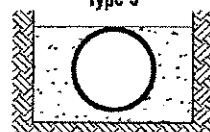
Type 3



Type 4



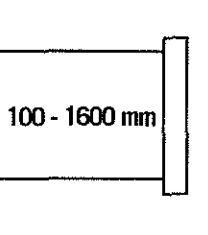
Type 5



* For sizes DN 800mm and larger, consideration should be given to the use of conditions other than Type 1.

† Flat bottom is defined as undisturbed soil.

†† "Loose soil" or "select backfill" is defined as native soil excavated from the trench, free of rocks foreign materials, and frozen earth.

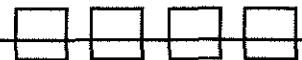


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Flanged Ductile Iron Pipe with Threaded Flanges

U.S. Pipe produces DN 100 through 1600 Ductile iron flanged pipe with PN10, PN16, or PN25 screwed-on ductile iron flanges in accordance with ISO 2531 and ISO 7005 Part 2 requirements. Full length flanged pipe are furnished in the following nominal lengths: DN 100 through 900 - 5.33 and DN 100 through 1600 - 5.94. Flanged pipe of shorter lengths can be furnished when specified.

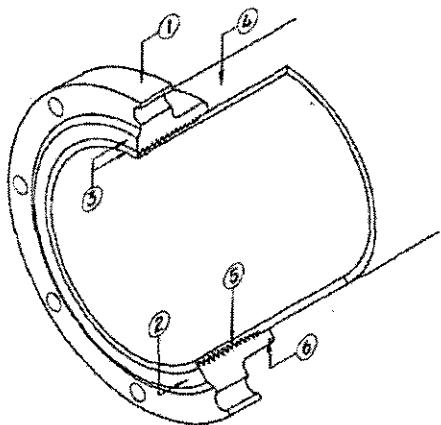
Flanged pipe can be furnished double flanged (one flange at each end); with one end flanged and the other end plain-end; with one end flanged and the other end with any pipe or fitting end configuration currently produced by U. S. Pipe.

Screw-on ductile iron flanges are fabricated on centrifugally cast ductile iron pipe of class K12 wall thickness as determined by the ISO 2531 for thickness. This K12 thickness exceeds the thickness requirements of ISO 2531 for pipe with screwed-on flanges and provides pipe metal thickness under the threads suitable to withstand working pressures greater than PN25. Pipe barrels and flanges have tapered pipe threads in accordance with ANSI B1.20.1 Standard adapted to ductile iron pipe outside diameters. After the flange is screwed onto the pipe and machine tightened until the pipe end extends beyond the flange face, the flange face and pipe end are machined so that they are flush. Threaded pipe and flanges are individually fitted and are not interchangeable in the field. In fact, flanges generally cannot be removed after fabrication without damaging the pipe or flange thread.

When furnished with two flanges, the face-to-face length shall be the specified length + 10 mm. Per ISO 2531, on agreement between the manufacturer and the purchaser, a smaller tolerance may be specified but not less than + 3 mm for < DN 600 and + 4 mm for > DN 600. The overall length of flange and plain end pipe shall be the specified length + 6.35 mm. Misalignment of corresponding bolt holes shall not exceed 3.04 mm. The machined flange faces shall be perpendicular to the pipe centerline and parallel such that any two face-to-face dimensions 180° apart at the flange OD shall not differ more than 1.5 mm. Bearing surfaces for bolting shall be parallel to the flange face within 3°.

Flanged pipes are furnished with exterior coating and interior lining as specified.

Consult your U. S. Pipe Sales Representative when special flange or drilling requirements such as BS-10 Table E and ANSI b16.1 Class 125 (for cast iron), ANSI B16.5 Class 150 (for steel) or ANSI/AWWA C115/A21.15 (for pipe and fitting) are required.



1. PN10, PN16, or PN25 Ductile Iron Flange
2. Raised Face
3. Raised Face of Flange and Barrel Machined.
4. ISO 2531 Ductile Iron Pipe Barrel
5. Pipe Threads, ANSI B1.20.0, Adapted to Ductile Iron Pipe Outside Diameters
6. Shroud

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100 - 1600 mm

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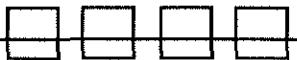
Loose Flanges, Flanged Joints Accessories, Flanged Fittings

CAUTION! U.S. Pipe does not recommend the practice of assembling screwed-on flanges on pipe in the field. As an accommodation to our customers, U.S. Pipe does provide flanged pipe with loose screwed-on type flanges when specified. Certain precautions must be taken when loose screwed-on type flanges are assembled to the pipe.

1. The threaded portion of the flange and the pipe are custom machined to accommodate the exact diameter of the pipe. In addition, the pipe and flange have been faced in the shop after proper tightening of the flange on the pipe. The loose flange must be mated only with the threaded pipe end with which it was shipped.
2. Extremely high torques are required to properly tighten screwed-on flanges. If there is a question regarding the adequacy of the field tightening means, a trial assembly using grease on the threads should be made prior to making the final assembly. Because of the difficulty in tightening large flanges at the job sites, sizes larger than 16" should not be attempted in the field.
3. The flange should never be assembled on the pipe without the use of lubricant or sealant on the threads.
4. Prior to making the final assembly of the flange on the pipe, the threaded portion of the flange and the pipe must be cleaned of all foreign material such as dirt, sand, or grit. A suitable solvent should be used to remove any grease or oil remaining on the threads.
5. A two-part 100% solids epoxy thread sealant should be applied to the threaded portion of the pipe and flange using the sealant manufacturer's recommended procedure.
6. The flange should be tightened until the face of the flange is flush with the faced end of the pipe. Normally the flange can be screwed-on the pipe by hand up to approximately the last three threads. Tightening the remaining threads creates the seal between the pipe and the flange threads if the face of the flange is not flush with the end of the pipe, a proper seal between the threads will not be made.

**U.S. PIPE ASSUMES NO RESPONSIBILITY FOR FIELD ASSEMBLY PRACTICES
AND DISCLAIMS ALL LIABILITY ARISING THEREFROM.**

Flanged Joint Accessories



866.DIP.PIPE

100 - 1600 mm

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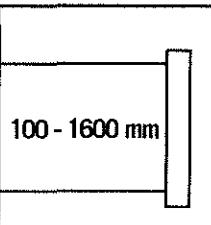
Loose Flanges, Flanged Joints Accessories, Flanged Fittings (cont.)

Flanged Joint Accessories

Flanged joint accessories (bolts, nuts and gaskets) can be furnished by U.S. Pipe as specified. U.S. Pipe's FLANGE TYPE® Gasket incorporates three annular half beads on each gasket face for performance superior to that of conventional flat rubber ring gaskets and is recommended. See separate brochure which follows.

Flanged Fittings

Flanged fittings, shown on the following pages, have wall thicknesses and performance characteristics equal to or greater than ISO 2531 requirements. These fittings, as covered in the "General Specifications: Dimensions and Masses" section of this catalog, may have lengths and masses which differ from those in ISO 2531.



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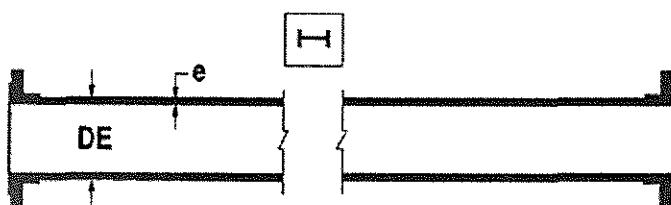


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Flanged Ductile Iron Pipe Dimensions and Masses K12

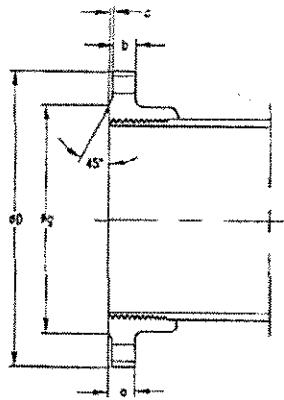


Nominal Diameter	DE	E	Barrel		Mass per Flange	
			K12	Mass per Meter	PN10	PN16
100	118	7,2		17,7	3,6	3,6
150	170	7,8		28,0	5,9	5,9
200	222	8,4		39,7	8,2	7,7
250	274	9,0		52,8	11,3	10,9
300	326	9,6		67,3	15,0	15,0
350	378	10,2		93,1	18,1	22,2
400	429	10,8		100,0	22,7	28,1
450	480	11,4		118,3	25,9	38,1
500	532	12,0		138,2	31,8	50,3
600	635	13,2		181,8	42,2	77,1
700	738	14,4		230,8	64,0	67,6
800	842	15,6		285,5	83,5	88,5
900	945	16,8		345,4	93,0	102,5
1000	1048	18,0		410,6	120,7	149,2
1200	1255	20,4		557,6	178,3	219,5
1400	1462	22,8		726,8	221,8	256,7
1500	1565	24,0		819,1	276,2	331,1
1600	1668	25,2		916,9	343,8	401,1
						543,0

Dimensions in millimeters. Masses in kilograms.

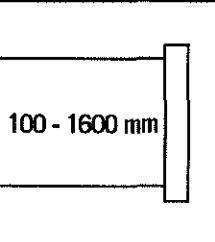


Screw Flanges for Ductile Iron Pipe PN10



PN10					
Nominal Size DN	D	g	a	b	c
100	220	153	19,0	16,0	3
150	285	209	19,0	16,0	3
200	340	264	20,0	17,0	3
250	400	319	22,0	19,0	3
300	455	367	24,5	20,5	4
350	505	427	24,5	20,5	4
400	565	477	24,5	20,5	4
450	615	527	25,5	21,5	4
500	670	582	26,5	22,5	4
600	780	682	30,0	25,0	5
700	895	797	32,5	27,5	5
800	1015	904	35,0	30,0	5
900	1115	1004	37,5	32,5	5
1000	1230	1111	40,4	35,0	5
1200	1455	1330	45,0	40,0	5
1400	1675	1530	46,0	41,0	5
1500	1785	1640	47,5	42,5	5
1600	1915	1750	49,0	44,0	5

Dimensions in millimeters.

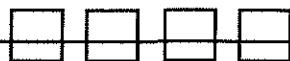


**INTERNATIONAL SALES
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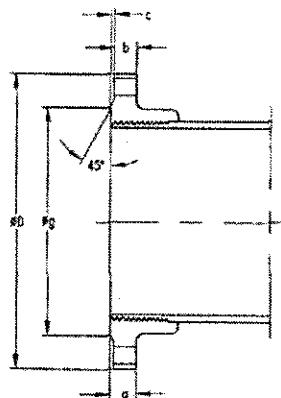


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**Screw Flanges for
Ductile Iron Pipe PN16**



PN16					
Nominal Size DN	D	g	a	b	c
100	220	153	19,0	16,0	3
150	285	209	19,0	16,0	3
200	340	264	20,0	17,0	3
250	400	319	22,0	19,0	3
300	455	367	24,5	20,5	4
350	520	432	26,5	22,5	4
400	580	484	28,0	24,0	4
450	640	544	30,0	26,0	4
500	715	600	31,5	27,5	4
600	840	721	36,0	31,0	5
700	910	791	39,5	34,5	5
800	1025	898	43,0	38,0	5
900	1125	998	46,5	41,5	5
1000	1255	1115	50,0	45,0	5
1200	1485	1330	57,0	42,0	5
1400	1685	1530	60,0	55,0	5
1500	1820	1640	62,5	57,5	5
1600	1930	1750	65,0	60,0	5

Dimensions in millimeters.

866.DIP.PIPE

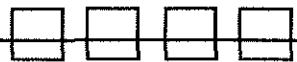
100 - 1600 mm

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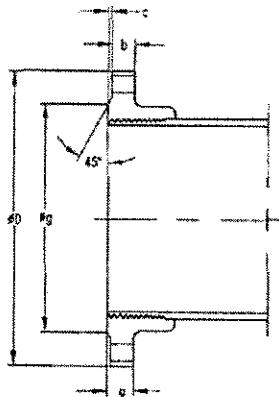


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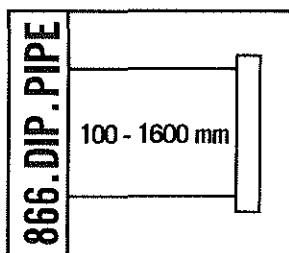


**Screw Flanges for
Ductile Iron Pipe PN25**



Nominal Size DN	D	g	a	b	c
100	235	159	19,0	16,0	3
150	300	214	20,0	17,0	3
200	360	274	2,0	19,0	3
250	425	331	24,5	21,5	3
300	485	389	27,5	23,5	4
350	555	446	30,0	26,0	4
400	620	503	32,0	28,0	4
450	670	553	34,5	30,5	4
500	730	613	36,5	32,5	4
600	845	718	42,0	37,0	5
700	960	820	46,5	41,5	5
800	1085	929	51,0	46,0	5
900	1185	1029	55,5	50,5	5
1000	1320	1142	60,0	55,0	5
1200	1530	1350	69,0	64,0	5
1400	1755	1560	74,0	69,0	5
1600	1975	1780	81,0	76,0	5

Dimensions in millimeters.



**INTERNATIONAL SALES
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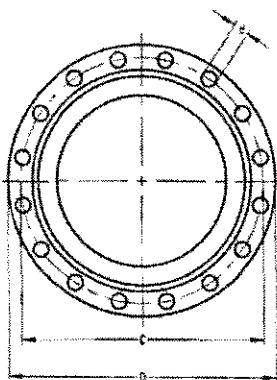


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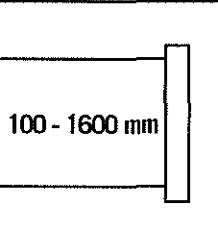


Drilling Details for PN10, PN16 and PN25 Flanges



Nominal Size DN	PN10				
	D	C	Holes Number	ød	Bolts
100	220	180	8	19	16
150	285	240	8	23	20
200	340	295	8	23	20
250	400	350	12	23	20
300	455	400	12	23	20
350	505	460	16	23	20
400	565	515	16	28	24
450	615	565	20	28	24
500	670	620	20	28	24
600	780	725	20	31	27
700	890	840	24	31	27
800	1015	950	24	34	30
900	1115	1050	28	34	30
1000	1230	1160	28	37	33
1200	1455	1380	32	40	36
1400	1675	1590	36	43	39
1500	1785	1700	36	43	39
1600	1915	1820	40	49	45

Dimensions in millimeters.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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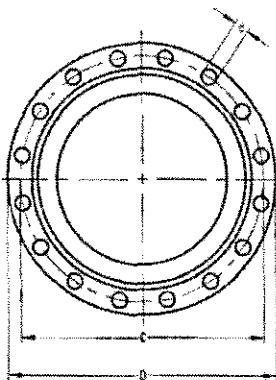


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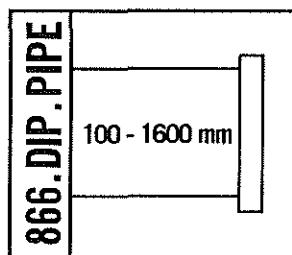
Drilling Details for PN10, PN16 and PN25 Flanges (cont.)



PN16

Nominal Size DN	D	C	Holes		Bolts
			Numbers	Ød	
100	220	180	8	19	16
150	285	240	8	23	20
200	340	295	12	23	20
250	400	355	12	28	24
300	455	410	12	28	24
350	520	470	16	28	24
400	580	525	16	31	27
450	640	585	20	31	27
500	715	650	20	34	30
600	840	770	20	37	33
700	910	840	24	37	33
800	1025	950	24	40	36
900	1125	1050	28	40	36
1000	1255	1170	28	43	39
1200	1485	1390	32	49	45
1400	1685	1590	36	49	45
1500	1820	1710	36	56	52
1600	1930	1820	40	56	52

Dimensions in millimeters.



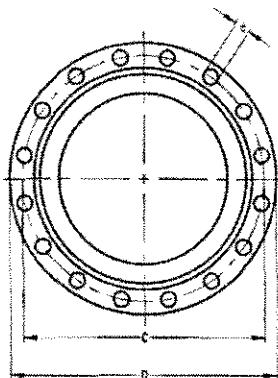
**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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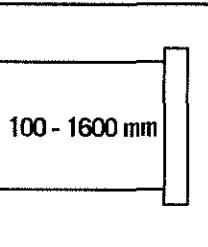
P 22

Drilling Details for PN10, PN16 and PN25 Flanges (cont.)



Nominal Size DN	PN25				
	D	C	Holes Numbers	Ød	Ø
100	235	190	8	23	20
150	300	250	8	28	24
200	360	310	12	28	24
250	425	370	12	31	27
300	485	430	16	31	27
350	555	490	16	34	30
400	620	550	16	37	33
450	670	600	20	37	33
500	730	660	20	37	33
600	845	770	20	40	36
700	960	875	24	43	39
800	1085	990	24	49	45
900	1185	1090	28	49	45
1000	1320	1210	28	56	52
1200	1530	1420	32	56	52
1400	1755	1640	36	62	56
1600	1975	1860	40	62	56

Dimensions in millimeters.

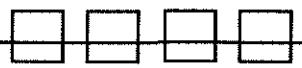


**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

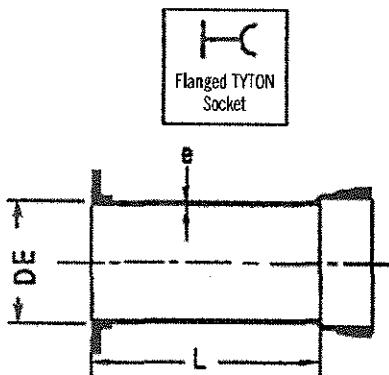


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Flanged Fittings - Flanged TYTON® Socket



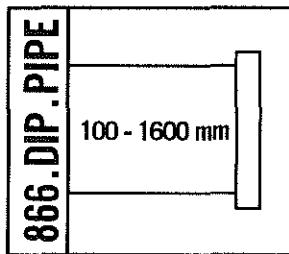
Nominal Size DN	DE	e	L	Mass with Flange		
				PN10	PN16	PN25
100	118	7,2	130	10	10	10
150	170	7,8	135	15	15	16
200	222	8,4	140	21	21	23
250	274	9,0	145	28	28	32
300	326	9,6	150	38	38	42
350	378	10,2	155	53	57	65
400	429	10,8	160	65	70	82
450	480	11,4	165	76	88	98
500	532	12,0	170	90	108	119
600	635	13,2	180	119	154	162
700	738	14,4	190	176	180	222
800	842	15,6	200	225	230	280
900	945	16,8	210	267	276	336
1000	1048	18,0	220	365	394	463
1200	1255	20,4	240	533	574	659
1400	1462	22,8	310	750	785	937
1500	1565	24,0	320	1092	1085	—
1600	1668	25,2	330	1402	1382	1384

DN 1500 and 1600 sizes are available only as TR FLEX® Fittings.

Dimensions in millimeters. Masses in kilograms.

These fittings can be supplied to buying lengths (L) other than those listed.

Flanges as provided on these fittings shall be screwed-on flanges.



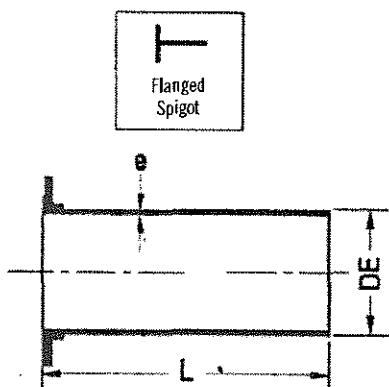
**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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Flanged Fittings - Flanged Spigots



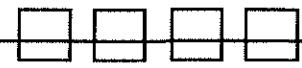
Nominal Size DN	DE	e	L	Mass with Flange		
				PN10	PN16	PN25
100	118	7,2	360	10	10	11
150	170	7,8	380	17	17	18
200	222	8,4	400	24	24	26
250	274	9,0	420	34	33	37
300	326	9,6	440	45	45	49
350	378	10,2	460	56	60	69
400	429	10,8	480	71	76	88
450	480	11,4	500	85	97	107
500	532	12,0	520	104	122	133
600	635	13,2	560	144	179	187
700	738	14,4	600	203	206	248
800	842	15,6	600	255	260	310
900	945	16,8	600	300	310	370
1000	1048	18,0	600	367	396	465
1200	1255	20,4	600	513	555	640
1400	1462	22,8	710	738	773	926
1500	1565	24,0	750	1090	1084	—
1600	1668	25,2	780	1418	1399	1381

DN 1500 and 1600 sizes are available only as TR FLEX® Fittings.

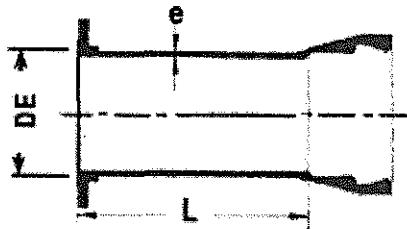
Dimensions in millimeters. Masses in kilograms.

These fittings can be supplied to buying lengths (L) other than those listed.

Flanges as provided on these fittings shall be screwed-on flanges.



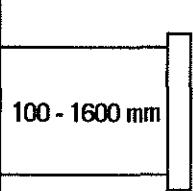
Flanged Fittings - Flanged TR FLEX® Socket



Nominal Size DN	DE	e	L	Mass with Flange		
				PN10	PN16	PN25
100	118	7,2	130	12	12	13
150	170	7,8	135	20	20	21
200	222	8,4	140	29	28	30
250	274	9,0	145	39	39	43
300	326	9,6	150	52	52	56
350	378	10,2	155	71	75	83
400	429	10,8	160	88	93	105
450	480	11,4	165	102	114	124
500	532	12,0	170	123	142	153
600	635	13,2	180	170	205	213
700	738	14,4	190	241	245	287
800	842	15,6	200	305	310	361
900	945	16,8	210	387	396	456
1000	1048	18,0	220	357	386	455
1200	1255	20,4	240	516	557	642
1400	1462	22,8	310	721	756	908
1500	1565	24,0	320	1056	1049	—
1600	1668	25,2	330	1377	1358	1340

Dimensions in millimeters. Masses in kilograms.

These fittings can be supplied to laying lengths (L) other than those listed.

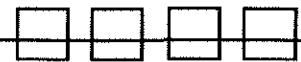


**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

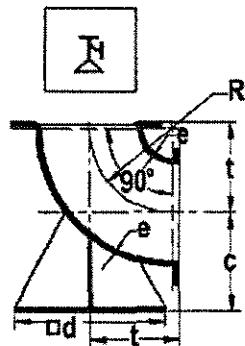


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Flanged Fittings - Flanged Duckfoot 90° Bend



Nominal Size DN	e	t	R	c	d	Mass Approx.		
						PN10	PN16	PN25
100	7,2	192	114	125	200	20	21	21
150	7,8	224	152	160	250	31	31	34
200	8,4	254	178	190	300	47	47	49
250	9,0	290	229	225	350	70	70	377
300	9,6	310	254	255	400	91	90	100
350	10,2	445	292	290	450	135	141	154
400	10,8	474	318	320	500	168	177	197
450	11,4	445	356	355	550	196	212	231
500	12,0	591	394	385	600	272	298	316
600	13,2	673	470	450	700	384	430	449

Dimensions in millimeters. Masses in kilograms.

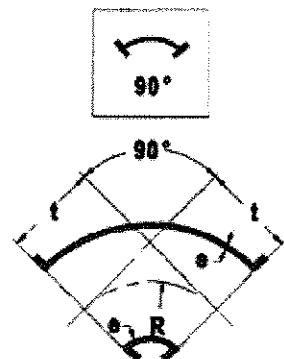
866.DIP.PIPE

100 - 1600 mm

**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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2009 EDITION

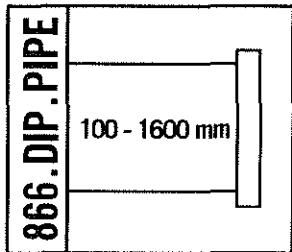
P 27

Flanged Fittings - 90° Flanged Bend

Nominal Size DN	e	t	R	Mass Approx.		
				PN10	PN16	PN25
100	7,2	192	114	11,3	11,3	13,6
150	7,8	224	152	20,4	20,4	22,7
200	8,4	254	178	29,5	29,5	31,8
250	9,0	290	229	43,1	43,1	49,9
300	9,6	310	254	57	57	66
350	10,2	445	292	91	95	109
400	10,8	474	318	113	122	143
450	11,4	445	356	125	138	159
500	12,0	591	314	188	215	234
600	13,2	673	470	270	318	336
700	14,4	800	572	390	413	474
800	15,6	900	671	538	565	651
900	16,8	806	610	603	637	739
1000	18,0	1100	846	909	975	1107
1200	20,4	965	711	1161	1263	1420
1400*	22,8	1028	900	1524	1626	1871
1500	24,0	1092	847	1814	1978	-
1600*	25,2	1219	896	2282	2440	2717

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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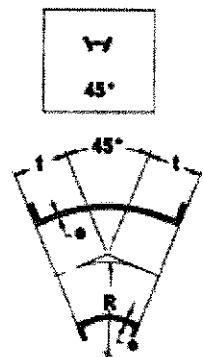


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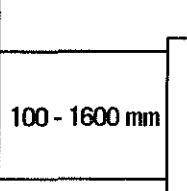
Flanged Fittings - 45° Flanged Bend



Nominal Size DN	e	t	R	Mass Approx.		
				PN10	PN16	PN25
100	7,2	129	122	11,3	11,3	11,3
150	7,8	147	184	18,1	18,1	20,4
200	8,4	165	214	24,9	24,9	29,5
250	9,0	175	276	36,3	36,3	40,8
300	9,6	196	337	48	48	57
350	10,2	279	306	73	77	91
400	10,8	296	337	88	98	118
450	11,4	241	368	91	107	125
500	12,0	375	429	145	170	188
600	13,2	394	356	200	247	265
700	14,4	484	616	293	318	379
800	15,6	529	736	397	426	513
900	16,8	552	506	508	542	644
1000	18,0	632	930	658	723	855
1200	20,4	711	736	1027	1129	1286
1400*	22,8	558	1043	1080	1182	1427
1500	24,0	597	1155	1263	1424	—
1600*	25,2	635	1214	1515	1674	1950

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.

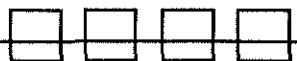


**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

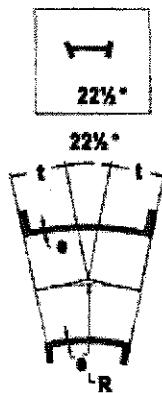


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Flanged Fittings - 22 1/2° Flanged Bend



Nominal Size DN	e	t	R	Mass Approx.		
				PN10	PN16	PN25
100	7,2	129	256	11,3	11,3	11,3
150	7,8	147	383	18,1	18,1	20,4
200	8,4	165	448	24,9	24,9	29,5
250	9,0	175	575	36,3	36,3	43,1
300	9,6	196	702	50	48	59
350	10,2	216	638	61	68	82
400	10,8	229	702	77	86	107
450	11,4	241	767	93	107	127
500	12,0	273	894	118	143	161
600	13,2	295	367	166	211	231
700	14,4	334	532	229	254	315
800	15,6	354	653	306	336	420
900	16,8	489	766	469	503	606
1000	18,0	412	826	492	558	687
1200	20,4	641	894	964	1064	1220
1400*	22,8	393	823	864	966	1211
1500	24,0	356	1001	905	1068	—
1600*	25,2	343	1059	1023	1182	1458

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.

**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

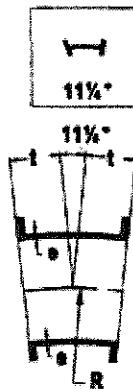


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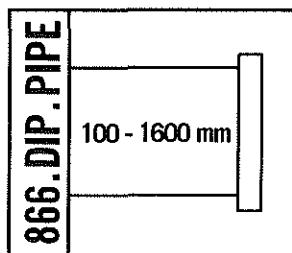
Flanged Fittings - 11 1/4° Bend



Nominal Size DN	e	t	R	Mass Approx.	PN10	PN16	PN25
100	7,2	129	516		11,3	11,3	11,3
150	7,8	147	775		18,1	18,1	20,4
200	8,4	165	902		24,9	24,9	29,5
250	9,0	175	1161		36,3	36,3	43,1
300	9,6	196	1418		50	48	59
350	10,2	216	1289		61	68	82
400	10,8	229	1418		77	86	107
450	11,4	241	1548		93	109	127
500	12,0	273	1805		118	145	163
600	13,2	295	355		166	213	231
700	14,4	254	517		193	218	279
800	15,6	295	962		272	302	388
900	16,8	489	1547		469	506	606
1000	18,0	332	1163		426	492	624
1200	20,4	641	1805		964	1066	1222
1400*	22,8	342	783		792	894	1139
1500	24,0	267	1119		764	925	—
1600*	25,2	241	1106		841	1000	1277

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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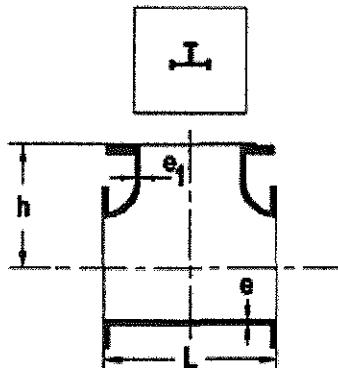
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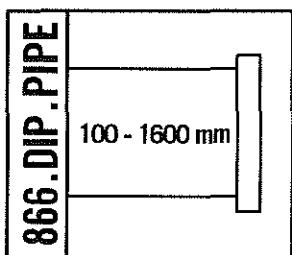


**Flanged Fitting
All Flanged PN10 Tee**

Nominal Size DN	Body		Nominal Size DN	Branch		Mass Approx.
	e	L		e ₁	h	
100	8,4	384	80	8,1	171	18,1
	8,4	384	100	8,4	192	20,4
150	9,1	447	80	8,1	210	27,2
	9,1	447	100	8,4	230	29,5
	9,1	447	150	9,1	224	31,8
200	9,8	508	80	8,1	235	40,8
	9,8	508	100	8,4	256	43,1
	9,8	508	150	9,1	249	45,4
	9,8	508	200	9,8	254	47,6
250	10,5	579	100	8,4	306	59,0
	10,5	579	150	9,1	300	61,2
	10,5	579	200	9,8	305	65,8
	10,5	579	250	10,5	290	68,0
300	11,2	620	100	8,4	332	77
	11,2	620	150	9,1	325	79
	11,2	620	200	9,8	330	84
	11,2	620	250	10,5	315	86
	11,2	620	300	11,2	310	88
350	11,9	889	150	9,1	375	122
	11,9	889	200	9,8	375	127
	11,9	889	250	10,5	375	132
	11,9	889	300	11,2	419	138
	11,9	889	350	11,9	445	145
400	12,6	947	150	9,1	400	154
	12,6	947	200	9,8	400	156
	12,6	947	250	10,5	400	161
	12,6	947	300	11,2	445	168
	12,6	947	350	11,9	470	175
	12,6	947	400	12,6	474	179



Dimensions in millimeters. Masses in kilograms.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



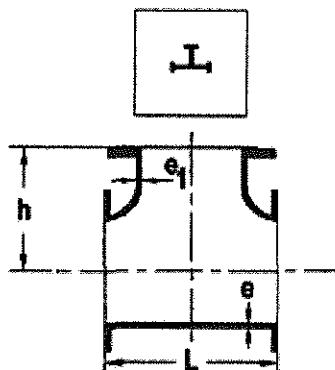
2009 EDITION

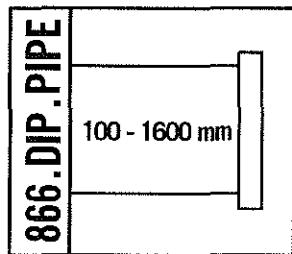
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**Flanged Fitting
All Flanged PN10 Tee (cont.)**

Nominal Size DN	Body		Nominal Size DN	Branch		Mass Approx.
	e	L		e ₁	h	
450	13,3	711	150	9,1	413	143
	13,3	711	200	9,8	413	145
	13,3	711	250	10,5	413	150
	13,3	711	300	11,2	413	154
	13,3	889	350	11,9	445	184
	13,3	889	400	12,6	445	188
	13,3	889	450	13,3	445	191
500	14,0	978	150	9,1	451	211
	14,0	978	200	9,8	451	213
	14,0	978	250	10,5	451	218
	14,0	978	300	11,2	495	225
	14,0	978	350	11,9	521	231
	14,0	978	400	12,6	483	231
	14,0	978	450	13,3	483	236
	14,0	978	500	14,0	489	238
600	15,4	991	150	9,1	502	281
	15,4	991	200	9,8	502	283
	15,4	991	250	10,5	502	288
	15,4	991	300	11,2	546	295
	15,4	991	350	11,9	572	302
	15,4	991	400	12,6	575	306
	15,4	1148	450	13,3	584	347
	15,4	1148	500	14,0	591	354
	15,4	1148	600	15,4	574	361
700	16,8	743	200	9,8	617	290
	16,8	949	400	12,6	638	365
	16,8	1314	700	16,8	657	503
900	19,6	1080	200	9,8	679	578
	19,6	1080	250	10,5	679	581
	19,6	1080	300	11,2	679	585
	19,6	1080	350	11,9	686	587
	19,6	1080	400	12,6	686	590
	19,6	1080	450	13,3	686	592
	19,6	1080	500	14,0	692	596
	19,6	1207	600	15,4	676	655
	19,6	1486	900	19,6	743	823

Dimensions in millimeters. Masses in kilograms.





**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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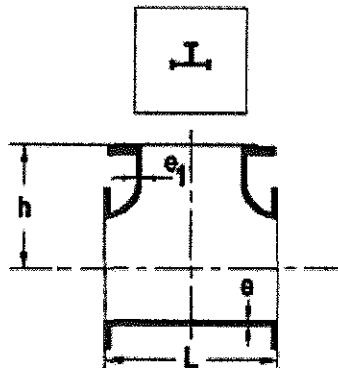
P 33

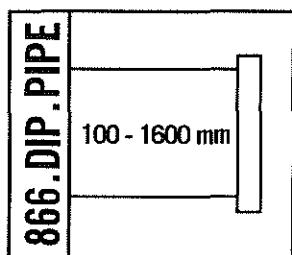
**Flanged Fitting
All Flanged PN10 Tee (cont.)**

Nominal Size DN	Body		Branch		Mass Approx.
	e	L	Nominal Size DN	e ₁	
1000	21,0	794	200	9,8	549
	21,0	990	400	12,6	653
	21,0	1123	500	14,0	730
	21,0	1650	600	15,4	991
	21,0	1452	800	18,2	941
	21,0	1650	900	19,6	1059
	21,0	1657	1000	21,0	1070
1200	23,8	1384	300	11,2	883
	23,8	1384	350	11,9	889
	23,8	1384	400	12,6	889
	23,8	1384	450	13,3	889
	23,8	1384	500	14,0	895
	23,8	1384	600	15,4	879
	23,8	1830	800	18,2	915
	23,8	1791	900	19,6	895
	23,8	1890	1000	21,0	945
	23,8	1930	1200	23,8	965
1400*	26,6	1310	600	15,4	1006
	26,6	1919	900	19,6	1035
	26,6	1919	1200	23,8	1092
	26,6	2160	1400	26,6	1080
1500	28,0	1676	900	19,6	1067
	28,0	2184	1200	23,8	1092
	28,0	2184	1400*	26,6	1092
	28,0	2184	1500	28,0	1092
1600*	29,4	1626	900	19,6	1118
	29,4	2438	1200	23,8	1143
	29,4	2438	1400	26,6	1168
	29,4	2438	1500	28,0	1168
	29,4	2438	1600	29,4	1219

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.





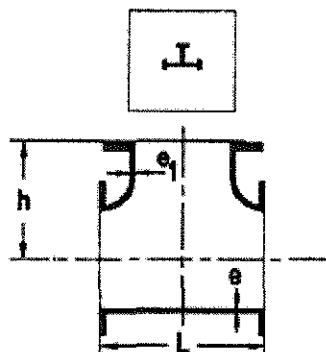
**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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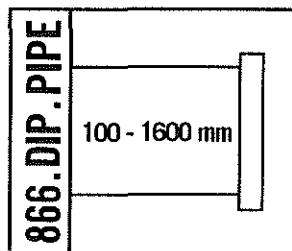
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**Flanged Fitting
All Flanged PN16 Tee**



Nominal Size DN	Body		Nominal Size DN	Branch		Mass Approx.
	e	L		e ₁	h	
100	8,4	384	80	8,1	171	18,1
	8,4	384	100	8,4	192	20,4
150	9,1	447	80	8,1	210	27,2
	9,1	447	100	8,4	230	29,5
	9,1	447	150	9,1	224	31,8
200	9,8	508	80	8,1	235	40,8
	9,8	508	100	8,4	256	43,1
	9,8	508	150	9,1	249	45,4
	9,8	508	200	9,8	254	47,6
250	10,5	579	100	8,4	306	59,0
	10,5	579	150	9,1	300	61,2
	10,5	579	200	9,8	305	65,8
	10,5	579	250	10,5	290	68,0
300	11,2	620	100	8,4	332	77
	11,2	620	150	9,1	325	79
	11,2	620	200	9,8	330	82
	11,2	620	250	10,5	315	86
	11,2	620	300	11,2	310	88
350	11,9	889	150	9,1	375	129
	11,9	889	200	9,8	375	132
	11,9	889	250	10,5	375	136
	11,9	889	300	11,2	419	145
	11,9	889	350	11,9	445	152

Dimensions in millimeters. Masses in kilograms.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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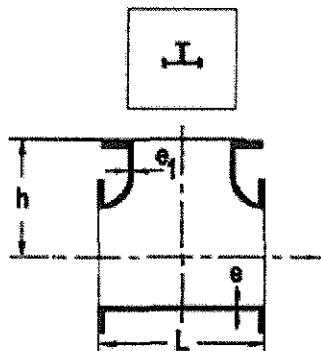
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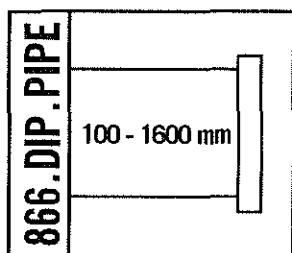


**Flanged Fitting
All Flanged PN16 Tee (cont.)**

Nominal Size DN	Body		Nominal Size DN	Branch		Mass Approx.
	e	L		e ₁	h	
400	12,6	947	150	9,1	400	163
	12,6	947	200	9,8	400	166
	12,6	947	250	10,5	400	170
	12,6	947	300	11,2	445	177
	12,6	947	350	11,9	470	188
	12,6	947	400	12,6	474	193
450	13,3	711	150	9,1	413	159
	13,3	711	200	9,8	413	161
	13,3	711	250	10,5	413	163
	13,3	711	300	11,2	413	168
	13,3	889	350	11,9	445	202
	13,3	889	400	12,6	445	209
	13,3	889	450	13,3	445	213
500	14,0	978	150	9,1	451	238
	14,0	978	200	9,8	451	240
	14,0	978	250	10,5	451	243
	14,0	978	300	11,2	495	252
	14,0	978	350	11,9	521	261
	14,0	978	400	12,6	483	263
	14,0	978	450	13,3	483	270
	14,0	978	500	14,0	489	279
600	15,4	991	150	9,1	502	329
	15,4	991	200	9,8	502	331
	15,4	991	250	10,5	502	333
	15,4	991	300	11,2	546	340
	15,4	991	350	11,9	572	349
	15,4	991	400	12,6	575	356
	15,4	1148	450	13,3	584	401
	15,4	1148	500	14,0	591	413
	15,4	1148	600	15,4	574	431
700	16,8	743	200	9,8	617	315
	16,8	949	400	12,6	638	395
	16,8	1314	700	16,8	657	540

Dimensions in millimeters. Masses in kilograms.





**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



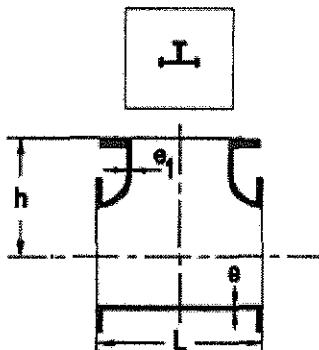
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**Flanged Fitting
All Flanged PN16 Tee (cont.)**

Nominal Size DN	Body		Branch			Mass Approx.
	e	L	Nominal Size DN	e ₁	h	
800	18,2	745	200	9,8	668	397
	18,2	951	400	12,6	689	488
	18,2	1003	450	13,3	690	513
	18,2	1363	600	15,4	664	662
	18,2	1363	700	16,8	678	671
	18,2	1418	800	18,2	709	712
900	19,6	1080	200	9,8	679	615
	19,6	1080	250	10,5	679	617
	19,6	1080	300	11,2	679	619
	19,6	1080	350	11,9	686	626
	19,6	1080	400	12,6	686	630
	19,6	1080	450	13,3	686	635
	19,6	1080	500	14,0	692	646
	19,6	1207	600	15,4	676	714
	19,6	1486	900	19,6	743	873
1000	21,0	794	200	9,8	768	615
	21,0	990	400	12,6	735	723
	21,0	1123	500	14,0	790	810
	21,0	1650	600	15,4	765	1080
	21,0	1452	800	18,2	804	1021
	21,0	1650	900	19,6	825	1143
	21,0	1657	1000	21,0	829	1170
1200	23,8	1384	300	11,2	883	1277
	23,8	1384	350	11,9	889	1281
	23,8	1384	400	12,6	889	1286
	23,8	1384	450	13,3	889	1290
	23,8	1384	500	14,0	895	1300
	23,8	1384	600	15,4	879	1315
	23,8	1830	800	18,2	915	1617
	23,8	1791	900	19,6	895	1624
	23,8	1890	1000	21,0	945	1726
	23,8	1930	1200	23,8	965	1828



Dimensions in millimeters. Masses in kilograms.

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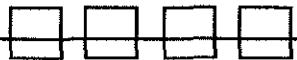
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**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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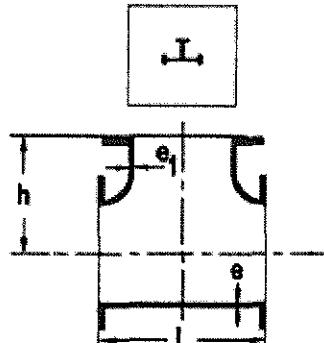


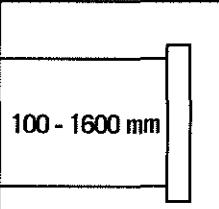
**Flanged Fitting
All Flanged PN16 Tee (cont.)**

Nominal Size DN	Body			Branch		Mass Approx.
	e	L	Nominal Size DN	e ₁	h	
1400*	26,6	1310	600	15,4	1006	1576
	26,6	1919	900	19,6	1035	2141
	26,6	1919	1200	23,8	1092	2279
	26,6	2160	1400	26,6	1080	2474
1500	28,0	1676	900	19,6	1067	2175
	28,0	2184	1200	23,8	1092	2769
	28,0	2184	1400*	26,6	1092	2803
	28,0	2184	1500	28,0	1092	2808
1600*	29,4	1626	900	19,6	1118	2377
	29,4	2438	1200	23,8	1143	3350
	29,4	2438	1400	26,6	1168	3406
	29,4	2438	1500	28,0	1168	3468
	29,4	2438	1600	29,4	1219	3495

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.





**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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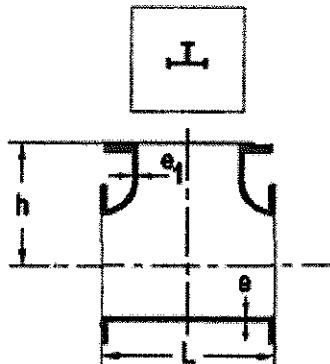
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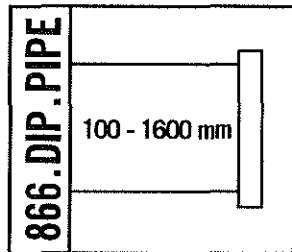


**Flanged Fitting
All Flanged PN25 Tee**

Nominal Size DN	Body		Branch		Mass Approx.
	e	L	Nominal Size DN	e ₁	
100	8,4	384	80	8,1	20,4
	8,4	384	100	8,4	20,4
150	9,1	447	80	8,1	31,8
	9,1	447	100	8,4	31,8
	9,1	447	150	9,1	36,3
200	9,8	508	80	8,1	43,1
	9,8	508	100	8,4	45,4
	9,8	508	150	9,1	49,9
	9,8	508	200	9,8	52,2
250	10,5	579	100	8,4	65,8
	10,5	579	150	9,1	70,3
	10,5	579	200	9,8	72,6
	10,5	579	250	10,5	77,1
300	11,2	620	100	8,4	86
	11,2	620	150	9,1	91
	11,2	620	200	9,8	93
	11,2	620	250	10,5	98
	11,2	620	300	11,2	102
350	11,9	889	150	9,1	143
	11,9	889	200	9,8	147
	11,9	889	250	10,5	152
	11,9	889	300	11,2	163
	11,9	889	350	11,9	172
400	12,6	947	150	9,1	184
	12,6	947	200	9,8	188
	12,6	947	250	10,5	193
	12,6	947	300	11,2	202
	12,6	947	350	11,9	213
	12,6	947	400	12,6	222

Dimensions in millimeters. Masses in kilograms.





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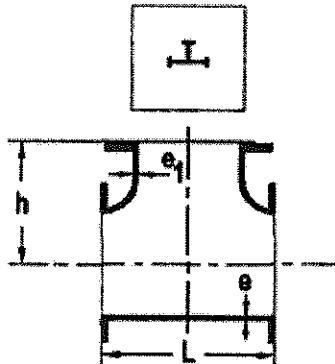
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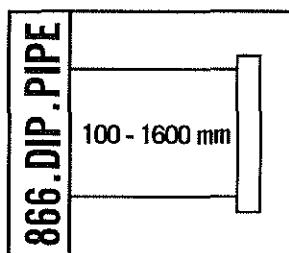


**Flanged Fitting
All Flanged PN25 Tee (cont.)**

Nominal Size DN	Body		Nominal Size DN	Branch		Mass Approx.
	e	L		e ₁	h	
450	13,3	711	150	9,1	413	179
	13,3	711	200	9,8	413	181
	13,3	711	250	10,5	413	186
	13,3	711	300	11,2	413	193
	13,3	889	350	11,9	445	229
	13,3	889	400	12,6	445	238
	13,3	889	450	13,3	445	240
500	14,0	978	150	9,1	451	256
	14,0	978	200	9,8	451	261
	14,0	978	250	10,5	451	265
	14,0	978	300	11,2	495	274
	14,0	978	350	11,9	521	286
	14,0	978	400	12,6	483	290
	14,0	978	450	13,3	483	297
	14,0	978	500	14,0	489	306
600	15,4	991	150	9,1	502	349
	15,4	991	200	9,8	502	352
	15,4	991	250	10,5	502	356
	15,4	991	300	11,2	546	365
	15,4	991	350	11,9	572	376
	15,4	991	400	12,6	575	386
	15,4	1148	450	13,3	584	429
	15,4	1148	500	14,0	591	442
	15,4	1148	600	15,4	574	458
700	16,8	743	200	9,8	617	376
	16,8	949	400	12,6	638	463
	16,8	1314	700	16,8	657	630
800	18,2	745	200	9,8	668	483
	18,2	951	400	12,6	689	583
	18,2	1003	450	13,3	690	608
	18,2	1363	600	15,4	664	758
	18,2	1363	700	16,8	678	787
	18,2	1418	800	18,2	709	841



Dimensions in millimeters. Masses in kilograms.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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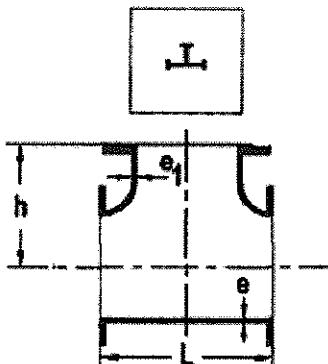
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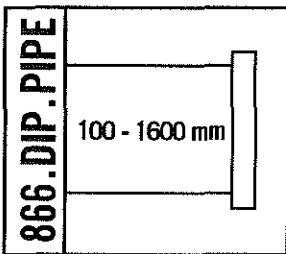
**Flanged Fitting
All Flanged PN25 Tee (cont.)**

Nominal Size DN	Body		Branch			Mass Approx.
	e	L	Nominal Size DN	e ₁	h	
900	19,6	1080	200	9,8	679	717
	19,6	1080	250	10,5	679	721
	19,6	1080	300	11,2	679	726
	19,6	1080	350	11,9	686	733
	19,6	1080	400	12,6	686	742
	19,6	1080	450	13,3	686	746
	19,6	1080	500	14,0	692	755
	19,6	1207	600	15,4	676	826
	19,6	1486	900	19,6	743	1025
1000	21,0	794	200	9,8	768	746
	21,0	990	400	12,6	735	864
	21,0	1123	500	14,0	790	950
	21,0	1650	600	15,4	765	1220
	21,0	1452	800	18,2	804	1195
	21,0	1650	900	19,6	825	1324
	21,0	1657	1000	21,0	829	1365
1200	23,8	1384	300	11,2	883	1438
	23,8	1384	350	11,9	889	1445
	23,8	1384	400	12,6	889	1451
	23,8	1384	450	13,3	889	1456
	23,8	1384	500	14,0	895	1465
	23,8	1384	600	15,4	879	1481
	23,8	1830	800	18,2	915	1814
	23,8	1791	900	19,6	895	1830
	23,8	1890	1000	21,0	945	1948
	23,8	1930	1200	23,8	965	2062
1400*	26,6	1259	600	15,4	1006	1830
	26,6	1868	900	19,6	1035	2436
	26,6	2275	1200	23,8	1092	2601
	26,6	2275	1400	26,6	1137	2842
1600*	29,4	1626	900	19,6	1118	2703
	29,4	2438	1200	23,8	1143	3704
	29,4	2438	1400	26,6	1168	3806
	29,4	2438	1600	29,4	1219	3910

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.



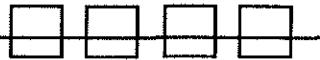


**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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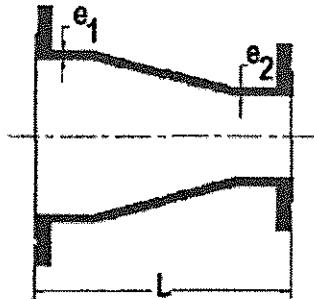
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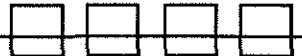


Flanged Fitting Double Flanged Taper

Large Diameter		Small Diameter		L	Mass Approx.		
Nominal Size DN	e ₁	Nominal Size DN	e ₂		PN10	PN16	PN25
150	7,8	100	7,2	276	13,6	13,6	15,9
200	8,4	100	7,2	332	18,1	18,1	20,4
	8,4	150	7,8	325	22,7	22,7	24,9
250	9,0	100	7,2	342	24,9	24,9	27,2
	9,0	150	7,8	335	27,2	27,2	31,8
	9,0	200	8,4	340	31,8	31,8	36,3
300	9,6	100	7,2	388	32	32	36
	9,6	150	7,8	381	34	34	41
	9,6	200	8,4	386	39	39	45
	9,6	250	9,0	371	43	41	50
350	10,2	150	7,8	451	43	45	54
	10,2	200	8,4	451	48	50	59
	10,2	250	9,0	451	52	57	66
	10,2	300	9,6	451	59	61	73
400	10,8	150	7,8	502	54	59	70
	10,8	200	8,4	502	59	64	75
	10,8	250	9,0	502	64	68	82
	10,8	300	9,6	502	70	75	88
	10,8	350	10,2	508	75	84	100
450	11,4	200	8,4	527	68	75	86
	11,4	250	9,0	527	73	79	93
	11,4	300	9,6	527	79	86	102
	11,4	350	10,2	533	84	95	111
	11,4	400	10,8	533	93	104	125
500	12,0	250	9,0	559	84	98	109
	12,0	300	9,6	559	91	104	118
	12,0	350	10,2	565	98	113	129
	12,0	400	10,8	565	104	122	141
	12,0	450	11,4	565	111	132	152
600	13,2	300	9,6	644	125	147	163
	13,2	350	10,2	650	129	156	172
	13,2	400	10,8	650	138	166	186
	13,2	450	11,4	650	145	177	195
	13,2	500	12,0	657	156	193	211

Dimensions in millimeters. Masses in kilograms.



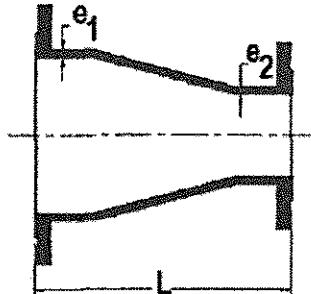


Flanged Fitting Double Flanged Taper (cont.)

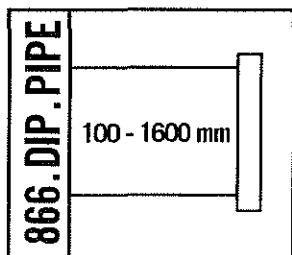
Large Diameter		Small Diameter		L	Mass Approx.		
Nominal Size DN	e ₁	Nominal Size DN	e ₂		PN10	PN16	PN25
700	14,4	500	12,0	478	147	172	211
	14,4	600	13,2	329	134	170	209
800	15,6	600	13,2	496	195	234	286
	15,6	700	14,4	600	245	272	345
900	16,8	500	12,0	978	327	356	417
	16,8	600	13,2	961	352	392	451
	16,8	700	14,4	502	247	277	358
	16,8	800	15,6	340	220	252	345
1000	18,0	600	13,2	911	379	435	510
	18,0	800	15,6	497	304	352	458
	18,0	900	16,8	600	365	415	531
1200	20,4	900	16,8	1283	771	839	968
	20,4	1000	18,0	480	424	508	651
1400*	22,8	900	16,8	979	726	794	966
	22,8	1200	20,4	731	730	832	1032
1500	24,0	900	16,8	813	685	785	—
	24,0	1200	20,4	508	628	760	—
	24,0	1400*	22,8	381	601	733	—
1600*	25,2	900	16,8	889	814	912	1100
	25,2	1200	20,4	635	778	909	1125
	25,2	1400	22,8	457	719	848	1109
	25,2	1500	24,0	432	737	896	—

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.



NOTE: On tapers of certain end combinations the number of bolt holes on one flange have an odd number in one quadrant and the opposite flange has an even number of holes in the same quadrant. Therefore there are only four (4) positions in which the tapers can be placed to properly assemble with the adjacent piping. Please take particular note that flanged tapers have the vertical centerline marked on the edge of the flange. If assembled with the centerline in the vertical plane, the fitting will properly assemble with the adjacent components.

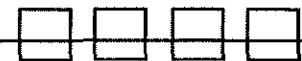


INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS

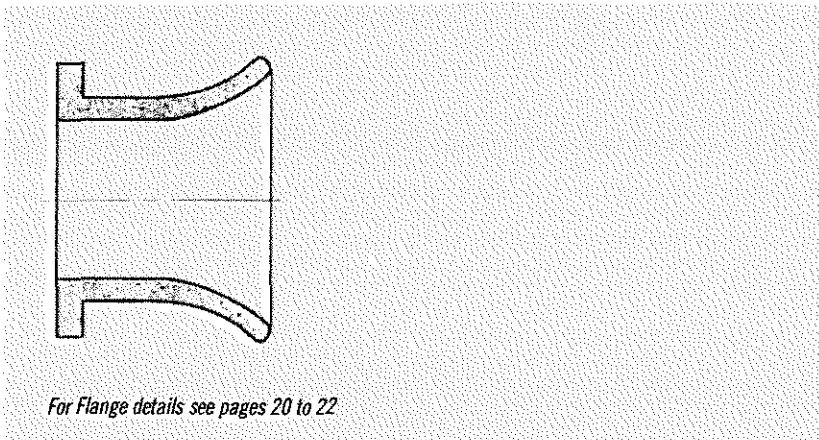


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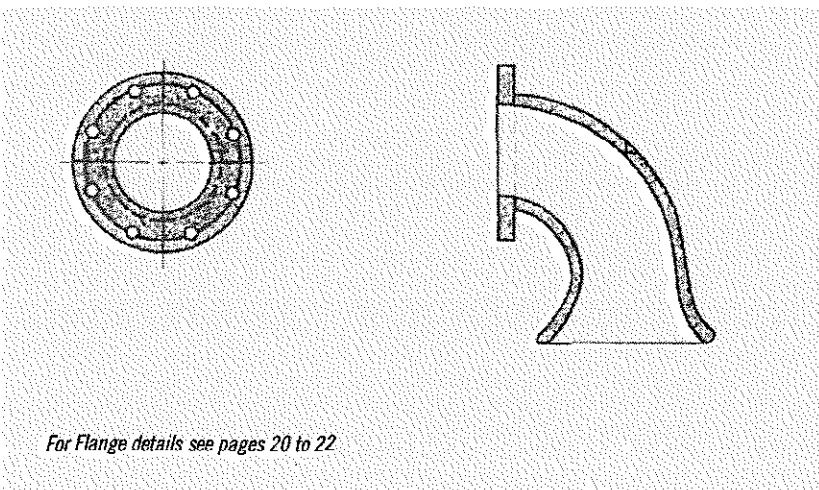
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Miscellaneous Flanged Fittings
Flange and Flare, PN 16



Flange and Flare, 90° Bends,
PN16, Standard and Long Radius



NOTE Consult U.S. Pipe's International Sales Representative for availability of these products.

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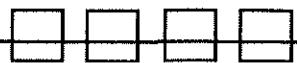
100 - 1600 mm

**INTERNATIONAL SALES
DUCTILE IRON FLANGED
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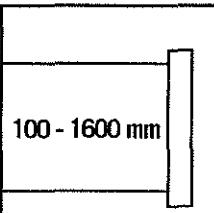
**Flanged Fittings
Blank Flange PN10**



Nominal Diameter DN	D	a	b	c	Mass
100	220	19,0	16,0	3	4,1
150	285	19,0	16,0	3	6,7
200	340	20,0	17,0	3	9,8
250	400	22,0	19,0	3	14,7
300	455	24,5	20,5	4	20,1
350	505	24,5	20,5	4	24,8
400	565	24,5	20,5	4	31,2
450	615	25,5	21,5	4	38,3
500	670	26,5	22,5	4	47,0
600	780	30,0	25,0	5	70,0
700	895	32,5	27,5	5	99,0
800	1015	35,0	30,0	5	138,0
900	1115	37,5	32,5	5	176,0
1100	1230	40,0	35,0	5	228,0
1000	1340	42,5	37,5	5	287,0
1200	1455	45,0	40,0	5	359,0
1400	1675	46,0	41,0	5	506,0
1500	1785	47,5	42,5	5	580,0
1600	1915	49,0	44,0	6	698,0

Dimensions in millimeters. Masses in kilograms.

866.DIP.PIPE



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DUCTILE IRON FLANGED
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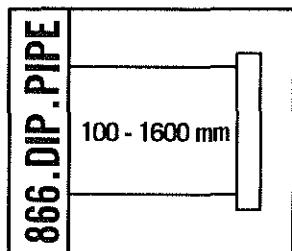
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**Flanged Fittings
Blank Flange PN16**



Nominal Diameter DN	D	a	b	c	Mass
100	220	19,0	16,0	3	4,1
150	285	19,0	16,0	3	6,7
200	340	20,0	17,0	3	9,8
250	400	22,0	19,0	3	14,7
300	455	24,5	20,5	4	20,1
350	520	26,5	22,5	4	28,3
400	580	28,0	24,0	4	36,8
450	640	30,0	26,0	4	47,6
500	715	31,5	27,5	4	63,0
600	840	36,0	31,0	5	96,0
700	910	39,5	34,5	5	116,0
800	1025	43,0	38,0	5	159,0
900	1125	46,5	41,5	5	201,0
1100	1255	50,0	45,0	5	272,0
1000	1355	53,5	48,5	5	333,0
1200	1485	57,0	52,0	5	429,0
1400	1685	60,0	55,0	5	582,0
1500	1820	62,5	57,5	5	664,0
1600	1930	65,0	60,0	5	784,0

Dimensions in millimeters. Masses in kilograms.



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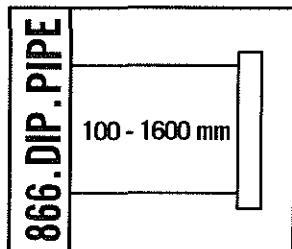
**Flanged Fittings
Blank Flange PN25**



Nominal Diameter DN	D	a	b	c	Mass
100	235	19,0	16,0	3	4,7
150	300	20,0	17,0	3	7,9
200	360	22,0	19,0	3	12,3
250	425	24,5	21,5	3	18,6
300	485	27,5	23,5	4	26,1
350	555	30,0	26,0	4	36,9
400	620	32,0	28,0	4	48,5
450	670	34,5	30,5	4	60,0
500	730	36,5	32,5	4	74,0
600	845	42,0	37,0	5	109,0
700	960	46,5	41,5	5	152,0
800	1085	51,0	46,0	5	211,0
900	1185	55,5	50,5	5	266,0
1000	1320	60,0	55,0	5	357,0
1100	1420	64,5	59,5	5	427,0
1200*	—	—	—	—	—
1400*	—	—	—	—	—
1500*	—	—	—	—	—
1600*	—	—	—	—	—

Dimensions in millimeters. Masses in kilograms.

*Check with your U.S. Pipe Sales Representative for availability.



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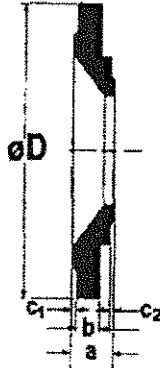
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Flanged Fittings Reducing Flange

PN10

Nominal Diameter DN	Large Diameter			Nominal Diameter DN	Small Diameter		
	D	b	c ₁		c ₂	a	Mass
200	340	17,0	3	100	3	40	13,2
350	505	20,5	4	250	3	48	32,0
400	565	20,5	4	250	3	48	39,0
	565	20,5	4	300	4	49	38,0
700	895	27,5	5	500	4	56	102,0
900	1116	32,5	5	700	5	63	165,0
1000	1230	35,0	5	700	5	63	222,0
	1230	35,0	5	800	5	68	209,0



PN16

Nominal Diameter DN	Large Diameter			Nominal Diameter DN	Small Diameter		
	D	b	c ₁		c ₂	a	Mass
200	340	17,0	3	100	3	40	13,0
350	520	22,5	4	250	3	54	36,5
400	580	24,0	4	250	3	54	46,0
	580	24,0	4	300	4	55	44,5
700	910	34,5	5	500	4	67	134,0
900	1125	41,5	5	700	5	73	200,0
1000	1255	45,0	5	700	5	73	285,0
	1255	45,0	5	800	5	77	260,0

PN25

Nominal Diameter DN	Large Diameter			Nominal Diameter DN	Small Diameter		
	D	b	c ₁		c ₂	a	Mass
200	360	19,0	3	100	3	47	16,8
350	555	26,0	4	250	3	60	48,5
400	620	28,0	4	250	3	60	61,0
	620	28,0	4	300	4	61	60,0

Dimensions in millimeters. Masses in kilograms.



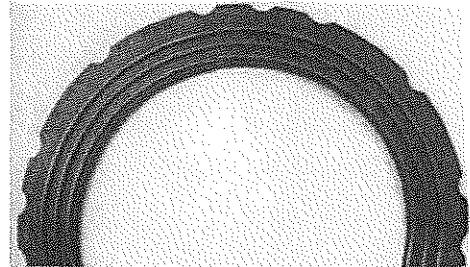
Metric FLANGE-TYTE® Gaskets for DN 80 through 1000 Flanged Pipe and Fittings

The FLANGE-TYTE® Gasket, a U.S. Pipe invention, is a superior ring gasket that should save money on installation and maintenance costs. When properly assembled, the FLANGE-TYTE Gasket gives a leak-free flanged joint at reasonable bolt torque even at high internal operating pressures. A leak-free joint can be effected on standard ISO flanged pipe, fittings, valves and hydrants having flanges with PN 10, 16 or 25 drilling and use of the FLANGE-TYTE Gasket. The outer edge of the gasket is scalloped to accommodate PN 10, 16, or 25 drilling.

Flanged pipe and fittings up through DN 300 size with PN 10 drilling assembled with FLANGE-TYTE Gaskets have been tested at 48 bars and did not leak. Thus, installations using FLANGE-TYTE Gaskets can be operated safely at high internal pressures and velocities and still handle the ever-present threat of surges without fear of gasket leaks.

U.S. Pipe DN 80 through 1000 Ductile Iron flanged pipe and fittings with ISO PN 10, 16, and 25 flanges joined with the FLANGE-TYTE Gasket will produce leak-free joints at reasonable bolt torques for working pressures up to and including 25 bars with a safety factor of 2. Only 12.5 kg·m of bolt torque is required for water working pressures up to and including 17 bars on the DN 100 – 300 sizes. See table on reverse side.

FLANGE-TYTE Gaskets are 3mm thick and normally furnished of SBR rubber per the requirements of ANSI/AWWA C111/A21.11 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Neoprene, EPDM, nitrile or fluorocarbon elastomers may be available by special order.



FLANGE-TYTE® is a registered trademark of U.S. Pipe & Foundry Company.

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FLANGE-TYTE® Gaskets

The FLANGE-TYTE® Gasket for flanged pipe and fittings should be assembled using the same general procedures and practices as for plain ring type flanged gaskets. As with all flanged assemblies, the faces of the flanges must be free of sand, grit, grease or other foreign matter.

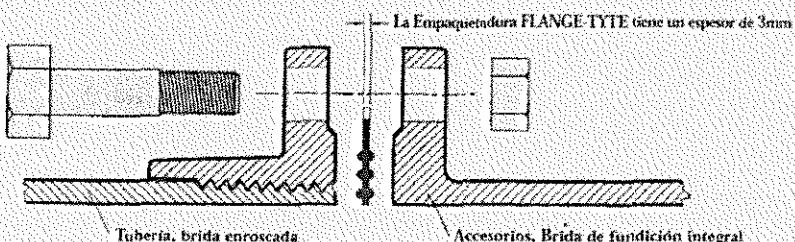
For larger diameters, it may be necessary to attach the FLANGE-TYTE Gasket to the face of one of the flanges using a Heavy Duty Adhesive, prior to aligning the flanges. For smaller diameter joints the gaskets can be dropped into the joint as it is being assembled. Align the flanges and insert several bolts in the lower half of the flanges. Drop the FLANGE-TYTE Gasket between the two flanges so that the gasket rests on the lower bolts. Insert the remaining bolts and follow the tightening procedure described below.

Center the FLANGE-TYTE Gasket on the lower flange before assembling the joint. The gasket can also be attached to the face of the flange with Heavy Duty Adhesive to keep the gasket from dislodging during assembly.

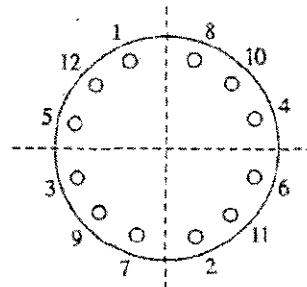
Bolt Tightening Procedure

After alignment has been completed, insert bolts and hand tighten the nuts, keeping any remaining gap between the flanges approximately uniform while tightening. Tighten the nuts in successive stages on bolts diametrically opposite one another, in the sequence of the numbers shown in the diagram.

The following bolt torques are required for 17 bar working pressure using FLANGE-TYTE Gaskets:



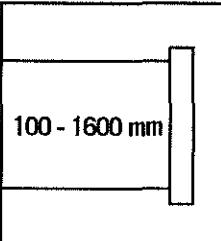
Bolt Torquing Sequence



Bolt Torque Requirements

DN (mm)	Torsión de Perno (kg*m)
80	12,5
100	12,5
150	12,5
200	12,5
250	12,5
300	12,5
350	15,0
400	15,0
450*	16,5
500	16,5
600	18,0
700*	18,7
800	19,5
900*	22,0
1000	22,0

*Check with U. S. Pipe's International Sales Representative for availability of these sizes.



**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**

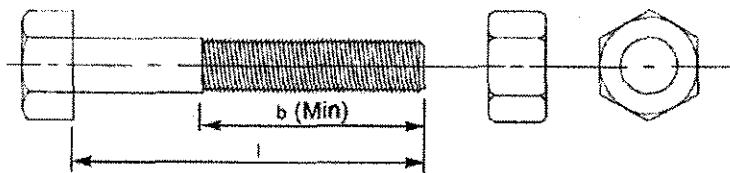


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Bolts for Flanged Pipe and Fittings - PN10



PN10

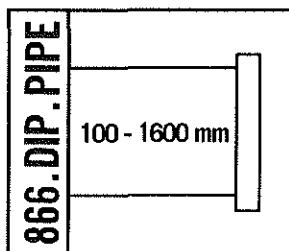
Nominal Diameter DN	No.	Bolts		
		Diameter mm	Large mm l/b	Mass
100	8	M16	90/62	1,6
150	8	M20	100/72	2,9
200	8	M20	100/72	2,9
250	12	M20	110/76	4,7
300	12	M20	120/83	5,0
350	16	M20	130/93	6,9
400	16	M24	140/103	11,3
450	20	M24	130/93	13,4
500	20	M24	150/110	14,8
600	20	M27	170/122	21,3
700	24	M27	150/105	23,4
800	24	M30	160/110	31,5
900	28	M30	160/110	36,8
1000	28	M33	180/117	49,5
1200	32	M36	180/110	73,4
1400	36	M39	180/105	94,4
1500	36	M39	180/105	94,4
1600	40	M45	190/110	156,0

Bolting, like gaskets, is not furnished with flanged products unless so ordered.

Hex head bolts (partially threaded) and hex nuts are of carbon steel with dimensions per the appropriate table(s) in ISO 4014.

The standard coating for bolting is zinc plating. Galvanized coating is available at an additional cost.

Masses shown are for one set of bolts and nuts.



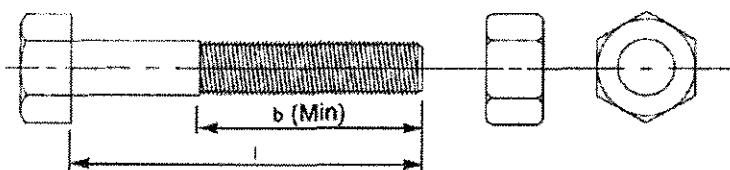
**INTERNATIONAL SALES
DUCTILE IRON FLANGED
PIPE AND FITTINGS**



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Bolts for Flanged Pipe and Fittings - PN16



PN16

Nominal Diameter DN	No.	Bolts		
		Diameter mm	Large mm l/b	Mass
100	8	M16	90/62	1,6
150	8	M20	100/72	2,9
200	12	M20	100/72	4,4
250	12	M24	110/82	7,3
300	12	M24	130/93	8,0
350	16	M24	130/93	10,7
400	16	M27	150/105	15,6
450	20	M27	130/90	17,7
500	20	M30	160/110	26,3
600	20	M33	180/117	35,4
700	24	M33	150/100	37,9
800	24	M36	160/92	48,8
900	28	M36	160/92	56,9
1000	28	M39	180/105	73,4
1200	32	M45	210/115	132,6
1400	36	M45	210/115	149,2
1500	36	M52	230/130	221,6
1600	40	M52	230/130	246,2

Bolting, like gaskets, is not furnished with flanged products unless so ordered.

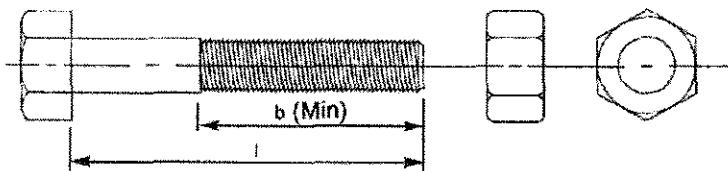
Hex head bolts (partially threaded) and hex nuts are of carbon steel with dimensions per the appropriate table(s) in ISO 4014.

The standard coating for bolting is zinc plating. Galvanized coating is available at an additional cost.

Masses shown are for one set of bolts and nuts.



Bolts for Flanged Pipe and Fittings - PN25



PN25

Nominal Diameter DN	No.	Diameter mm	Bolts Large mm l/b	Mass
100	8	M20	100/72	2,9
150	8	M24	110/82	4,9
200	12	M24	110/82	7,3
250	12	M27	130/90	10,6
300	16	M27	130/90	14,2
350	16	M30	140/93	19,2
400	16	M33	150/100	25,2
450	20	M33	150/100	31,6
500	20	M33	160/100	32,8
600	20	M36	180/110	45,9
700	24	M39	180/105	62,9
800	24	M45	190/110	93,6
900	28	M45	190/110	109,2
1000	28	M52	230/130	172,3
1200	32	M52	230/130	197,0
1400	36	M56	260/130	281,9
1600	40	M56	260/120	313,2

Bolting, like gaskets, is not furnished with flanged products unless so ordered.

Hex head bolts (partially threaded) and hex nuts are of carbon steel with dimensions per the appropriate table(s) in ISO 4014.

The standard coating for bolting is zinc plating. Galvanized coating is available at an additional cost.

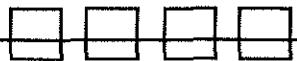
Masses shown are for one set of bolts and nuts.

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PIPE AND FITTINGS



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Pipe	30"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
Grooved Pipe	4"-36" Ductile Iron
USIFLEX® Boltless Ball Joint Pipe For Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Restrained Joint	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
HP LOK® Fittings and HP LOK® Telescoping Sleeves	30"-64" Ductile Iron
Mechanical Joint Fittings	30"-48" Ductile Iron
Flanged Fittings	30"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
GLASS Lined Ductile Iron Pipe for Wastewater Treatment Plants	4"-30" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
MJ Harness-Lok	4"-48" Ductile Iron
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

*All U.S. Pipe brochures and/or products are
subject to change without further notice.*

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FAX 205.254.7174
international@uspipe.com
www.uspipe.com

**MORE
THAN
JUST
PIPE.**





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4"-64"

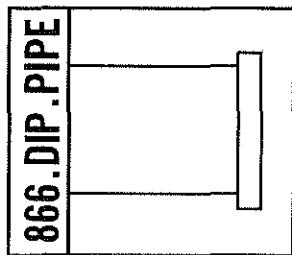
FULL FACE FLANGE-TYTE® Gasket FOR FLANGED JOINTS



FOR WATER & WASTEWATER, FIRE PROTECTION & INDUSTRIAL APPLICATIONS

EXCELLENT
TECHNICAL
SUPPORT





FULL FACE FLANGE-TYTE® Gasket

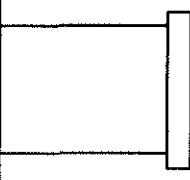


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FULL FACE FLANGE-TYTE® Gasket



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FULL FACE FLANGE-TYTE Gasket

The FULL FACE FLANGE-TYTE Gasket is a high performance gasket for flanged joint piping systems.

The most vulnerable element of a piping system is the joint. Many times, the weakest part of the joint is the gasket that is used. Lots of time and money are spent in the design and specification of the pipe, fittings, valves, and various components of the project to insure the piping system is able to withstand the requirements of your application, only to have all that time and expense undermined by the lowest cost item in the piping system; a flat sheet of thin rubber between the flanges. U.S. Pipe offers a solution that will provide peace of mind through superior performance, the FULL FACE FLANGE-TYTE Gasket. Below we list some of the high performance features this product provides.

Pressure:

By combining the effectiveness of "o-ring" technology into a molded flat gasket, the FULL FACE FLANGE-TYTE Gasket can operate safely at high internal pressures, high velocities, and still handle the common occurrence of surges in pressure without fear of joint leaks. The gasket may also help to resolve installation issues that arise such as imperfections in the flange face, flange alignment, and pipe or equipment alignment.

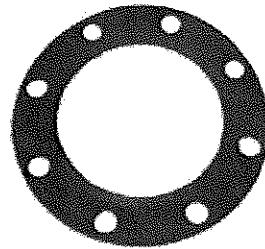
The FULL FACE FLANGE-TYTE Gasket is rated for a water working pressure of 350 psi for 4"-24" sizes, 250 psi for 30"-48" sizes and 150 psi for 54"-64" sizes. If your application requires higher working pressures, please contact your U.S. Pipe Sales Representative. The gasket is listed by Underwriters Laboratories and flanged joints with FLANGE-TYTE® gaskets are approved by Factory Mutual.

Torque:

The FULL FACE FLANGE-TYTE Gasket employs (3) - "bulb type" rings on the faces of both sides of the gasket (see drawing page 5). This provides 3 times the sealing peace of mind than gaskets that provide only (1) bulb, or none at all. By using (3) - "bulb type" rings on the face of the gasket, the bolt torque required to effectively complete the seal is greatly reduced. This results in reducing stresses on flanges, bolts, and nuts in addition to providing a much safer and dependable assembly for the installer. Please refer to the bolt torque ratings in Table 1 on page 6.

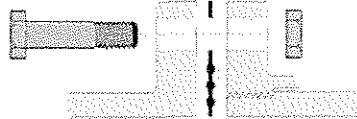
Compatibility:

The FULL FACE FLANGE-TYTE Gasket is compatible with flanges conforming to ANSI/AWWA C115/A21.15, ANSI/AWWA C110/A21.10, ASME B16.1 class 125, and ANSI/AWWA C207 class B, D, and E flanges.



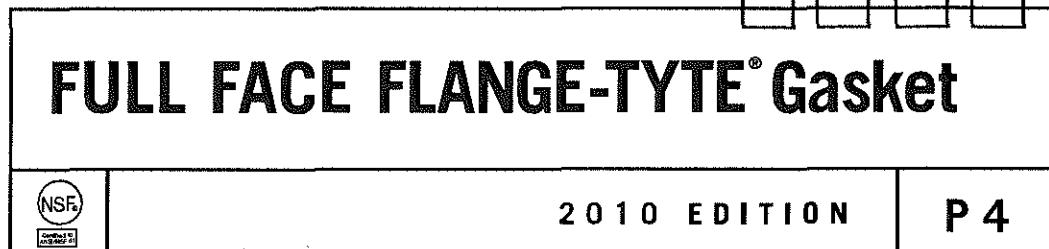
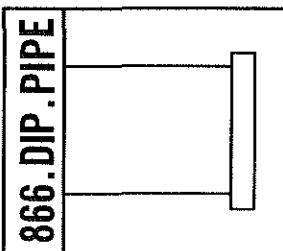
Full Faced Style Gasket

1/8" thick



NOTE: U.S. Pipe recommends the use of FULL FACE FLANGE-TYTE® Gaskets or RING FLANGE-TYTE® Gaskets with Ductile Iron flanged joint products supplied by U.S. Pipe. These gaskets were designed specifically for the unique surface of Ductile Iron. Flat rubber gaskets are NOT considered equal in performance and may not provide the sealing capability the project requires. In addition, their use could result in unintended damage to the flanges and threads of the fabricated pipe by applying excess torque to the bolts/flanges in order to seal the joint.

FULL FACE FLANGE-TYTE® and RING FLANGE-TYTE® are Registered Trademarks of United States Pipe and Foundry Company, LLC.



Special Elastomers & Applications

U.S. Pipe offers FULL FACE FLANGE-TYTE® Gaskets made of special elastomers which may be necessary for special applications. High temperature water and air applications and piping systems transmitting fluids with elevated contact with certain oils or chemicals may require elastomers with enhanced performance criteria. The table below can be used to assist in gasket selection. If special elastomers are required for your project, it is necessary to include the requirement in the project specifications and on the purchase order to U.S. Pipe.

Description	Maximum Service Temperature ^{1,2}		Uses ³
	Water & Sewer °F	Air ⁴ °F	
SBR (Styrene Butadiene)	150	125	Common: Drinking Water, Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
Nitrile (NBR) (Acrylonitrile Butadiene)	150	125	Common: Hydrocarbons, Fats, Oils, Greases, Chemicals, Oils & Fluids, Refined Petroleum Other Acceptable Services: Drinking Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
Neoprene® (Polychloroprene)	200	150	Common: Greasy Waste. Other Acceptable Services: Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
EPDM (Ethylene Propylene Diene Monomer)	212	150	Common: Alcohols, Dilute Acids, Dilute Alkalies, Ketones (MEK, Acetone), Vegetable Oil. Other Acceptable Services: Drinking Water, Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
FKM ⁵	212	300	Common: Aromatic Hydrocarbons and Fuels, Acids, Vegetable Oils, Petroleum Products, Chlorinated Hydrocarbons, Most Chemicals and Solvents Other Acceptable Services: Drinking Water, Reclaimed Water, Raw Water, Storm Water

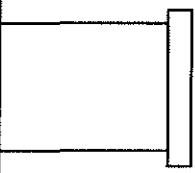
¹Maximum service temperatures listed are intended as general guidelines for ductile iron pipe gaskets. For service temperatures greater than those listed, consult pipe manufacturer for specific recommendations.

²Maximum service temperature is not usually a meaningful parameter for piping gaskets; however, low temperatures during pipeline installation may necessitate precautions. Consult your U.S. Pipe Sales Representative for pertinent recommendations.

³Water, including sewage, with low levels of the listed contaminants.

⁴Lubricating oil in the air will adversely affect SBR and EPDM performance.

⁵Consult your U.S. Pipe Sales Representative for availability of FKM gaskets.



FULL FACE FLANGE-TYTE® Gasket



2010 EDITION

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Gasket Thickness and Material:

The FULL FACE FLANGE-TYTE Gasket is only offered in 1/8" thickness per the recommendation of ANSI/AWWA C115/A21.15 Appendix A, Sec. A.2. The FULL FACE FLANGE-TYTE Gasket is commonly provided in SBR elastomer which is adequate for most conditions of service for potable or domestic wastewater contact. SBR elastomer carries a maximum service temperature of 150°F for water and 125°F for air applications.

Suggested Specification:

Ductile Iron pipe flanged joints shall conform to ANSI/AWWA C115/A21.15. Gaskets for Ductile Iron flanged joints shall be full face type SBR elastomer per ANSI/AWWA C111/A21.11 and shall be 1/8" thickness. Flanged gaskets shall be the high performance type satisfying the special requirements of ANSI/AWWA C111/A21.11 Appendix C, Sec. C.2 and have at least (3) bulb type rings molded into both faces of the gasket. Flanged gaskets shall be U.S. Pipe FULL FACE FLANGE-TYTE Gasket or pre-approved equal.

Assembly Procedures:

The FULL FACE FLANGE-TYTE Gasket should be assembled using the same general procedures and practices for installing flanged joints. ANSI/AWWA C115/A21.15 Appendix C, Sec. C.3 can be used for general guidance.

The use of flanged joints underground is NOT recommended because of the rigidity of the joint.

The faces of the flanges must be free of sand, grit, grease, or other foreign matter.

Flanged bolts should be tightened in a progressively crisscross pattern, such as tightening the bottom bolt; then, the top bolt; next, the bolts at either side; and finally, the remaining bolts. This process should be repeated until all bolts are sufficiently tightened.

See Table 1 on page 6 for bolt torque requirements.

Storage Recommendation:

Gaskets should be stored in a cool location, out of direct sunlight and shall not come in contact with petroleum products. Gaskets should be inaccessible to vermin and should be stored away from any electrical equipment such as switchgear unless adequate precautions are taken to avoid the concentration of ozone in the storage area. Gaskets should be used on a first-in, first-out basis and should be inspected annually and prior to installation. Evidence of surface cracking, dry rot, or vermin attack is cause for discarding the gaskets and replacement with new gaskets.

ANSI/AWWA C115/A21.15

Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

ANSI/AWWA C110/A21.10

Ductile-Iron and Gray-Iron Fittings for Water

ANSI/AWWA C153/A21.53

Ductile-Iron Compact Fittings for Water Service

ANSI/AWWA C111/A21.11

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ASME/ANSI B16.1

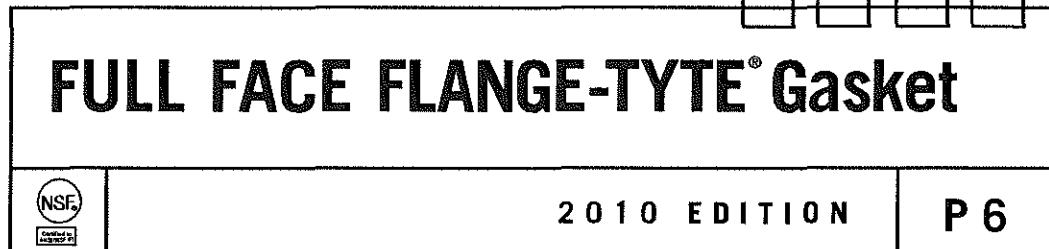
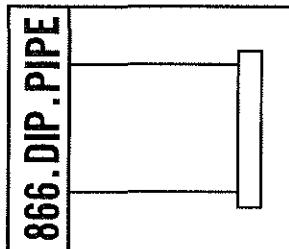
Cast Iron Pipe Flanges and Flanged Fittings

ASME/ANSI B16.5

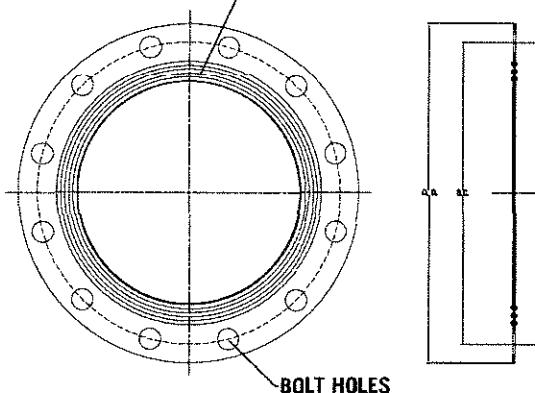
Pipe Flanges and Flanged Fittings

AWWA C207

Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.



(3) BULB TYPE RINGS



NOTE: U.S. Pipe recommends the use of **FULL FACE FLANGE-TYTE® Gaskets** or **RING FLANGE-TYTE® Gaskets** with Ductile Iron flanged joint products supplied by U.S. Pipe. These gaskets were designed specifically for the unique surface of Ductile Iron. Flat rubber gaskets are NOT considered equal in performance and may not provide the sealing capability the project requires. In addition, their use could result in unintended damage to the flanges and threads of the fabricated pipe by applying excess torque to the bolts/flanges in order to seal the joint.

FULL FACE FLANGE-TYTE® is a Registered Trademark of United States Pipe and Foundry Company, LLC.

Table 1. FULL FACE FLANGE-TYTE® Technical Data

Size Inches	BC Inches	OD Inches	Bulb-type rings each side	No. of Bolt Holes	Working Pressure psi		
					150	250	350
4	7.50	9.00	3	8	-	90	110
6	9.50	11.00	3	8	-	90	110
8	11.75	13.50	3	8	-	90	110
10	14.25	16.00	3	12	-	90	130
12	17.00	19.00	3	12	-	90	130
14	18.75	21.00	3	12	-	110	150
16	21.25	23.50	3	16	-	110	160
18	22.75	25.00	3	16	-	120	180
20	25.00	27.50	3	20	-	120	200
24	29.50	32.00	3	20	-	130	220
30	36.00	38.75	3	28	-	140	-
36	42.75	46.00	3	32	-	160	-
42	49.50	53.00	3	36	-	585	-
48	56.00	59.50	3	44	-	625	-
54	62.75	66.25	3	44	550	-	-
60	69.25	73.00	3	52	600	-	-
64	76.00	80.00	3	52	600	-	-

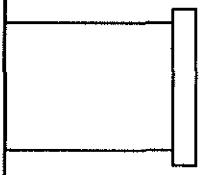
NOTE:

Gasket Thickness: All FULL FACE FLANGE-TYTE Gaskets are 1/8" thickness. Thinner gaskets are NOT recommended for use with Ductile Iron flanges.

Material: Unless otherwise specified by the purchaser, gaskets will be furnished as SBR. Special elastomers such as neoprene, nitrile, EPDM, and fluorocarbon are available upon request. Gaskets made with special elastomers are marked with color dots. Neoprene is yellow, EPDM is orange, Nitrile is green, Fluorocarbon is red.

Assembly: See Page 4 of the FULL FACE FLANGE-TYTE Brochure for guidance.

Compatibility: The FULL FACE FLANGE-TYTE Gasket is compatible with flanges conforming to ANSI/AWWA C115/A21.15, ANSI/AWWA C110/A21.10, ASME B16.1 class 125, and ANSI/AWWA C207 class B, D, and E flanges.



FULL FACE FLANGE-TYTE® Gasket



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64"
Mechanical Joint Pipe	4"-12"
TR FLEX® Pipe	4"-36"
HP LOK™ Restrained Joint Pipe	30"-64"
Flanged Pipe	3"-64"
USIFLEX® Boltless Flexible Ball Joint Pipe	4"-48"

Restrained Joints

TR FLEX® Pipe	4"-36"
HP LOK™ Restrained Joint Pipe	30"-64"
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36"
TR TELE FLEX® Assemblies	4"-24"

Fittings

TRIM TYTON® Fittings	4"-12"
TYTON® Fittings	14"-64"
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-64"
Mechanical Joint Fittings CJO	30"-48"
Flanged Fittings	30"-64"
XTRA FLEX® Couplings	4"-24"

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
Polymeric Linings	For all pipe sizes
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.



*All U.S. Pipe brochures and/or products are
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4"-36"

RING FLANGE-TYTE® Gasket

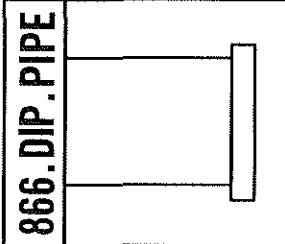
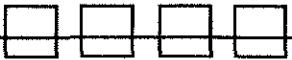
FOR FLANGED JOINTS



FOR WATER & WASTEWATER, FIRE PROTECTION & INDUSTRIAL APPLICATIONS

RAIDER
TEKAN
JETSET
PIPE,





RING FLANGE-TYTE® Gasket

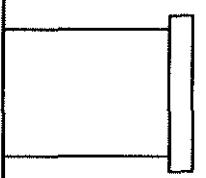


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RING FLANGE-TYTE® Gasket



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RING FLANGE-TYTE® Gasket

The RING FLANGE-TYTE® Gasket is a high performance gasket for flanged joint piping systems.

The most vulnerable element of a piping system is the joint. Many times, the weakest part of the joint is the gasket that is used. Lots of time and money are spent in the design and specification of the pipe, fittings, valves, and various components of the project to insure the piping system is able to withstand the requirements of your application, only to have all that time and expense undermined by the lowest cost item in the piping system; a flat sheet of thin rubber between the flanges. U.S. Pipe offers a solution that will provide peace of mind through superior performance, the RING FLANGE-TYTE® Gasket. Below we list some of the high performance features this product provides.

Pressure:

By combining the effectiveness of "o-ring" technology into a molded flat gasket, the RING FLANGE-TYTE® Gasket can operate safely at high internal pressures, high velocities, and still handle the common occurrence of surges in pressure without fear of joint leaks. The gasket may also help to resolve installation issues that arise such as imperfections in the flange face, flange alignment, and pipe or equipment alignment.

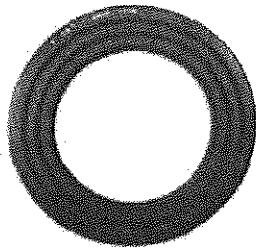
The RING FLANGE-TYTE® Gasket is rated for a water working pressure of 350 psi for 4"-24" sizes, 250 psi for 30"-48" sizes, 150 psi for 54"-64" sizes. If your application requires higher working pressures, please contact your U.S. Pipe Sales Representative. The gasket is listed by Underwriters Laboratories and flanged joints with RING FLANGE-TYTE® Gaskets are approved by Factory Mutual.

Torque:

The RING FLANGE-TYTE® Gasket employs (3) - "bulb type" rings on the faces of both sides of the gasket (see drawing page 5). This provides 3 times the sealing peace of mind than gaskets that provide only (1) bulb, or none at all. By using (3) - "bulb type" rings on the face of the gasket, the bolt torque required to effectively complete the seal is greatly reduced. This results in reducing stresses on flanges, bolts, and nuts in addition to providing a much safer and dependable assembly for the installer. Please refer to the bolt torque ratings in Table 1 on page 5.

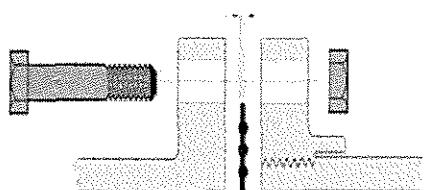
Compatibility:

The RING FLANGE-TYTE® Gasket is compatible with flanges conforming to ANSI/AWWA C115/A21.15, ANSI/AWWA C110/A21.10, ASME B16.1 class 125, ANSI/AWWA C207 class B, D, E and F flanges, and ANSI B16.5 in sizes 4"-24".



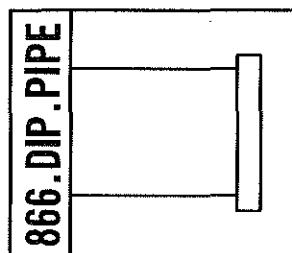
Ring Style Gasket

1/8" thick.



NOTE: U.S. Pipe recommends the use of FULL FACE FLANGE-TYTE® Gaskets or RING FLANGE-TYTE® Gaskets with Ductile Iron flanged joint products supplied by U.S. Pipe. These gaskets were designed specifically for the unique surface of Ductile Iron. Flat rubber gaskets are NOT considered equal in performance and may not provide the sealing capability the project requires. In addition, their use could result in unintended damage to the flanges and threads of the fabricated pipe by applying excess torque to the bolts/flanges in order to seal the joint.

FULL FACE FLANGE-TYTE® and RING FLANGE-TYTE® are Registered Trademarks of United States Pipe and Foundry Company, LLC.



RING FLANGE-TYTE® Gasket



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Special Elastomers & Applications

U.S. Pipe offers RING FLANGE-TYTE® Gaskets made of special elastomers which may be necessary for special applications. High temperature water and air applications and piping systems transmitting fluids with elevated contact with certain oils or chemicals may require elastomers with enhanced performance criteria. The table below can be used to assist in gasket selection. If special elastomers are required for your project, it is necessary to include the requirement in the project specifications and on the purchase order to U.S. Pipe.

Description	Maximum Service Temperature ^{1,2}		Uses ³
	Water & Sewer °F	Air ⁴ °F	
SBR (Styrene Butadiene)	150	125	Common: Drinking Water, Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
Nitrile (NBR) (Acrylonitrile Butadiene)	150	125	Common: Alcohols, Dilute Acids, Dilute Alkalies, Ketones (MEK, Acetone), Vegetable Oil Other Acceptable Services: Drinking Water, Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
Neoprene® (Polychloroprene)	200	150	Common: Hydrocarbons, Fats, Oils, Greases, Chemicals, Oils & Fluids, Refined Petroleum Other Acceptable Services: Drinking Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
EPDM (Ethylene Propylene Diene Monomer)	212	150	Common: Greasy Waste. Other Acceptable Services: Sea Water, Sanitary Sewage, Reclaimed Water, Raw Water, Storm Water
FKM ⁵	212	300	Common: Aromatic Hydrocarbons and Fuels, Acids, Vegetable Oils, Petroleum Products, Chlorinated Hydrocarbons, Most Chemicals and Solvents Other Acceptable Services: Drinking Water, Reclaimed Water, Raw Water, Storm Water

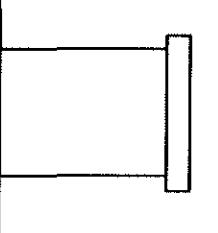
¹ Maximum service temperatures listed are intended as general guidelines for ductile iron pipe gaskets. For service temperatures greater than those listed, consult pipe manufacturer for specific recommendations.

² Maximum service temperature is not usually a meaningful parameter for piping gaskets; however, low temperatures during pipeline installation may necessitate precautions. Consult your U.S. Pipe Sales Representative for pertinent recommendations.

³ Water, including sewage, with low levels of the listed contaminants.

⁴ Lubricating oil in the air will adversely affect SBR and EPDM performance.

⁵ Consult your U.S. Pipe Sales Representative for availability of FKM gaskets.



RING FLANGE-TYTE® Gasket



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Gasket Thickness and Materials:

The RING FLANGE-TYTE® Gasket is only offered in 1/8" thickness per the recommendation of ANSI/AWWA C115/A21.15 Appendix A, Sec. A.2. The RING FLANGE-TYTE® Gasket is commonly provided in SBR elastomer which is adequate for most conditions of service for potable or domestic wastewater contact. SBR elastomer carries a maximum service temperature of 150°F for water and 125°F for air applications.

Suggested Specification:

Ductile Iron pipe flanged joints shall conform to ANSI/AWWA C115/A21.15. Gaskets for Ductile Iron flanged joints shall be ring type SBR elastomer per ANSI/AWWA C111/A21.11 and shall be 1/8" thickness. Flanged gaskets shall be the high performance type satisfying the special requirements of ANSI/AWWA C111/A21.11 Appendix C, Sec. C.2 and have at least (3) bulb type rings molded into both faces of the gasket. Flanged gaskets shall be U.S. Pipe RING FLANGE-TYTE® Gasket or pre-approved equal.

Assembly Procedures:

The RING FLANGE-TYTE® Gasket should be assembled using the same general procedures and practices for installing flanged joints. ANSI/AWWA C115/A21.15 Appendix C, Sec. C.3 can be used for general guidance.

The use of flanged joints underground is NOT recommended because of the rigidity of the joint.

The faces of the flanges must be free of sand, grit, grease, or other foreign matter.

For smaller diameter joints, align the flanges and insert several bolts in the lower half of the flanges. Drop the RING FLANGE-TYTE® Gasket between the two flanges so that the gasket rests on the lower bolts. Insert the remaining bolts and follow the tightening procedure below.

Flanged bolts should be tightened in a progressively crisscross pattern, such as tightening the bottom bolt; then, the top bolt; next, the bolts at either side; and finally, the remaining bolts. This process should be repeated until all bolts are sufficiently tightened.

See Table 1, Page 5 for bolt torque requirements.

Storage Recommendation:

Gaskets should be stored in a cool location, out of direct sunlight and shall not come in contact with petroleum products. Gaskets should be inaccessible to vermin and should be stored away from any electrical equipment such as switchgear unless adequate precautions are taken to avoid the concentration of ozone in the storage area.

Gaskets should be used on a first-in, first-out basis and should be inspected annually and prior to installation. Evidence of surface cracking, dry rot, or vermin attack is cause for discarding the gaskets and replacement with new gaskets.

ANSI/AWWA C115/A21.15

Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

ANSI/AWWA C110/A21.10

Ductile-Iron and Gray-Iron Fittings for Water

ANSI/AWWA C153/A21.53

Ductile-Iron Compact Fittings for Water Service

ANSI/AWWA C111/A21.11

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ASME/ANSI B16.1

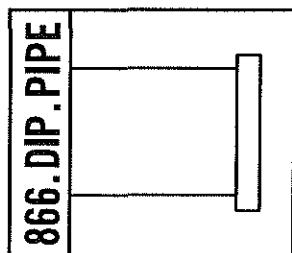
Cast Iron Pipe Flanges and Flanged Fittings

ASME/ANSI B16.5

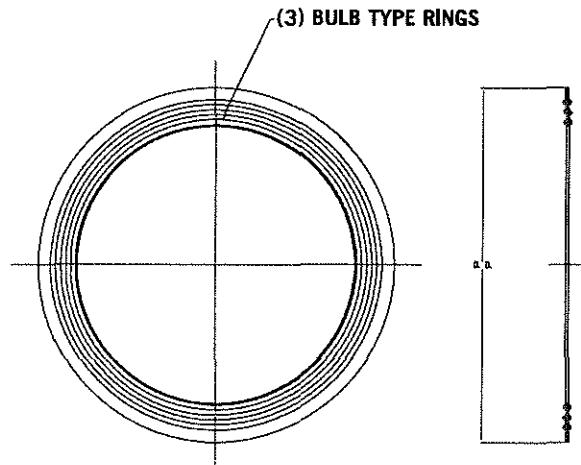
Pipe Flanges and Flanged Fittings

AWWA C207

Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.



RING FLANGE-TYTE® Gasket



NOTE: U.S. Pipe recommends the use of **FULL FACE FLANGE-TYTE®** Gaskets or **RING FLANGE-TYTE®** Gaskets with Ductile Iron flanged joint products supplied by U.S. Pipe. These gaskets were designed specifically for the unique surface of Ductile Iron. Flat rubber gaskets are NOT considered equal in performance and may not provide the sealing capability the project requires. In addition, their use could result in unintended damage to the flanges and threads of the fabricated pipe by applying excess torque to the bolts/flanges in order to seal the joint.

Table 1. Technical Data

SIZE Inches	OD Inches	Bulb-type rings each side	WORKING PRESSURE psi		
			150	250	350
4	6.88	3	-	90	110
6	8.75	3	-	90	110
8	11.00	3	-	90	110
10	13.38	3	-	90	130
12	16.13	3	-	90	130
14	17.75	3	-	110	150
16	20.25	3	-	110	160
18	21.63	3	-	120	180
20	23.88	3	-	120	200
24	28.25	3	-	130	220
30	34.75	3	-	140	-
36	41.25	3	-	160	-

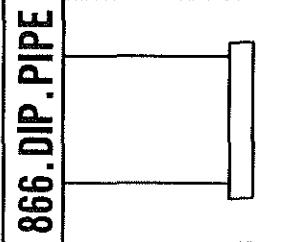
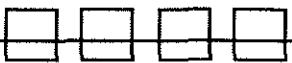
NOTE:

Gasket Thickness: All RING FLANGE-TYTE® Gaskets are 1/8" thickness. Thinner gaskets are NOT recommended for use with Ductile Iron flanges.

Material: Unless otherwise specified by the purchaser, gaskets will be furnished as SBR. Special elastomers such as neoprene, nitrile, EPDM, and fluorocarbon are available upon request. Gaskets made with special elastomers are marked with color dots. Neoprene is yellow, EPDM is orange, Nitrile is green, Fluorocarbon is red.

Assembly: See Page 5 of the RING FLANGE-TYTE® Brochure for guidance.

Compatibility: The RING FLANGE-TYTE® Gasket is compatible with flanges conforming to ANSI/AWWA C115/A21.15, ANSI/AWWA C110/A21.10, ASME B16.1 class 125, ANSI/AWWA C207 class B, D, E and F flanges, and ANSI B16.5 in sizes 4"-24".



RING FLANGE-TYTE® Gasket



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	3"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Pipe	30"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
Grooved Pipe	4"-36" Ductile Iron
USIFLEX® Boltless Ball Joint Pipe For Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Restrained Joint	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
HP LOK® Fittings and HP LOK® Telescoping Sleeves	30"-64" Ductile Iron
Mechanical Joint Fittings	30"-48" Ductile Iron
Flanged Fittings	30"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
GLASS Lined Ductile Iron Pipe for Wastewater Treatment Plants	4"-30" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
MJ Harness-Lok	4"-48" Ductile Iron
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

*All U.S. Pipe brochures and/or products are
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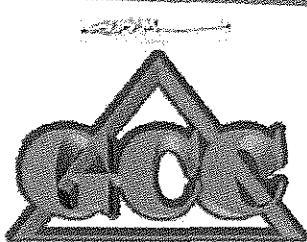
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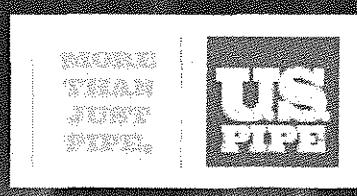


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KSA BRANCH
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ADDITIONAL TECHNICAL INFORMATION



Trenchless Applications

People across the country are finding out that Ductile Iron pipe can be used for Horizontal Directional Drilling (HDD) and for Pipe Bursting. The same great qualities of ruggedness, durability and dependability that make Ductile Iron pipe the choice for water systems across the nation are the same qualities that make it the right choice for Trenchless Technology. The proven and reliable TR FLEX® and HP LOK™ Restrained Joint, ensures quick and easy assembly with the great strength needed for the toughest trenchless jobs. Another benefit to our pipe is that the same standard restrained joint, with a pipe length of 18-ft, can be used for either HDD or pipe bursting, no need for expensive special pipe with long lead times, standard restrained joint pipe is usually in stock. The 18-ft lay lengths not only pull in quickly but also are convenient to use with the cartridge method when working in tight city streets or congested urban areas.

For trenchless sewer applications requiring a protective pipe lining, PROTECTO 401™ is proudly offered.

Horizontal Directional Drilling With Ductile-Iron

The HDD pipeline installation method is becoming more and more common in our industry. In certain unique situations, a trenchless installation may be the only way for a pipeline to be installed or replaced. But whether your project is a traditional open trench or trenchless installation, you want to install the best pipe material available – and that's Ductile Iron pipe from U.S. Pipe and Foundry Company.

U.S. Pipe's proven and reliable TR FLEX and HP LOK Restrained Joint is approved for use in applications using Horizontal Directional Drilling. The great strength of Ductile Iron, combined with the renowned TR FLEX and HP LOK Restrained Joint, make it the right choice for HDD. Providing ease of assembly and positive thrust restraint, the TR FLEX and HP LOK Restrained Joint can easily withstand the unique rigors and demands of HDD.

We've developed several guidelines to assist you when you decide to use U.S. Pipe's TR FLEX and HP LOK Restrained Joint in trenchless installations:

Pulling Force Capability:

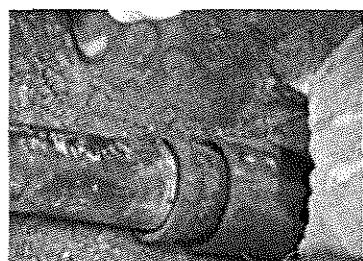
Today's HDD machines are capable of generating tremendous pulling forces when pulling the pipe into the borehole. The pipe joint must be capable of withstanding these forces. The pulling force for the TR FLEX and the HP LOK pipe joint is based on PC 350 pipe in a dead-end thrust condition of the working pressures. The pipe should be pulled only from a spigots first orientation to take advantage of the low-profile, streamlined bell. Table 1 (pg. 3) lists the recommended pull forces. If higher pulling forces are required please contact your U.S. Pipe Sales Representative.

Long Radius Pulls:

Long radius pulls should be designed to stay within the deflection capability of the joint to ensure that the joint is not over-deflected. Table 1 lists the industry standards for minimum radius for an 18-ft pipe and borehole diameters for straight or radius pulls. A tighter pull radius can be achieved with shorter lay length pipe. See the free HDD Radius Calculator at www.uspipe.com for planning an HDD creek, canal crossing or standard directional drill.

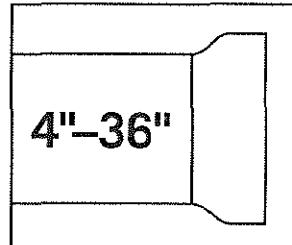
Polyethylene Encasement:

U.S. Pipe recommends that pipe used for HDD be polyethylene encased if the project area has a history of corrosive soil or soil survey determines the soil to be corrosive. The polyethylene must meet the material specifications of AWWA Standard ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Ductile-Iron Pipe Systems". See assembly instructions on page 4 for a suggested procedure if the pipe is poly-wrapped.



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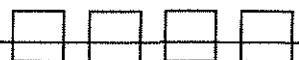


TR FLEX® Pipe

TRENCHLESS APPLICATIONS WITH DUCTILE IRON HORIZONTAL DIRECTIONAL DRILLING (HDD) AND PIPE BURSTING



U.S. PIPE AND FOUNDRY COMPANY / 866.DIP.PIPE / WWW.USPIPE.COM

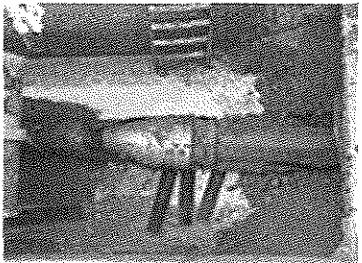


Pulling Heads:

U.S. Pipe offers specially-designed pulling heads for purchase in 4" – 24" sizes. These pulling heads can also be used for pressure testing the line. 30" and 36" pulling heads will be offered in the near future.

Pipe Bursting With Ductile-Iron

The same TR FLEX® or HP LOK™ Restrained Joint that is used for HDD can also be used for pipe bursting. The great joint strength makes it ideal for the pulling process in pipe bursting for water or sewer applications. Most pipe bursting applications are from manhole to manhole and are for sewer system updates such as upsizing for current or future capacity requirements or for pipe replacement of existing leaking or collapsed piping systems in compliance to the EPA's Clean Water Act.



Ductile-Iron pipe can be installed and used to burst pipe materials such as Clay, Asbestos-Cement, PVC, HDPE, Steel, Concrete, and Ductile-Iron. Ductile-Iron pipe can also be used to burst Cast-Iron pipe as long as the soil resistivity (around the Cast-Iron pipe) is equal to/or greater than 2,000 ohm-cm.

Pipe Bursting Pulling Head:

A special head is not required for pipe bursting. A standard spigot end of a short TR FLEX® or HP LOK™ bell piece of Ductile-Iron pipe is inserted into the pipe bursting expander head or cone of the pulling equipment and is secured inside the bell internally by the pulling rod cone. The expander head or cone diameter is typically 2-inches larger than the bell diameter.

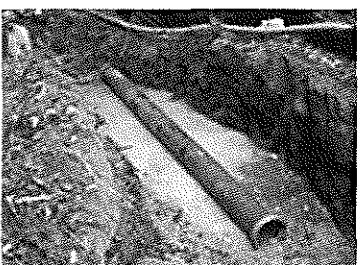


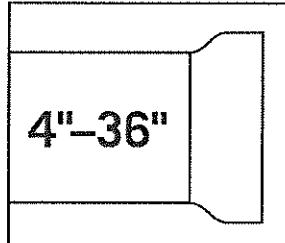
Polyethylene Encasement:

Polyethylene Encasement cannot be used because the bursting process leaves the previous pipe broken; the sharp edges will tear and shred the polyethylene.

Pull Force:

See Table 1 for pull force. In pipe bursting most of the pulling force is concentrated at the expanding cone or head with the pipe behind being pulled in with very little force. Another factor in low pull back forces is that the bell is larger than the pipe barrel; and only contacts the host pipe in a small contact area every 18-feet, unlike other materials that have a continuous uninterrupted outside diameter.





TR FLEX® Pipe
TRENCHLESS APPLICATIONS WITH DUCTILE IRON
HORIZONTAL DIRECTIONAL DRILLING (HDD) AND PIPE BURSTING



U.S. PIPE AND FOUNDRY COMPANY / 866.DIP.PIPE / WWW.USPIPE.COM



Table 1 – HORIZONTAL DIRECTIONAL DRILLING WITH *TR FLEX*® PIPE

SIZE Inches	BELL O.D. Inches	BOREHOLE DIA @ 1.25 X BELL DIA (Rounded) Inches	BOREHOLE DIA @ 1.5 X BELL DIA (Rounded) Inches	ALLOWABLE JT. DEFLECTION Degrees	RADIUS @ 1/2 JT- DEFLECT. – 18' PIPE Feet	PULL FORCE PC-350 PIPE Pounds	BUOYANCY (IN WATER) PIPE FULL OF AIR PC-350 PIPE (-WILL NOT FLOAT) Pounds/Feet
4	7.00	9	11	5	412	10,000	-5.5
6	9.27	12	14	5	412	20,000	-3.4
8	11.68	15	18	5	412	30,000	1.6
10	14.12	18	22	5	412	45,000	8.1
12	16.43	21	25	5	412	65,000	16.3
14	18.40	23	28	3.25	634	85,000	21.1
16	20.70	26	31	3.25	634	110,000	37.4
18	23.00	29	35	3	687	135,000	44.5
20	25.28	32	38	2.5	825	165,000	56.0
24	29.85	38	45	2.25	916	240,000	94.2
30-HP	36.38	46	55	.5	4125	365,000	157.8
36-HP	43.36	55	65	.5	4125	520,000	241.3

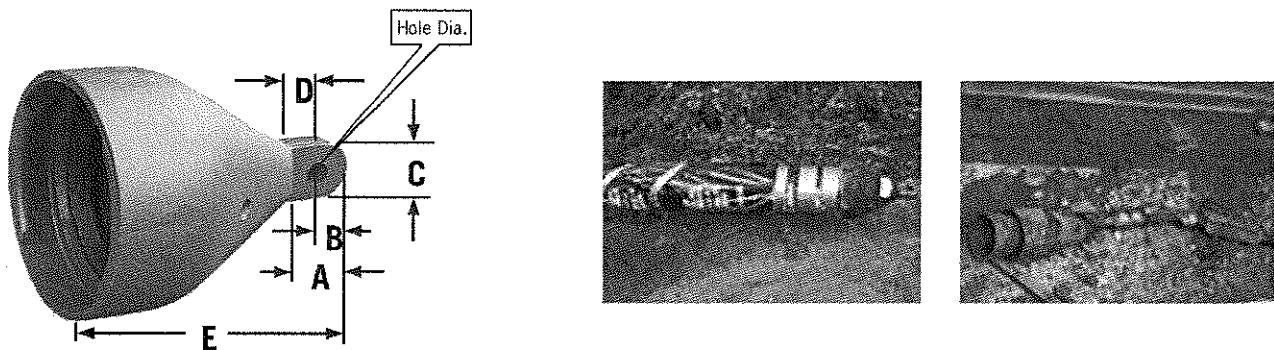


Table 2 – PULLING HEAD DIMENSIONS

SIZE Inches	HOLE DIAMETER Inches	WEIGHT Lbs	A Inches	B Inches	C Inches	D Inches	E Inches
4	.812	23	2.24	1.22	1.88	1.12	10.81
6	1.06	41	2.70	1.38	2.25	1.25	13.13
8	1.187	70	3.51	1.9	3.00	1.5	15.81
10	1.437	97	4.63	2.05	3.63	1.5	18.47
12	1.437	142	4.42	2.09	3.63	1.56	20.60
14	1.812	177	5.42	2.72	5.44	1.94	20.50
16	2.406	239	7.00	3.5	9.00	2.5	21.50
18	2.406	291	7.00	3.5	9.00	2.5	22.75
20	2.940	368	8.50	4.5	10.00	3.62	25.25
24	3.340	508	9.25	4.75	10.00	3.62	28.50
30*	5.00	1400	13.30	8.00	16.25	6.50	43.28
36*	5.00	1800	13.63	8.00	16.25	6.50	46.00

Notes:

- Radius is based on Industry Standard of $\frac{1}{2}$ of joints deflection capability – using 18' ft. lengths – a lighter Radius can be achieved by using shorter length pipe. See Radius Calculator www.uspipe.com/trenchless.
- 30" and 36" are HP LOK™ Pipe.
- Industry Standards is 1.25 – 1.5 times bell Dia. For Straight Pulls and 1.5 or larger for Curved or Radius Pulls.
- Pull loads are based on PC-350 Pipe – Contact your U.S. Pipe Sales Representative for lower PC pipe or higher pull loads if needed.

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DAVISON
TELLER
JONES
FURR

US
PIPE

*Available soon



4"-36"

TR FLEX® Pipe

TRENCHLESS APPLICATIONS WITH DUCTILE IRON

HORIZONTAL DIRECTIONAL DRILLING (HDD) AND PIPE BURSTING



U.S. PIPE AND FOUNDRY COMPANY / 866.DIP.PIPE / WWW.USPIPE.COM

Assembly Instructions

Step 1 — Cut polyethylene tube, or sheet, to 21 to 22 foot lengths to provide sufficient overlap. Slide the polyethylene onto the first pipe before assembling the pipe to the pulling head.

Step 2 — Clean and dry the pipe. Position the edge of the polyethylene to the second assembly stripe. Fold the polyethylene to take up the slack so that it lays flat against the pipe. Using the polyethylene tape, tightly tape over all leading edges of the polyethylene to prevent mud from flowing underneath (Fig. 1). Pulling the polyethylene tape very tight in a spiral winding motion, tape the first half of the pipe being sure not to leave a gap or space between the tape wraps before connecting to the pulling head.

Step 3 — Assemble the pipe to the pulling head per the assembly instructions in the U.S. Pipe's *TR FLEX® Restrained Joint Ductile Iron Pipe and Fittings* brochure.

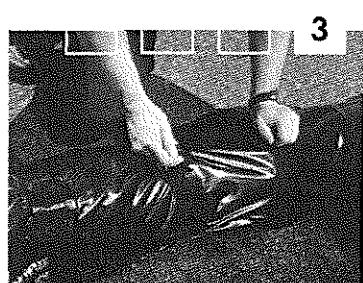
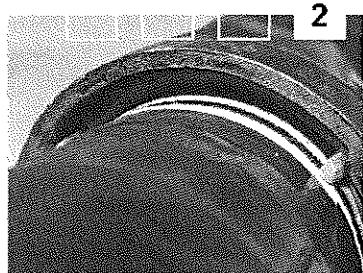
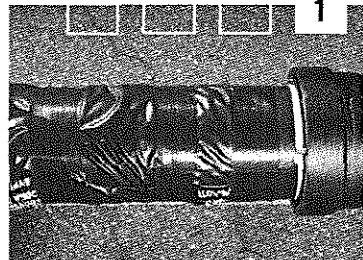
Step 4 — Securing the TR FLEX locking segments: Trim the rubber retainer approximately $\frac{1}{4}$ " longer than the gap between the locking segments when they are inserted into the segment cavity. Using a hammer or screwdriver, drive the rubber retainer to the back of the segment cavity (Fig. 2). The rubber is in compression and will hold the locking segments in place.

Step 5 — Sleeve the next pipe with polyethylene and assemble the joint per the instructions in Step 4. Slide the polyethylene from the second pipe forward over the bell of the first pipe and secure with a tight tape wrap. Pull the polyethylene of the first pipe over the bell creating an overlap with the direction of the pull and continue tightly taping the remainder of the first pipe over the bell and to the barrel of the second pipe. The gap or space between the tape wraps in this area of the pipe and for the remainder pipe should not be greater than 6 to 8-inches apart. All slack in the polyethylene encasement should be folded flat and against of the pipe. Continue overlapping and tightly spiral winding the tape for the remainder of the pipe. (Fig. 3)

Use of TR FLEX GRIPPER® Rings: TR FLEX GRIPPER Rings should not be used in the pulling or pull-back process. TR FLEX GRIPPER Rings may only be used for closure pieces where a restrained joint is needed.

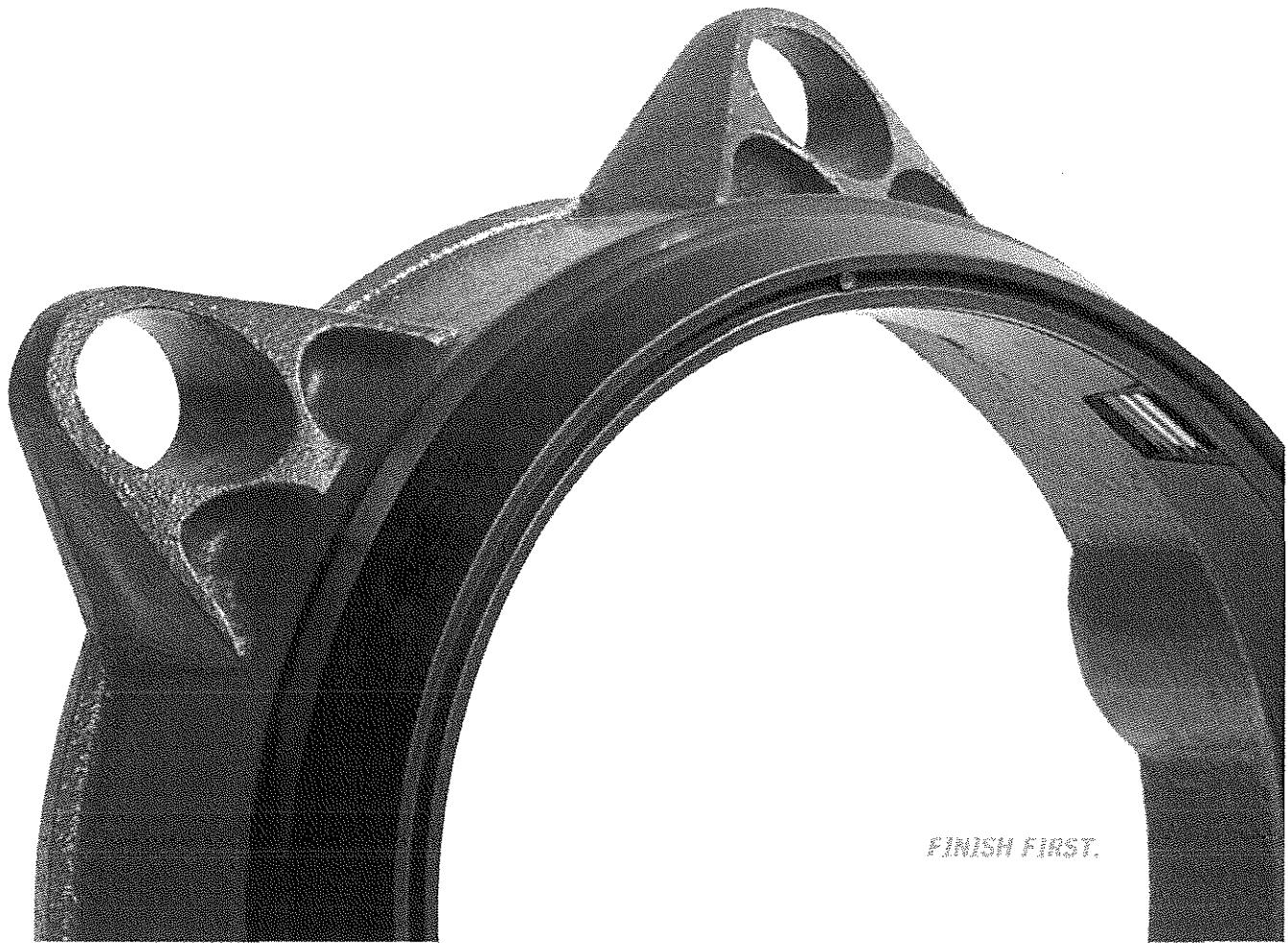
Field Weld Applied Rings: TR FLEX field weld rings can be used in the pulling or pull-back process. Field weldment rings, kits and instructions are available from U.S. Pipe. (See U.S. Pipe's brochure, "Field Cutting and Welding Procedure for TR FLEX® Pipe.")

Drilling Fluids: Various types of soils and soil formations require different drilling fluids and additives. It is recommended that HDD users follow the drilling fluid manufacturer's recommendations for the proper mud mix formulation and viscosity.

MORE
THAN
JUST
PIPE



PROVEN JOINT
RESTRAINT TECHNOLOGY
NO LEARNING CURVE
FOR DUCTILE IRON
AND PVC PIPE
SERIES DI: 4"-24"
SERIES PV: 4"-12"



Pipe and Foundry Company, MJ FIELD LOK fittings are made exclusively by MJ Pipe & Foundry Co., Inc., The World's Largest
Manufacturers of Pipe and Fittings.

SPEND LESS TIME — AND MONEY — RETRAINING MECHANICAL JOINT FITTINGS WITH THE NEW **MJ FIELD LOK® GASKET**

With the introduction of the MJ FIELD LOK® Gasket, you can now eliminate the time and expense of retraining your crews to install mechanical joint fittings.



www.mjfieldlok.com

U.S. PIPE AND FOUNDRY CO. A registered trademark

U.S. PIPE AND FOUNDRY CO. MJFL BRO-100

REVISED 12.05

A RESTRAINT REVOLUTION

MJ FIELD LOK® Gasket Series PV (4"-12")



MJ FIELD LOK® Gasket Series DI (4"-24")

Forget those heavy lug-type restraints and switch to the new MJ FIELD LOK® Gasket. It not only seals, but also provides the joint restraint that typically requires concrete thrust blocks or lug-type restraints outside the joint. This means you'll have fewer installation steps, and faster and easier installations.

Two primary components make up the MJ FIELD LOK Gasket. The first, an elastomeric material, does the sealing. The second, either stainless steel locking segments (*Series DI*) or a Ductile Iron locking ring (*Series PV*), are the teeth that give MJ FIELD LOK its bite. Embedded in the elastomeric material, they lock in to the pipe and

provide joint restraint when the pipe system is internally pressurized.

There's no learning curve either. Install it just like a standard mechanical joint gasket. The joint is automatically restrained when the MJ FIELD LOK® Gland bolts are tightened to the recommended torque.

FINISH FIRST

MJ FIELD LOK® Gasket

- Proven joint restraint technology.
- No learning curve — installs just like a standard mechanical joint gasket and gland.
- No more need for time-consuming thrust blocks or heavy lug-type restraints.
- No loose wedges or torque-off control nuts to get lost or broken.
- Can be disassembled just like a standard mechanical joint.
- Suitable for potable water and wastewater applications.
- The state-of-the-art MJ FIELD LOK® Gland is designed for maximum strength and easy product identification.
- MJ FIELD LOK Gaskets are provided as part of a kit that also includes the MJ FIELD LOK Gland, nuts and bolts.

MJ FIELD LOK® Gasket Series DI (4"-24")

- Can be used on any Pressure Class or Special Thickness Class Ductile Iron pipe up to 350 psi.
- Stainless steel locking segments provide proven joint restraint technology.

MJ FIELD LOK® Gasket Series PV (4"-12")

- Can be used on any Thickness Class of AWWA C900 PVC pipe.
- Pressure rated at a 2:1 safety factor, based on the pressure rating of the pipe on which it is installed.
- Can be used on C909 PVC pipe and has the same rating as the pipe that it is installed on.
- Ductile Iron locking ring provides proven joint restraint technology.

MJ FIELD LOK® Gland (4"-24")

- Highly engineered to provide the strength and rigidity necessary for restrained joint applications.
- Installs just like a standard mechanical joint gland.
- All Ductile Iron components are manufactured to ASTM A536 Grade 70-50-05.

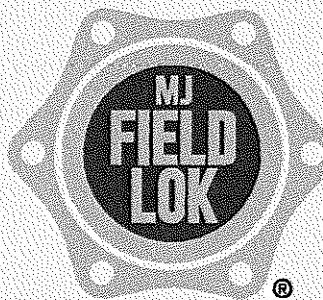
MJ FIELD LOK KIT INCLUDES: MJ FIELD LOK® GASKET, STATE-OF-THE-ART MJ FIELD LOK® GLAND, NUTS AND BOLTS. CONTACT YOUR U.S. PIPE TYLER UNION OR MWANE COMPANIES' SALES REPRESENTATIVE OR VISIT WWW.MJFIELDLOK.COM FOR MORE INFORMATION.

Application Notes:

1. MJ FIELD LOK® Gaskets are designed to seal and restrain a centrifugally cast Ductile Iron or PVC pipe (C900 or C909) with Ductile Iron pipe spigot diameters in either a Ductile Iron pipe or a Ductile Iron fitting bell.
2. MJ FIELD LOK Gaskets are available to fit mechanical joints conforming to ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
3. If Ductile Iron pipe with a lower pressure rating than the gasket is used, then the lower pressure rating will apply to the MJ FIELD LOK Gasket also.
4. MJ FIELD LOK® Gaskets require 90 ft-lb of bolt torque for 4"-8" gaskets, and 120 ft-lb of bolt torque for 10"-24" gaskets. As per AWWA C600 Mechanical-Joint assembly instructions (**the lubrication is not required for DI version of MJ FIELD LOK® Gaskets**) all bolts for MJ joints should be tightened in an alternating pattern. The alternating tightening pattern should be repeated until the recommended bolt torque is achieved i.e. several repetitions will be required before the proper torque is reached. Most common 1/2" drive air powered impact wrenches are capable of applying these torques.
5. U.S. Pipe does not recommend that the joints be deflected after the bolts have been tightened.
6. Bolts: The standard MJ FIELD LOK Gasket kit comes with T-Head bolts/nuts to be used with C153 MJ Bell Flanges. Kits with bolts/nuts to be used with C110 MJ Bell Flanges may be provided if noted on the order. Bolts made of special materials such as Stainless Steel or Fluorocarbon Coated Steel may also be furnished separately upon request.
7. MJ FIELD LOK Gaskets are suitable for either potable water or wastewater applications.
8. MJ FIELD LOK Gaskets are NSF 61 Approved.
9. Series DI Gaskets are UL Listed for 350 psi in 4"-16" sizes and 250 psi in 18"-24" sizes; and FM Approved, with a rating of 175 psi in 4"-12" sizes.
10. MJ FIELD LOK Gaskets Series DI products are not recommended for use with cast iron pipe, plastic pipe, oversize pipe, metric pipe, or for use as a transition gasket, or pipe with an O.D. coating of any kind that is thicker than 5 mils.
11. MJ FIELD LOK Gaskets Series PV products are not recommended for use with cast iron pipe, Ductile Iron pipe, oversize pipe, metric pipe, or as a transition gasket. Series PV Gaskets should not be used on any pipe with an O.D. coating of any kind that is thicker than 5 mils.

MJ FIELD LOK® Gasket Series DI (Protected by U.S. Patent Nos. 7,093,863; 7,104,573; 7,108,285)

SIZE	PIPE ID	ORDER NUMBER	DISCHARGE	PRESSURE RATING	TEST PRESSURE	TEST RATED CAPACITY
4	4.80	DI04	5	350	3	7.3
6	6.90	DI06	5	350	4	10.9
8	9.05	DI08	5	350	6	13.5
10	11.10	DI10	3	350	9	18.5
12	13.20	DI12	3	350	13	19.7
14	15.30	DI14	2	350	18	26.9
16	17.40	DI16	2	350	24	31.8
18	19.50	DI18	1.5	250	30	49.8
20	21.60	DI20	1.5	250	36	59.7
24	25.80	DI24	1.5	250	52	81.3



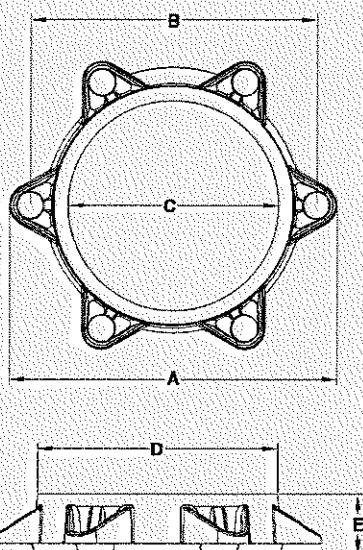
MJ FIELD LOK® Gasket Series PV (Protected by U.S. Patent Nos. 7,125,054; 6,974,160; 6,945,570; D514,671)

SIZE	PIPE ID	ORDER NUMBER	PRESSURE RATING DR-18	PRESSURE RATING DR-30	TEST PRESSURE
4	4.80	PV04	150	200	7.8
6	6.90	PV06	150	200	11.8
8	9.05	PV08	150	200	14.8
10	11.10	PV10	150	200	20.1
12	13.20	PV12	150	200	21.6

MJ FIELD LOK® Gland See illustration at right. (Protected by U.S. Patent Nos. D515,573; D513,793; D514,669)

SIZE	WEIGHT	DIMENSIONS				
		A	B	C	D	E
4	3.3	8.88	7.50	4.90	5.92	1.75
6	5.0	10.87	9.50	7.00	8.02	2.00
8	7.2	13.13	11.75	9.15	10.17	2.25
10	10.2	15.38	14.00	11.20	12.22	2.25
12	11.0	17.63	16.25	13.30	14.32	2.25
14	17.2	20.13	18.75	15.44	16.40	2.51
16	25.0	22.38	21.00	17.54	18.50	2.75
18	38.0	24.75	23.25	19.64	20.60	3.14
20	46.0	27.00	25.50	21.74	22.70	3.20
24	64.0	31.50	30.00	25.94	26.90	3.57

MJ FIELD LOK® Gland



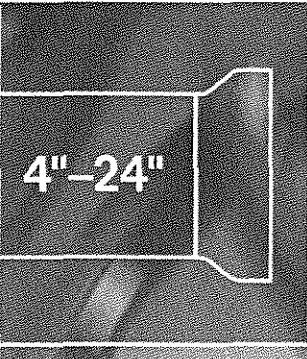
Suggested Specifications:

Joint restraint for mechanical joint pipe and fittings shall be the MJ FIELD LOK® Gasket. The restraint system shall be completely integral to the gasket, requiring only standard mechanical joint assembly techniques. The restraining system for Ductile Iron shall be pressure rated to 350 psi in sizes up to and including 16", and 250 psi in sizes 18"-24". The restraining system for PVC shall be rated at a 2:1 safety factor for the pipe on which it is installed. The restraining system shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

FINISH FIRST.



2005 EDITION



4"-24"

FIELD LOK 350® Gasket

JOINT RESTRAINT

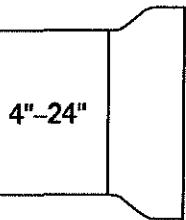


FOR WATER & WASTEWATER, FIRE PROTECTION & INDUSTRIAL APPLICATIONS

MORE
THAN
JUST
PIPE.



866.DIP.PIPE



FIELD LOK 350® Gasket



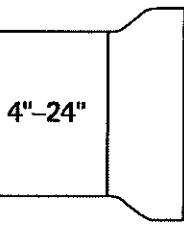
2005 EDITION

P 2

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866.DIP.PIPE



FIELD LOK 350® Gasket



2005 EDITION

P 3

FIELD LOK 350® Gasket

Restrained joint pipe and fittings are used in pressurized Ductile Iron pipelines to prevent the joints of the line from separating due to thrust forces. Thrust forces generally occur at changes of direction in the line. Usually, a calculated length of pipeline extending from the location of the thrust force is restrained in the joints so that this force can be transmitted to the soil surrounding the line. The entire pipeline is often restrained for installations in poor soil or for critical lines.

U.S. Pipe's FIELD LOK 350 Gasket has proven to be an extremely successful, trouble-free means of joint restraint for well over one million Ductile Iron pipe and fitting joint assemblies across North America. By simply inserting a FIELD LOK 350 Gasket into the socket of a TYTON JOINT® Pipe, Fitting or Valve, restraint is instantly achieved when the joint is assembled. Stainless steel locking segments vulcanized into the FIELD LOK 350 Gasket grip the pipe to prevent joint separation.

FIELD LOK 350 Gaskets, utilizing patented improvements, are rated by U.S. Pipe for operating pressures up to 350 psi — a rating that now matches that of Pressure Class 350 pipe — giving the engineer and user new flexibility in designing piping systems.

Underwriters Laboratories lists the 4"-24" sizes for 350 psi. Factory Mutual, utilizing a safety factor of 4, approves the 4"-16" sizes for 250 psi and the 18"-24" sizes for 200 psi service.

With the use of the FIELD LOK 350 Gasket, push-on joint Ductile Iron TYTON JOINT Pipe or Fittings can be quickly and securely restrained as the joint is assembled. The restraint provided shall be a boltless, integral restraining system and shall be rated for 350 psi in accordance with the performance requirements of ANSI/AWWA C111/A21.11. Field cut pipe are no longer a problem to restrain. No pipe surface preparation* or grooving is required for field cut pipe other than the cut end needing to be beveled as required for any push-on joint spigot end. With the FIELD LOK 350 Gasket in place, the joints are restrained without thrust blocks, bolts, grooves, rods, clamps or retainer glands, resulting in savings of labor, material and time.

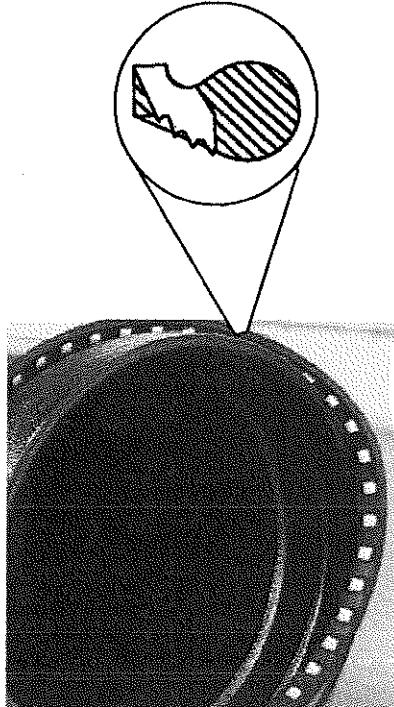
CAUTION: U.S. Pipe does not recommend FIELD LOK 350 Gaskets for use above ground. The long-term effect of cyclical movements can be gradual joint separation to the point that the seal on the gasket bulb is compromised. Sources of cyclical movements include vibration as may be found on bridge crossings, and thermal expansion and contraction resulting from atmospheric temperature changes. These conditions are not experienced with buried pipe lines.

*See note on page 5 regarding pipe with thick coatings or tape wrap.

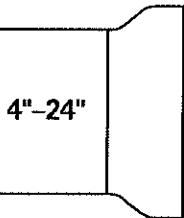
FIELD LOK®, FIELD LOK 350®, TYTON®, TYTON JOINT® and TR FLEX® are registered trademarks of U.S. Pipe and Foundry Company. FIELD LOK 350 Gaskets are covered by U.S. Patent Numbers 5,295,697 and 5,464,228.

ANSI/AWWA C111/A21.11 Standard for
Rubber-Gasket Joints for Ductile Iron
Pressure Pipe and Fittings.

FIELD LOK 350 Gaskets are available in
4"-24" sizes and the pressure rating is
based on the performance requirements
of ANSI/AWWA C111/A21.11.



NOTE: If specifiers and users believe that corrosive soils will be encountered where products are to be installed, please refer to ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile Iron Pipe Systems for proper external protection procedures.



FIELD LOK 350® Gasket

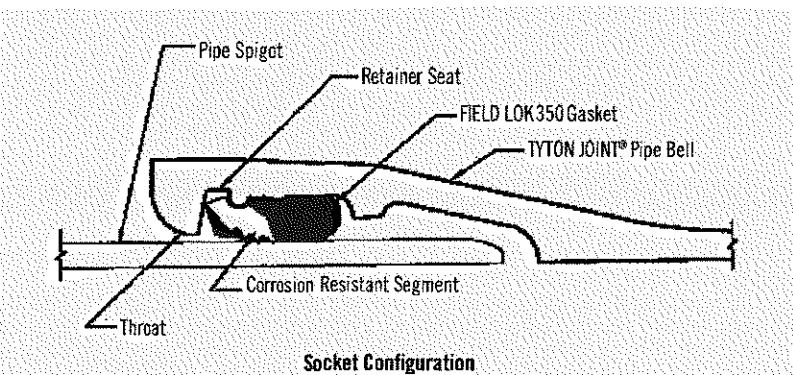


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Assembly



NOTE: Actual socket configuration may vary from illustration.

Figure 1.

Loop the gasket for insertion and place in the socket with the heel of the gasket in the retainer seat of the socket.

Figure 2.

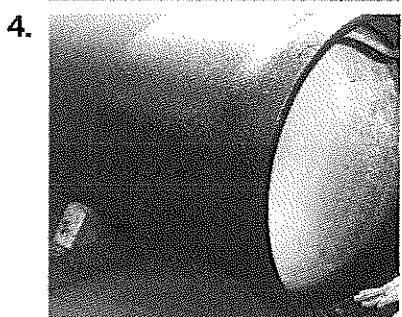
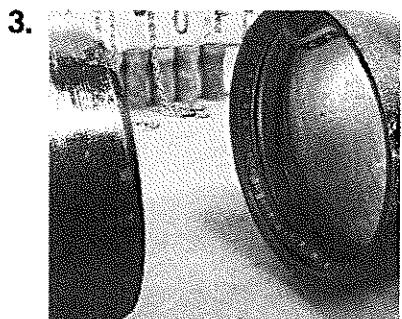
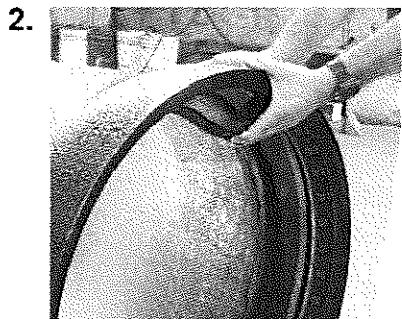
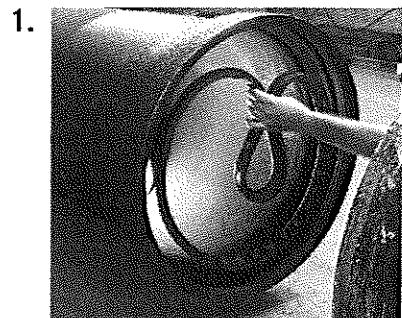
After inserting the gasket, seat it by pushing in the existing loop. However, in some cases it may be required to utilize two or more loops to properly seat the gasket.

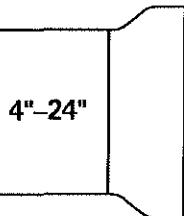
Figure 3.

When two or more loops are required they should be as equal as possible and located at approximately the three and nine o'clock positions.

Figure 4.

The two loops are then pushed into place completing the insertion.





FIELD LOK 350® Gasket



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Assembly (cont.)

Figure 5.

Apply a thin film of TYTON JOINT® Lubricant to the exposed surface of the gasket that will come into contact with the entering pipe spigot. Only TYTON JOINT Lubricant should be used.

CAUTION: The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.

Figure 6.

When pipe is cut in the field, the cut end may be readily conditioned so that it can be used to make up the next joint. The outside of the cut end (or any pipe without a bevel) should be beveled about 1/4" at an angle of about 30 degrees and the leading edge should be rounded. This can be done quite easily with a portable grinder. The operation removes any sharp, rough edges which otherwise might damage the gasket.

Figure 7.

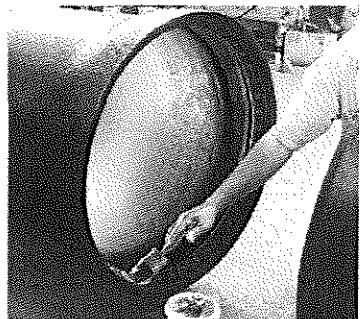
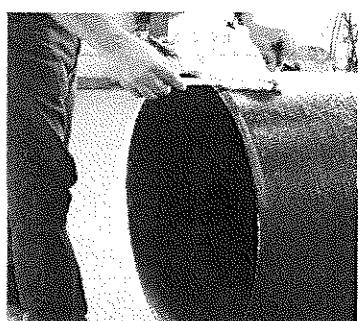
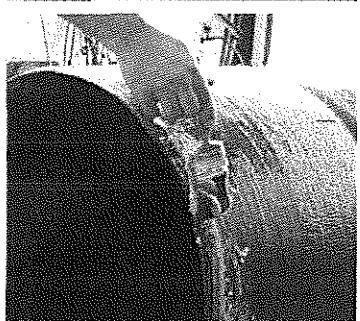
When cut pipe, which have no assembly stripes, are to be assembled, the spigot insertion depth should be marked on the spigot to ensure that the joint is fully assembled. When deflection is required at the joint, the spigot should not be completely horned. Assembly mark locations by size and deflection information is given in Table 2.

Figure 8.

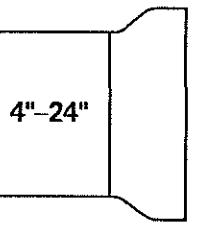
6 to 7 inches of the spigot should be cleaned and a thin coat of TYTON JOINT® Lubricant applied.

NOTE: Thick Coatings or Tape Wrap — The FIELD LOK 350 Gasket should not be used on pipe and fittings which have thick coatings or tape wrap on the outer diameter of the pipe. In general, if the peen pattern is not visible on the pipe surface, the coating may be too thick for proper penetration of the teeth of the FIELD LOK 350 Gasket. The thick asphalt coating should be removed from the end of the pipe or fitting before assembly. The coating must be no more than 2 mils thick for asphalt coating and 6 mils nominal thickness for 2 part epoxy coating on the plain end of the pipe.

When it is known that field cuts will be made, several lengths can be ordered as "gauged full length". U.S. Pipe "gauged full length" pipe are marked with a green stripe on the bell face. The ANSI/AWWA C151/A21.51 standard for Ductile Iron pipe requires factory gauging of the spigot end. Accordingly, pipe selected for field cutting should be measured at the location of the intended cut and must be within the tolerances shown in Table 1.

5.**6.****7.****8.**

866.DIP.PIPE



FIELD LOK 350® Gasket



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Assembly (cont.)

Figure 9.

Insert the end of the pipe into the socket until it contacts the gasket. Keep the pipe in alignment during assembly.

Figure 10.

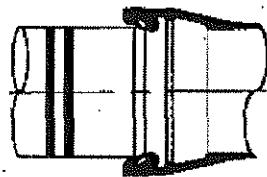
Assemble the joint until the stripe closest to the plain end has the edge farthest from the plain end, flush with the bell face. It is not hemmed as deeply as with TYTON® Gaskets. Carefully reverse the assembly force to ensure that the joint is properly restrained.

NOTE: If the pipe is inserted too far into the socket, it will not be possible to fully deflect the joint. See Table 2.

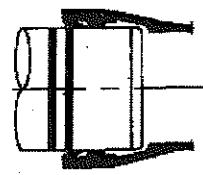
Figure 11.

A feeler gauge can be inserted into the socket to verify the proper installation of the joint. After assembly, the joint may be deflected up to the number of degrees shown in Table 2.

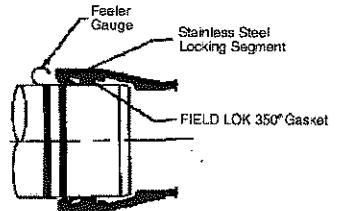
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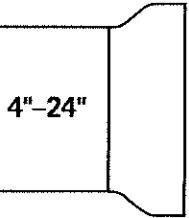
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FIELD LOK 350® Gasket



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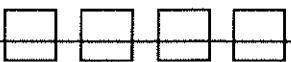
Alternative Assembly Methods

The Backhoe Method of Assembly

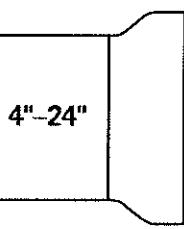
A backhoe may be used to assemble pipe of all sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to push the pipe until fully seated. Keep pipe in alignment to avoid damage to or dislodging of the gasket. A timber header should be used between the pipe and backhoe bucket to avoid damage to the pipe. Avoid "slamming" the pipe home to prevent damage to the lining material inside the bell at the back of the socket.

The Come-A-Long Method of Assembly

Some installers may prefer to use come-alongs to assemble TYTON JOINT® Pipe with FIELD LOK 350 Gaskets.



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FIELD LOK 350® Gasket



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Pipe Diameters

Table 1. Suitable Pipe Diameters for Field Cuts and Restrained Joint Field Fabrication.

NOMINAL PIPE SIZE Inches	PIPE DIAMETER Inches		PIPE CIRCUMFERENCE Inches	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
4	4.74	4.86	14-7/8	15-9/32
6	6.84	6.96	21-15/32	21-7/8
8	8.99	9.11	28-1/4	28-5/8
10	11.04	11.16	34-11/16	35-1/16
12	13.14	13.26	41-9/32	41-21/32
14	15.22	15.35	47-13/16	48-7/32
16	17.32	17.45	54-13/32	54-13/16
18	19.42	19.55	61	61-13/32
20	21.52	21.65	67-19/32	681/32
24	25.72	25.85	80-25/32	81-7/32

Assembly Mark and Deflection

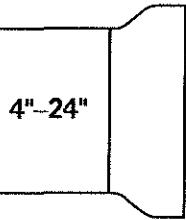
Table 2. Assembly Mark and Deflection.

PIPE SIZE Inches	LOCATION OF ASSEMBLY MARK* Inches	MAXIMUM** JOINT DEFLECTION Degrees	DEFLECTION OF 18 ft LENGTHS Inches	APPROX. RADIUS OF CURVE PRODUCED BY SUCCESSION OF JOINTS-18 ft LENGTHS Feet
4	2-3/4	5	19	205
6	2-15/16	5	19	205
8	3-1/4	5	19	205
10	3-5/16	5	19	205
12	3-5/16	5	19	205
14	4-9/16	4	15	257
16	4-9/16	4	15	257
18	4-9/16	4	15	257
20	5-1/16	2.5	9.5	412
24	5-1/2	2.5	9.5	412

*For full deflection application, insert spigot no deeper than the first assembly stripe.

**The pipe to be installed must be kept in straight alignment with the previously installed pipe or fitting during assembly. Joint deflection may be made upon completion of the assembly.

866.DIP.PIPE



FIELD LOK 350® Gasket



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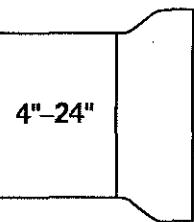
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Special Notes Regarding the use of FIELD LOK 350 Gaskets

FIELD LOK 350 Gaskets will have a tag attached to them with gasket assembly instructions and a "CAUTION!" notice.

1. Do not use FIELD LOK 350 Gaskets to provide electrical joint conductivity for thawing purposes. Such use may damage the gaskets.
2. Use FIELD LOK 350 Gaskets only in push-on joints which have the trademark TYTON® or TYTON JOINT®. Use in other joints may result in joint separation.
3. FIELD LOK 350 Gaskets should not be used in above ground installations.
4. Do not use FIELD LOK 350 Gaskets with corroded pipe.
5. U.S. Pipe has not conducted tests with gray iron or plastic piping products and, therefore, cannot recommend or warrant the use of FIELD LOK 350 Gaskets with gray iron (pipe, fittings or valves) or plastic (pipe or fittings).
6. Always make sure that the gasket is properly placed in the socket with the bulb or thickest portion of the gasket being deepest in the socket.
7. Use in casings: Pipelines restrained with FIELD LOK 350 Gaskets may be installed in straight casings by pulling, not pushing, the line through the casing. Assembly of the joints must be controlled, such as with come-a-longs or cable hoists, to prevent fully "homing" the spigot to the base of the socket to allow for joint deflection. When it is necessary that the pipeline be installed through a casing, TR FLEX® Pipe is recommended.
8. Do not reuse FIELD LOK 350 Gaskets.
9. Do not use FIELD LOK 350 Gaskets with Tyton Plugs since it is not possible to remove the plug after the joint is assembled.
10. Although disassembly of joints restrained with FIELD LOK 350 Gaskets is possible, the use of TR FLEX® Pipe and Fittings is recommended if disassembly of the joints is planned or anticipated.
11. If the maximum joint deflection is necessary, do not push the pipe to the bottom of the socket.
12. For cold weather assemblies, keep the temperature of the FIELD LOK 350 Gaskets above 40° F.
13. Approximately twice as much assembly force may be required to assemble a FIELD LOK 350 Gasket joint as is required for a conventional TYTON® Gasket push-on joint.

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FIELD LOK 350® Gasket



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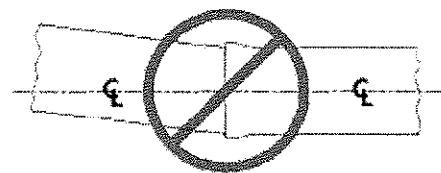
Special Notes Regarding the use of FIELD LOK 350 Gaskets (cont.)

14. If FIELD LOK 350 Gaskets are used in vertical installations, provisions must be made to keep the joint extended and not allow the teeth to become disengaged from the pipe. Failure to keep vertical joints extended can result in joint separation.
15. For cut pipe, select pipe with diameters or circumferences at the cut location which conform to Table 1.
16. For cut pipe, ensure that a tapered bevel similar to the one furnished with the pipe is ground onto the end of the pipe. (See illustration at right.)
17. Measure the socket depth and make a mark on the pipe spigot that distance from the end of the pipe. This mark will indicate when the joint is fully "home".
18. Keep the joint in straight alignment during assembly, especially when handling fittings. Do not fully "home" the joint if maximum joint deflection is required. Set the joint deflection after the assembly is made.
19. Check for correct positioning of the FIELD LOK 350 Gasket by inserting a feeler gauge in the space between the bell and the pipe OD in several locations around the socket to assure that the gasket is in proper position in the socket.

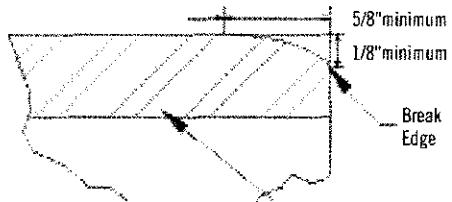
CAUTION!! DURING ASSEMBLY



CORRECT

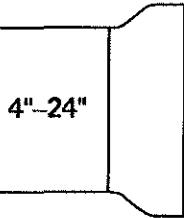


WRONG



Grind Bevel
(See Note #16)

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Disassembly for All Sizes

Figure 1.

While wearing gloves to protect hands, insert an extractor shim into the carrying anvil (slotted and curved steel block) and apply lubricant over the leading edge of the shim. Commencing at the bottom of the joint, drive the shim under the gasket by striking the anvil. Pry the anvil off the shim and insert a new shim.

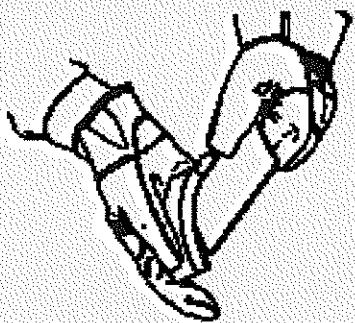
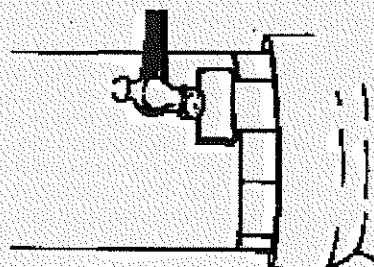


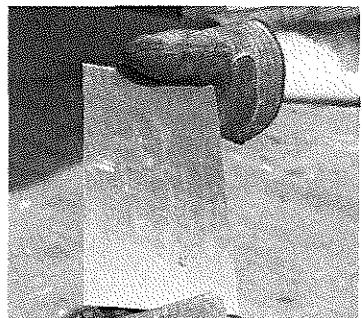
Figure 2.

Continue driving shims under the gasket around the whole circumference of the joint. Keep the gap between the shims to a minimum. Insert the final shim so that it is overlapped by the shims on either side. After all shims have been properly installed, the joint can be separated by pulling, using a cable and a backhoe or other equipment to force joint separation. Reuse of the gasket is not recommended.

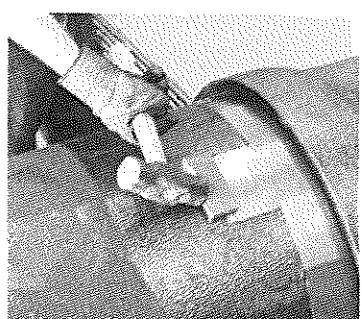


For disassembly for sizes 14"-24", follow the same procedure shown in Figures 1 and 2. Use a backhoe to force joint separation. Reuse of the gasket is not recommended.

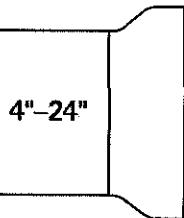
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FIELD LOK 350® GASKET



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
USIFLEX® Boltless Flexible Joint Pipe — for Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Pipe	4"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron
HP LOK™ Restrained Joint	30"-42"

Ductile Iron Fittings

TYTON® Fittings	14"-64" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-64" Ductile Iron
Mechanical Joint Fittings	3"-48" Ductile Iron
TRIM TYTE® MJ Fittings	3"-48" Ductile Iron
Flanged Fittings	3"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
FLANGE-TYTE® Gaskets	4"-64"
Polymeric Linings	For all pipe sizes
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

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4"-48"

USIFLEX®

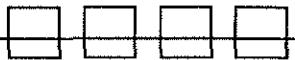
DUCTILE IRON PIPE



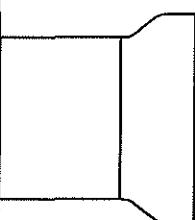
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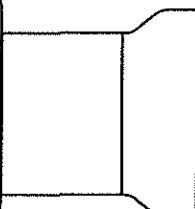
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USIFLEX®
DUCTILE IRON PIPE



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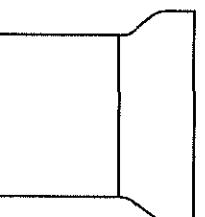
Overview

USIFLEX® Pipe is a simple, rugged, bottle-tight flexible restrained joint without the use of bolts. USIFLEX Boltless Flexible Joint Pipe is ideally suited for underwater installations where the high cost of equipment and manpower emphasizes the importance of ease and speed of assembly. USIFLEX Pipe may also be used for other types of installations where an appreciable amount of joint deflection and a positive lock against joint separation is required.

USIFLEX Pipe has a design working pressure of 350 psi for sizes 4"-12" and 250 psi for sizes 14"-48". The maximum joint deflection for all USIFLEX Pipe is 15°. For design and installation purposes a 12° limitation is recommended to allow for additional deflection after installation. For higher working pressures consult your U.S. Pipe Representative.

NOTE: If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile Iron Pipe Systems for proper external protection procedures.

USIFLEX® is a Registered Trademark of U.S. Pipe and Foundry Company, LLC.



USIFLEX®

DUCTILE IRON PIPE



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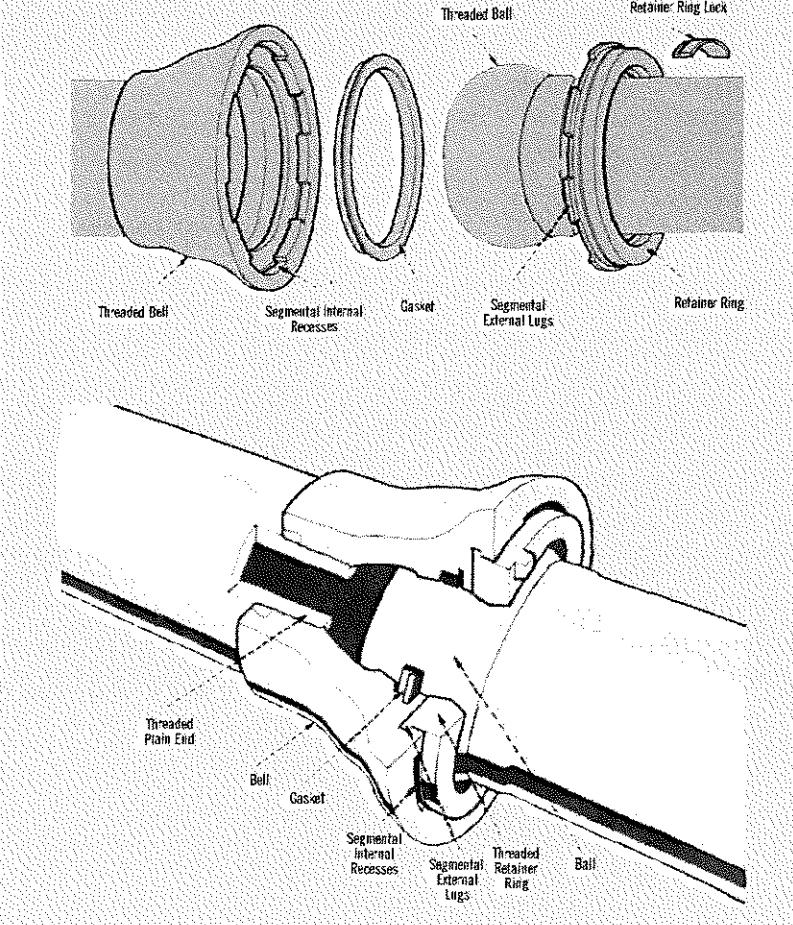


4"-48" Pipe

USIFLEX Pipe furnished in sizes 4"-48" are made with Thickness Class Ductile Iron. The outside pipe diameters are standard making it convenient for tying in with standard pipe and fittings.

The centrifugally cast Ductile Iron USIFLEX Pipe meets the applicable requirements of ANSI/AWWA C151/A21.51. The separately cast Ductile-Iron ball, bell and retainer ring conforms with the requirements of ASTM A 536, Grade 70-50-05. The ball and bell are threaded and screwed onto the threaded ends of the barrel. Critical surfaces of the ball, bell socket and retainer ring are machined.

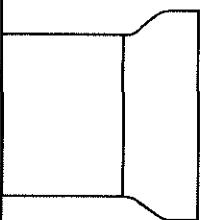
The maximum nominal laying lengths are 18.5' or 21' for sizes 4" - 24", 19' for sizes 30" - 36", and 22' for 42" - 48".



The centrifugally cast Ductile Iron USIFLEX Pipe in sizes 4"-48" meets the applicable requirements of ANSI/AWWA C151/A21.51. *Standard for Ductile-Iron Pipe, Centrifugally Cast for Water.*

The separately cast Ductile Iron bell, ball and retainer ring conforms with the applicable requirements of ANSI/AWWA C110/A21.10, *Standard for Ductile-Iron and Gray-Iron Fittings for Water.*

ASTM A536 "Standard Specification for Ductile Iron Castings."



USIFLEX®

DUCTILE IRON PIPE



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Advantages

The gasket and the retainer ring lock are the only loose accessories. No bolts, nuts or wrenches are required to make up the joint. Fewer accessories to handle and account for means a substantial savings in time and labor.

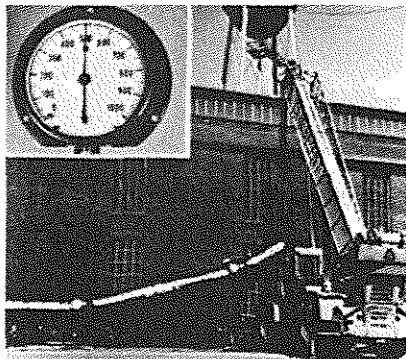
The design of the gasket and gasket seat is such that, rather than being dependent on an exterior force from a gland, the gasket is self-sealing.

Only a moderate longitudinal thrust is required to insert the ball into the socket.

Clearances between the machined retainer ring and the bell permit easy entry and rotation of the retainer ring in the bell.

Because of the unique design, when the joint is subjected to end pull, the rugged retainer ring withstands the radial forces and prevents transmittal of these forces to the bell casting.

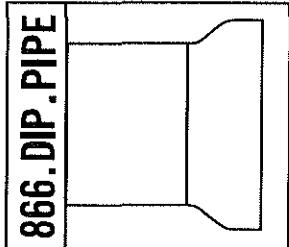
The inside contour at the end of the ball is shaped so that when the joint is deflected, the ball does not project into the waterway to obstruct the flow.



42" USIFLEX pipe fully deflected to 15° at 500 psi test pressure (2 times rated pressure).



The flexibility of the joint permits bottle-light operation at deflections up to 15°.



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DUCTILE IRON PIPE



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4"-48" Pipe Assembly

USIFLEX Pipe are shipped with a shop-applied protective coating on the machined surface of the ball.

Before assembly, remove the coating with acetone or methyl ethyl ketone.

Insert the USIFLEX Gasket into its seat in the socket.

Lubricate the ball and exposed surface of the inserted gasket with TYTON JOINT® Lubricant. In warm, dry weather conditions, the lubricant can dry out, especially when applied to warm or hot pipe, it will be necessary to add a small amount of water to hydrate the lubricant. Only TYTON JOINT Lubricant should be used. This will permit easy assembly and deflection of the joint. The lubricant furnished is a non-toxic material. If assembly is to be made underwater, special lubricant can be furnished. Lubricant other than that furnished with the pipe should not be used.

CAUTION: *The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.*

With the entering pipe suspended by a crane or other means, place the lubricated ball in the receiving bell and force the ball into the socket, thereby compressing the gasket to effect a bottle-tight seal. Bring up the retainer ring, line up the lugs with the recesses in the bell, move the retainer ring inward and turn it until the retainer ring lugs interlock with the internal flange segments in the bell.

Insert one retainer ring lock into a space between two segments to hold the retainer ring in the locked position, then caulk the retainer ring lock to keep it in place. Only a few hammer blows on a wide caulking iron are sufficient. **Only one retainer lock is required per joint to prevent the ring from rotating.**

Figure 1.

Insert the gasket into its seat in the socket. Forming gasket loop helps initial stage of seating. Release the gasket and press it into the gasket seat where it is securely held.

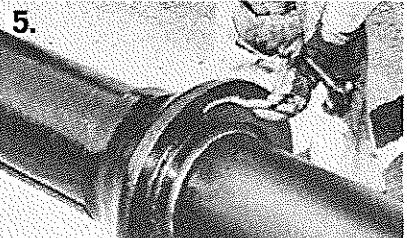
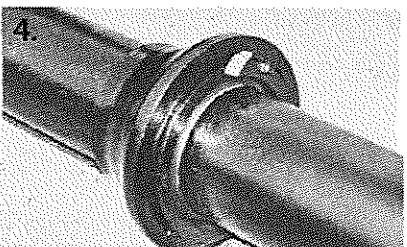
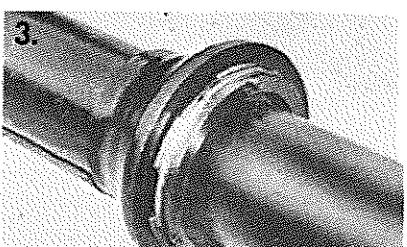
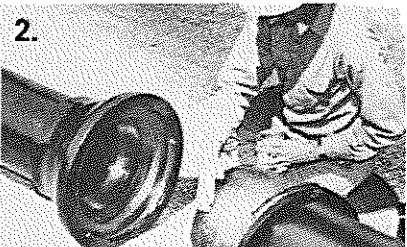


Figure 2.

Apply lubricant to the ball and exposed surface of seated gasket in socket. Lubricant other than that furnished with the pipe should not be used. After lubrication, ball is ready to be pushed into socket.

Figure 3.

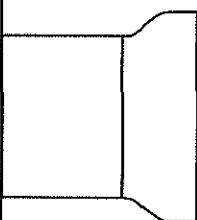
Ball has been socketed. Retainer ring lugs have been lined up with recesses in bell and retainer ring is ready to be moved into the bell and rotated.

Figure 4.

After insertion and rotation of retainer ring in bell, the lugs on retainer ring are in back of and in register with internal flange segments in bell. Retainer ring lock is shown partially inserted into recess between the bell and retainer ring.

Figure 5.

Retainer ring lock completely inserted into recess is being caulked in place by hammer blows on a wide caulking iron.



Large Diameter Assembly

Figure 1.

Insert the gasket into its seat in the socket. Several gasket loops help the initial stage of seating, particularly in the larger pipe sizes.

Figure 2.

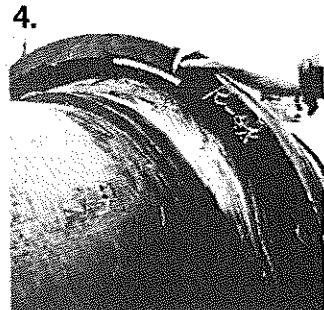
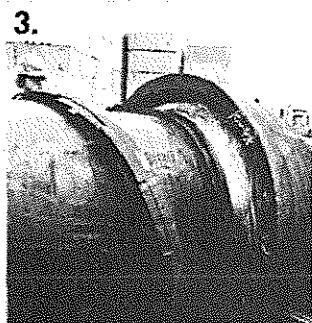
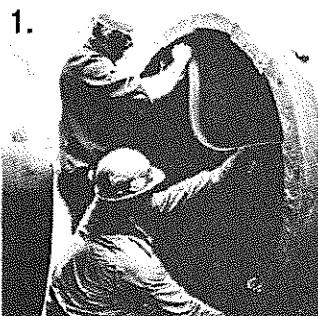
Apply lubricant onto the ball of the pipe and the exposed surface of the seated gasket in the socket. Lubricant other than that furnished with the pipe should not be used. After lubrication, the ball is ready to be pushed into the socket.

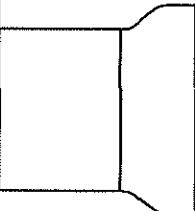
Figure 3.

After the ball has been socketed, line up the retainer ring lugs with the recesses in the bell. The split in the retainer ring should be located near the six o'clock position. The retainer ring should then be moved into the bell and rotated.

Figure 4.

Insert a retainer ring lock into one of the recesses between the bell and the retainer ring. Caulk into place with hammer blows. Only one retainer ring lock is required per joint to prevent ring rotation.





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Installation

Submarine installations, the type of service for which USIFLEX Pipe is usually used, are so varied that a specific installation procedure cannot be recommended. Some methods that have been used successfully by installers of flexible joint submarine lines are:

- Assemble two or more sections above water, lower with the aid of a strongback or multiple slings from a derrick barge and have a diver make up connecting joints under water.
- Lay the pipe with a chute or cradle attached to a derrick barge or similar type of floating equipment.

Ramp launching and flotation method

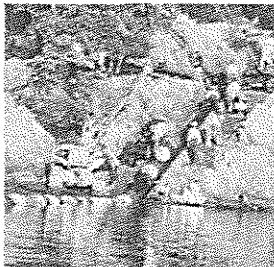
Assemble the joints on shore, attach empty drums to aid buoyancy, pull into the water by attached cable and lower to the bottom by progressively releasing the drums or allowing them to fill with water. Barrels should be retrieved after installation is complete.

Each joint of USIFLEX Boltless Flexible Joint Pipe provides variable deflection up to 15° and the joint may be deflected to this position without harm to the pipe or joint components. A 12° installation limitation is recommended to provide additional deflection capability to accommodate earth settlement or movement. Care should be taken, however, to ensure that no joint is ever forced beyond the 15° maximum design deflection.

When USIFLEX pipe is installed in areas of water traffic, shallow depths or waterways prone to flood carrying debris, the pipe should be laid in a trench or backfill placed over the pipe to reduce the chance of damage to the pipe. All the pipe joints should be supported underneath each bell. A thorough bottom survey in the design stage of a project will reveal if backfill or support is required under the pipe to stay within the deflection limits of the joint.



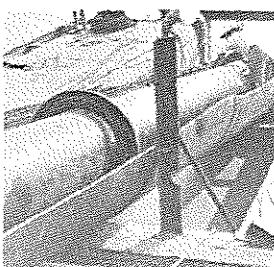
Ramp launching and flotation method used at Dalecarlia, Indiana.



8" USIFLEX Pipe being installed around rock cliff in Rockport, Indiana.

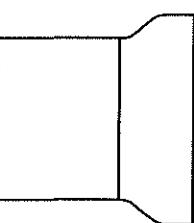


Another illustration of ramp launching.



24" force main being installed across the Passaic River at Garfield, New Jersey.

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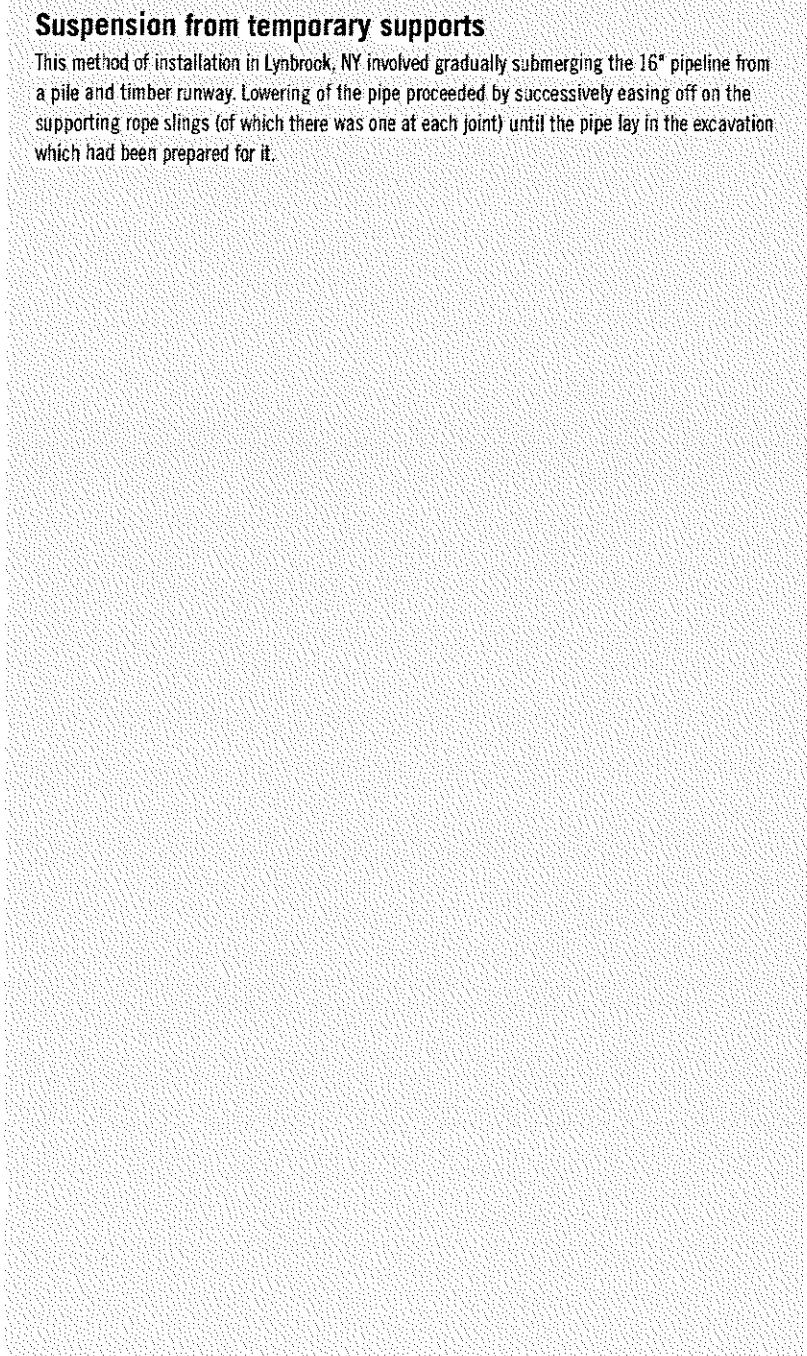
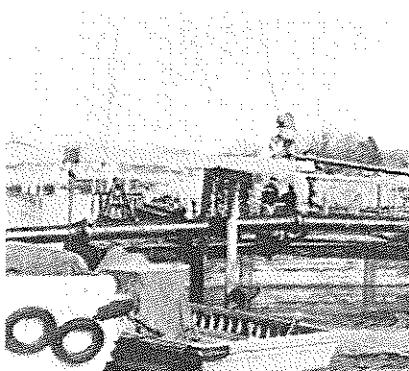
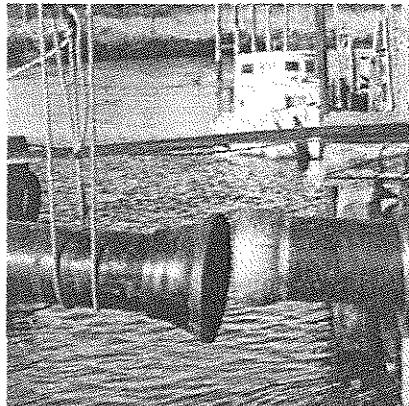
P 9

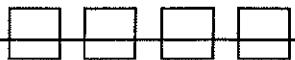


Installation (cont.)

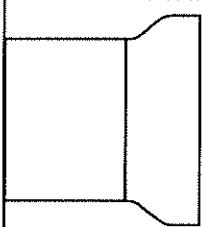
Suspension from temporary supports

This method of installation in Lymrock, NY involved gradually submerging the 16" pipeline from a pile and timber runway. Lowering of the pipe proceeded by successively easing off on the supporting rope slings (of which there was one at each joint) until the pipe lay in the excavation which had been prepared for it.





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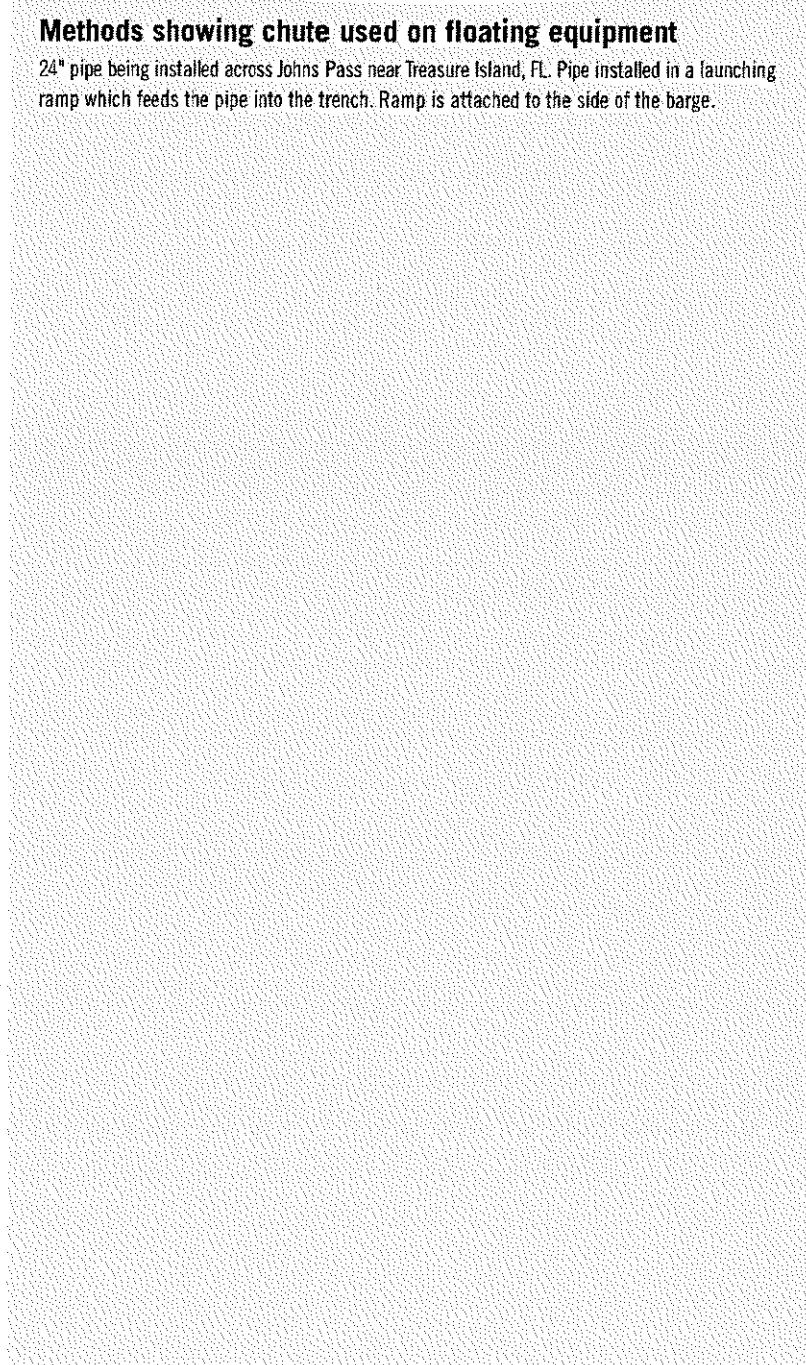
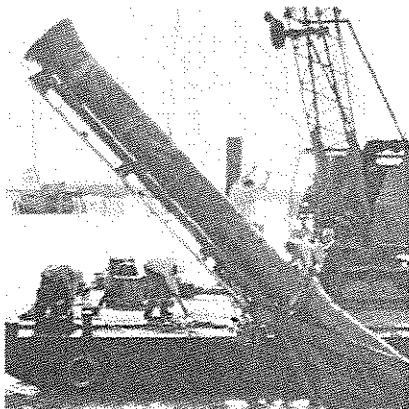
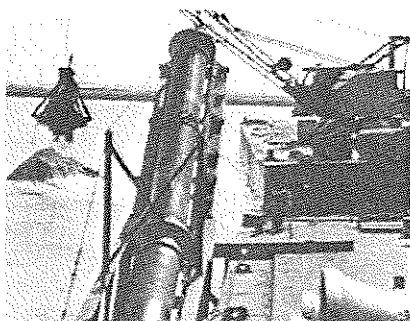
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Installation (cont.)

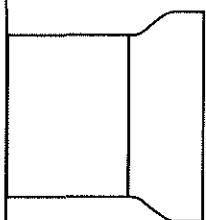
Methods showing chute used on floating equipment

24" pipe being installed across Johns Pass near Treasure Island, FL. Pipe installed in a launching ramp which feeds the pipe into the trench. Ramp is attached to the side of the barge.





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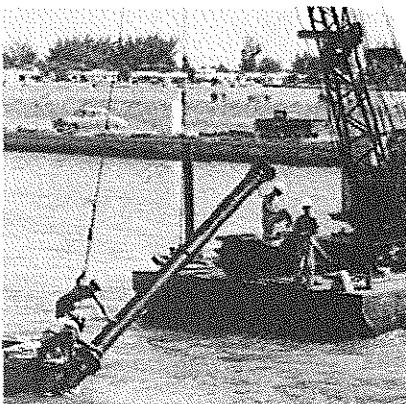
P 11

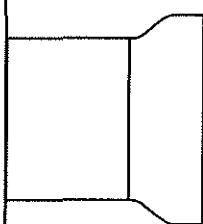
Installation (cont.)

Floating equipment method

One method of assembly when pipeline is suspended above water by the crane on floating equipment.

One line from crane holds bell of last laid length out of water while second line supports new length as the boltless flexible joint is made up. This method is used only in shallow water. Care must be taken not to exceed allowable joint deflection.





4"-48" Pipe Calculation of Weight When Submerged

The weight of submerged pipe may be calculated with the aid of the information in tables 1-3. Preliminary calculations may be made using the nominal weights and lengths shown in the tables. Take into consideration that the actual weights will vary within the scope of manufacturing tolerances. If the pipe are on hand, more accurate weight determination may be made using the actual measurements and marked pipe weights.

Method of Calculation:

1. Measure the length of the barrel from the bell skirt to the ball or select the nominal barrel length from Table 1.
2. Multiply the length of the barrel in feet by the displacement volume per foot of barrel from Table 2 or 3 to obtain the barrel displacement volume.
3. Add the barrel displacement to the assembled joint displacement from the appropriate table to obtain the total pipe displacement volume.
4. Multiply the total pipe displacement in cubic feet by the density of the medium in which the pipe is to be installed (approximately 62.4#/cu. ft. for fresh water, 64.0#/cu. ft. for salt water, etc.) to obtain the weight of the displaced medium.
5. Subtract the weight of the displaced medium from the marked pipe weight, or from the nominal pipe weight in the tables, plus the accessory weight to obtain the weight of the submerged pipe. (A negative value indicates that the pipe will float.)

Table 1. Nominal Lengths in Feet

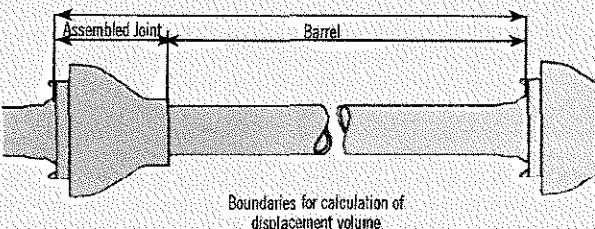
SIZE	DIMENSIONS			ASSEMBLED PIPE LENGTH [†]
	ASSEMBLED JOINT LENGTH	BARREL LENGTH*	PIPE LENGTH*	
4	.62	17.76	18.38	—
6	.69	17.78	18.47	19.78
8	.83	17.76	18.59	19.76
10	.98	17.72	18.70	19.72
12	1.10	17.72	18.82	19.72
14	1.29	16.89	18.18	19.46
16	1.39	16.78	18.17	19.42
18	1.51	16.66	18.17	19.39
20	1.69	16.73	18.42	19.35
24	1.85	16.57	18.42	19.28
30	2.22	17.08	19.30	—
36	2.50	17.05	19.55	—
42	3.71	18.29	22.00	—
48	4.18	—	—	18.07
				22.25

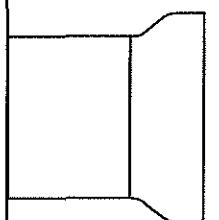
Lengths in this table are based on the maximum nominal laying lengths of 18.5' or 21' for 4" - 24", 19' for sizes 30" - 36", 22' for 42 - 48".

* Barrel length as manufactured from nominal 18' lay length pipe.

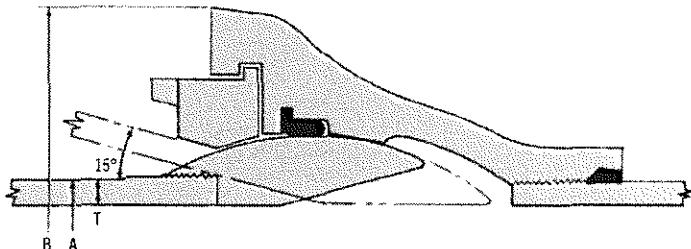
† Barrel length as manufactured from nominal 20' lay length pipe.

Assembled Pipe Length





4"-48" Pipe Standard Wall — Thicknesses, Dimensions, and Weights



NOTE: Actual component configuration may differ from drawing.

Table 2. Standard Wall Thickness, Dimensions and Weights

SIZE Inches	ANSI THICK. CLASS NO.	T Nom. THICK. (In.)	A PIPE OUT DIA. (In.)	B BELL OUT DIA. (In.)	SIZE Inches	NOMINAL WEIGHT* Pounds	WEIGHT OF SUBMERGED PIPE MAY BE CALCULATED FROM FIGURES IN THESE COLUMNS						
							PER FOOT	ACTUAL WEIGHT Pounds	DISPLACEMENT VOLUME (CU. FT.)		MAXI SAFE END PULL Tons		
							PIPE	ACC.	FILLED WITH AIR	FILLED WITH WATER	FILLED WITH AIR	FILLED WITH WATER	
4	54	.35	4.80	10.95	4	21.28		1	.26	.19	.13	.05	19
6	54	.37	6.90	13.29	6	32.26		1	.43	.27	.26	.08	32
8	55	.42	9.05	16.71	8	48.50		2	.82	.48	.45	.12	40
10	55	.44	11.10	20.05	10	65.40		2	1.37	.74	.67	.16	45
12	56	.49	13.20	23.13	12	87.50		2	2.07	1.05	.95	.20	50
14	56	.51	15.30	25.30	14	107.90		4	3.36	1.42	1.28	.27	90
16	56	.52	17.40	27.94	16	125.03		4	4.47	1.76	1.65	.32	100
18	56	.53	19.50	31.04	18	146.60		5	5.90	2.27	2.07	.36	110
20	56	.54	21.60	34.36	20	172.95		7	7.98	3.03	2.54	.41	115
24	56	.56	25.80	39.48	24	218.36		9	11.79	4.07	3.63	.50	120
30	56	.63	32.00	46.77	30	290.62		13	20.32	5.60	5.58	.76	220
36	56	.73	38.30	54.10	36	393.81		15	31.29	8.06	8.00	.99	250
42	56	.83	44.50	64.18	42	577.04		22	63.86	17.95	10.80	1.35	305
48	56	.93	50.80	73.12	48	888.58		27	91.90	25.47	14.07	1.50	320

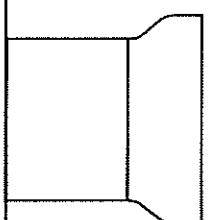
* Nominal weights are based on nominal lengths and thicknesses and are subject to manufacturing tolerances. Weight includes pipe, retainer ring, and cement lining.

The maximum nominal laying lengths are 18.5' for 4" - 12", 21' or 18.3' for 14" - 24", 19.5' for 30" - 36", 22' for 42" and 22.25' for 48". Actual laying lengths may vary from published to slightly over nominal. A maximum of 10% of the total number of pipe each size of an order may be furnished with laying lengths to 2 ft. shorter.

If more exact lengths are required, pipe may be furnished cut to length at an additional charge. Cut lengths shall not exceed the nominal laying length and will be subject to a tolerance of plus or minus 1/2".

The maximum working pressure rating is U.S. Pipe's suggested rating based on a conservative factor of safety to allow for laying and service conditions encountered in marine installations. The design engineer must decide whether barrel thicknesses shown are adequate to meet installation and service conditions for a particular project.

Maximum allowable deflection of joint is 15°.



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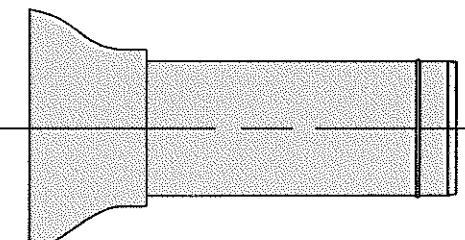


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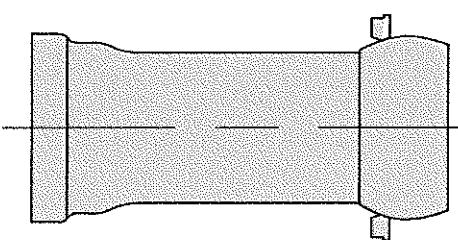
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Test Caps and Test Plugs



USBE x PETR (or HP)



TRB (or HP) x USBA

SIZE Inches	USBELL X PETR		TR BELL X USBALL		
		WEIGHT Pounds		WEIGHT Pounds	LAYING Lengths
4	USBE x PETR	96	TRB x USBA	93	3'- 6"
6	USBE x PETR	141	TRB x USBA	142	3'- 6"
8	USBE x PETR	214	TRB x USBA	211	3'- 6"
10	USBE x PETR	309	TRB x USBA	312	3'- 6"
12	USBE x PETR	426	TRB x USBA	418	3'- 6"
14	USBE x PETR	504	TRB x USBA	574	3'- 6"
16	USBE x PETR	572	TRB x USBA	691	3'- 6"
18	USBE x PETR	677	TRB x USBA	831	3'- 6"
20	USBE x PETR	819	TRB x USBA	1067	3'- 6"
24	USBE x PETR	1097	TRB x USBA	1364	3'- 6"
30	USBE x PEHP	1733	HPB x USBA	1743	5'- 0"
36	USBE x PEHP	2293	HPB x USBA	2526	5'- 0"
42	USBE x PEHP	4918	HPB x USBA	5030	5'- 0"
48	USBE x PEHP	6903	HPB x USBA	7133	5'- 0"

Each TR FLEX® (4-24") or HP LOK® (30-48") cap and plug and the USIFLEX® joint is positively locked to prevent joint separation from internal pressure or external pulling forces. TR FLEX® or HP LOK® caps and plugs can be used with USI-Bell x TR (or HPL) PE and TR (or HPL) Bell x USI-Ball to hydrostatically pressure test the pipe assembly and/or pull/float the pipe assembly into place. Each cap and plug is provided with a pipe tap and screw plug for filling the assembly with water and orienting the top pipe tap to the 12 o'clock position to bleeding air.

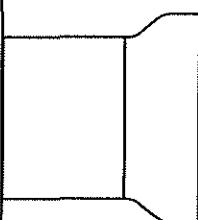
If the pipe assembly is to be pulled or floated into position, the pipe should be pulled with balls or spigot end first. Do not attempt to pull the assembly by attaching to the plug or cap directly. If a cap is used instead of a pull head, a choker cable behind the cap joint placed around the pipe is suggested. A 4"- 36" USP HDD Pulling Head can be used with a USI-Bell x TR (or HPL) PE to pull the pipe assembled pipe string. The pulling head also serves as a pressure test head and is equipped with pipe taps. Please refer to the USP Trenchless Application brochure for pulling head dimensions.

Please refer to the TR FLEX® or HP LOK® product brochures for cap and plug details.

TR FLEX® or HP LOK® plugs and caps, USI-Bell x TR (or HPL) PE and TR (or HPL) Bell x USI-Ball Test pipe, and pull heads are available for sale or rental.



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DUCTILE IRON PIPE



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Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe

	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Pipe	30"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
Grooved Pipe	4"-36" Ductile Iron
USIFLEX® Bottless Ball Joint Pipe For Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Restrained Joint	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
HP LOK® Fittings and HP LOK® Telescoping Sleeves	30"-64" Ductile Iron
Mechanical Joint Fittings	30"-48" Ductile Iron
Flanged Fittings	30"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
GLASS Lined Ductile Iron Pipe for Wastewater Treatment Plants	4"-30" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
MJ Harness Lok	4"-48" Ductile Iron
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.



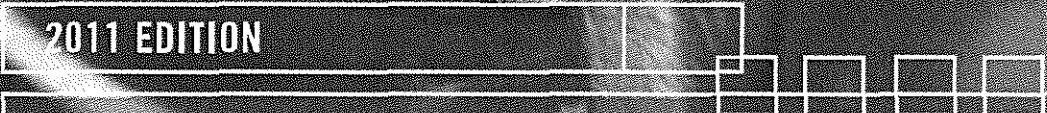
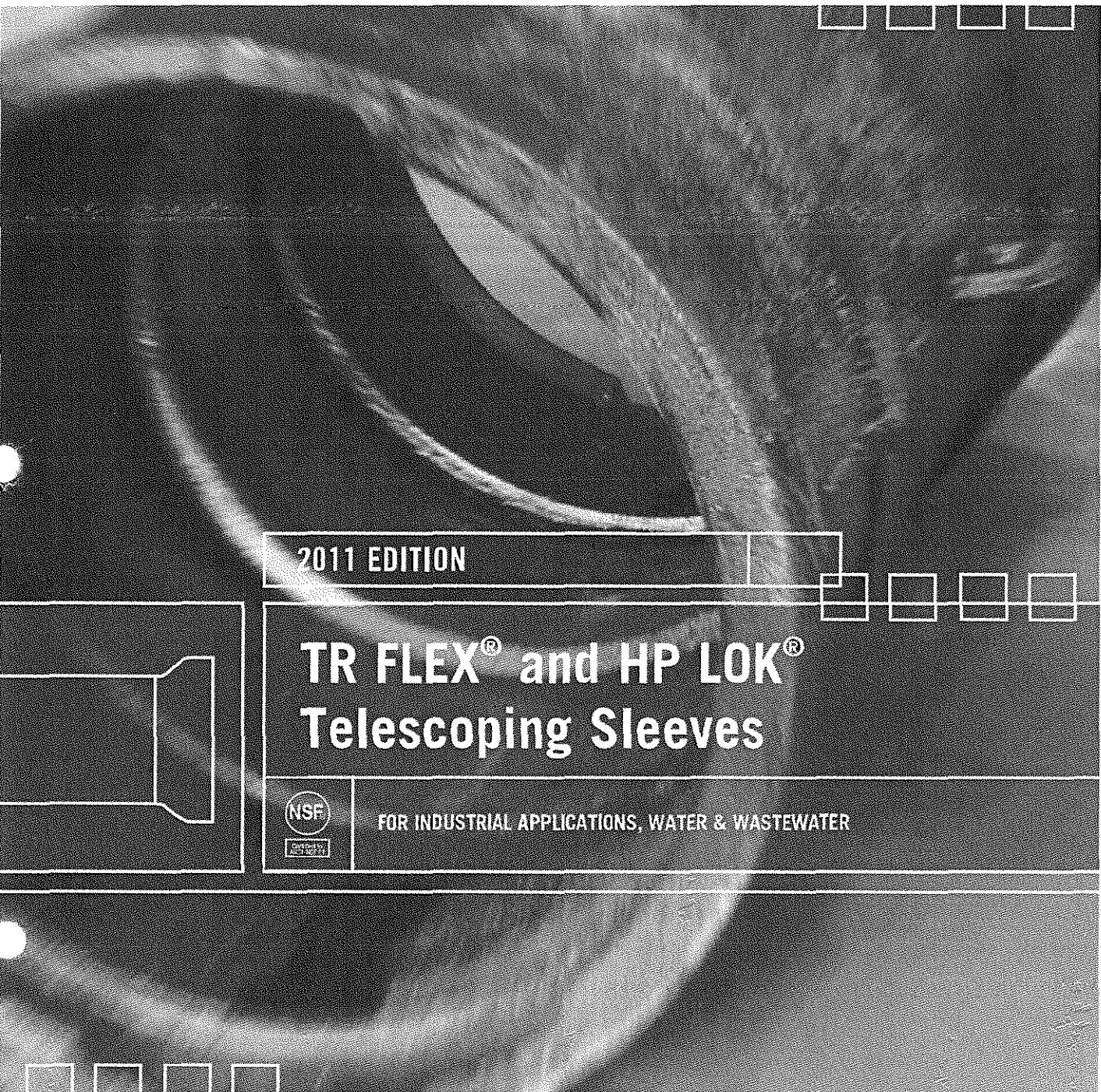
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THAN
JUST
PIPE.**

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TR FLEX® and HP LOK® Telescoping Sleeves

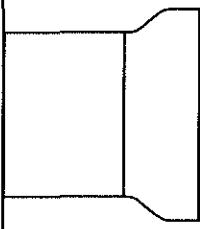


FOR INDUSTRIAL APPLICATIONS, WATER & WASTEWATER

REGULATED
STREAM
JUST
PIPE.



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TR FLEX® and HP LOK® Telescoping Sleeves

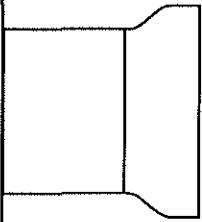


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TR FLEX® and HP LOK® Telescoping Sleeves



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Telescoping Sleeves

U.S. Pipe Telescoping Sleeves are Ductile Iron restrained joint fittings which can be utilized to provide expansion and contraction capability in a pipeline. Telescoping sleeves are available with TR FLEX ends for 4" through 24" sizes and with HP LOK ends for 30" through 64" sizes. The restrained joints of the telescoping sleeves are suitable for 350psi operating pressure in all sizes. Standard lining and coating is a petroleum asphaltic material.

The Telescoping Sleeves are capable of extending or contracting from approximately 10" to 24", depending upon the nominal diameter as given in Column B of Table 1, page 7.

A special section of Ductile Iron pipe is used in each end of the telescoping sleeve to make up a telescoping sleeve unit. Each pipe spigot end socketing in the sleeve has a weld bead located at a greater distance away from the end of the pipe (Column C, Table 1) than the conventional weld bead of TR FLEX / HP LOK pipe. The ends of the telescoping sleeve unit are provided with either TR FLEX / HP LOK socket(s) or with TR FLEX / HP LOK plain end(s) with weld beads as required.

Applications

The Telescoping Sleeve may be used:

- In lieu of a mechanical joint sleeve where joint restraint is required.
- As a closure piece when connecting a new restrained joint pipeline to an existing one.
- To make repairs to an existing restrained joint pipeline.
- To facilitate the installation of fittings or valves in an existing restrained joint pipeline.
- To provide expansion or contraction capability in areas of potential extreme soil movement or where settling is anticipated.

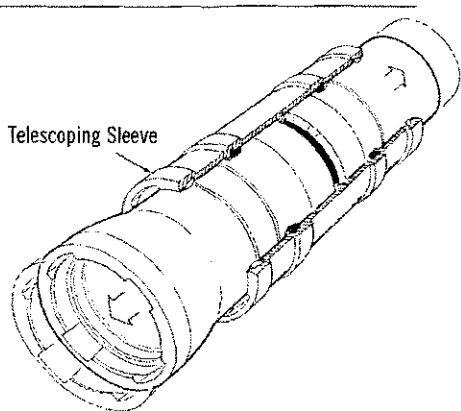
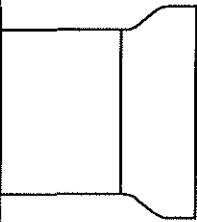


Figure 1. Telescoping Sleeve

NOTE: Conventional TR FLEX/HP LOK Pipe plain ends cannot be used in the telescoping sleeve. Special pipe ends are required which have weld beads located farther from the end of the pipe than the standard bead on TR FLEX/HP LOK Pipe. 6" through 64" Telescoping Sleeves are one-piece units which contain the gasket seat and locking segment cavities. The 4" size is a three-piece unit with the center section containing the gasket seats and each end section containing a locking segment cavity. The 4" unit is shipped pre-assembled. Joint restraint is not provided until the sleeve is fully extended.

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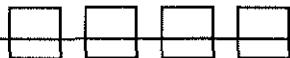


TR FLEX® and HP LOK® Telescoping Sleeves



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Assembly Instructions

The special pipe sections used with the telescoping sleeve are normally furnished from the factory but can be fabricated in the field. Use the following procedure to assemble and install the Telescoping Sleeve unit.

If the special pipe sections are to be prepared in the field, these sections should first be fabricated according to the instructions for field cut pipe given on page 6.

Insertion Slot Orientation

Orientation of the segment insertion slots at each end of the sleeve is important for ease of assembly. The slots should be oriented as shown in Figure 2.

Gasket Installation

Telescoping Sleeves utilize the conventional TYTON® Gasket for 4" through 64" sizes.

Clean the sockets of all dirt, sand, gravel or other foreign material.

Clean the gasket and place it with the rounded bulb end entering first, into the socket. Do not apply joint lubricant to the seating surface under the gasket. Loop the gasket as shown in Figure 3. Smaller gaskets (4" through 20") usually require only one loop. With larger sizes, additional loops may be required: 24" through 54", four to six loops; 60" and 64", six or more loops.

The inside of the socket, the gasket and the plain end to be inserted, must be kept clean throughout the assembly. If the joint is somewhat difficult to assemble, inspect for proper gasket positioning, adequate lubrication or foreign material in the joint.

Press the loop(s) of the gasket so that the gasket is uniformly seated in the socket.

Apply TYTON JOINT® Lubricant to the exposed surface of the gasket. In warm, dry weather conditions, the lubricant can dry out, especially when applied to warm or hot pipe, it will be necessary to add a small amount of water to hydrate the lubricant. Only TYTON JOINT Lubricant should be used.

CAUTION: *The use of spray-on lubricant is not recommended. Experience has determined that spray-on lubricant may not have sufficient lubricity to allow joint assembly without gasket displacement.*

In subfreezing weather, gaskets should be kept at temperatures above 40°F, to ensure resiliency during installation. The gaskets should be stored in a warm location or immersed in warm water prior to installation. Gaskets which have been immersed should be dried before installation.

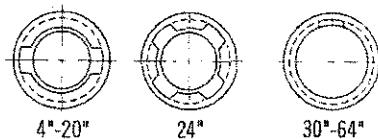


Figure 2. Slot Orientation

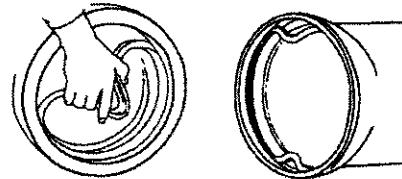
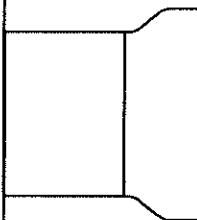


Figure 3. For illustration only — gasket seat of Telescoping Sleeves is located farther back inside socket.

NOTE: *If specifiers or users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Ductile Iron Pipe Systems" for proper external protection procedures.*

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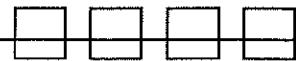


TR FLEX® and HP LOK® Telescoping Sleeves



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Telescoping Sleeve Assembly

Clean the plain end of the pipe to be inserted into the telescoping sleeve. Apply a heavy film of TYTON JOINT® Lubricant from the end of the pipe to the weld bead. Do not allow the lubricated plain end to touch the ground.

For TR FLEX Sleeves, insert each of the special plain ends into the telescoping sleeve until the plain end bottoms out in the socket. Insert the TR FLEX locking segments and the rubber segment retainers into the ends of the telescoping sleeve. For HP LOK Sleeves, the locking rings are factory installed. Ensure that the jack bolt in the locking ring handles is in the expanded position (i.e., the handles are apart and have the ring snug in the bell). Insert each of the special plain ends into the telescoping sleeve until each plain end bottoms out in the socket. Remove the jack bolt and install the tensioning bolt so that the locking ring ears can be brought together thus snugging the ring against the plain end. These bolts should only be snugged up to bring the ring in contact with the plain end. The bolts will be torqued once the sleeve has been installed.

The installation should be made as soon as possible after the assembly of the sleeve to ensure that the joint lubricant has not dried.

As a Closure Piece

With the telescoping sleeve assembled unit in the closed (telescoped in) position, lay the unit between the two pipe plain ends or bells which are to be joined. For TR FLEX, first make the joint assembly on one end and insert the TR FLEX locking segments and rubber retainer(s). Then make the assembly on the other end by pulling out the telescoped joint. Insert the locking segments and rubber retainer(s) on that end and the installation is complete. For HP LOK, first ensure that the locking ring is fully expanded and make the joint assembly. Remove the jack bolt and install the tensioning bolt so that the locking ring ears can be brought together thus snugging the ring against the plain end. Then make the assembly on the other end by pulling out the telescoped joint. Remove the last jack bolt and install the tensioning bolt so that the locking ring ears can be brought together thus snugging the ring against the plain end. The bolts may now be torqued.

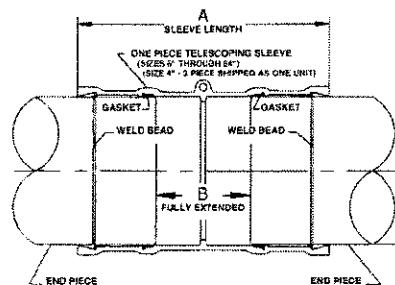


Figure 4. TR FLEX.

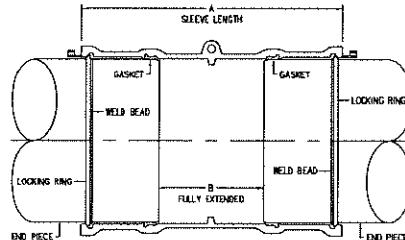
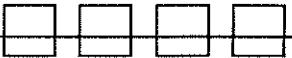
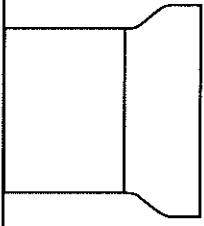


Figure 4b. HP LOK.



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Telescoping Sleeve Assembly (cont.)

As an Expansion Joint (To Allow Elongation of a Line)

If it is required that the sleeve be used as an expansion joint, the sleeve should be installed in the telescoped in position and left in that position.

The sleeve should be encased in polyethylene wrap prior to the installation to keep the surrounding soil out of the components.

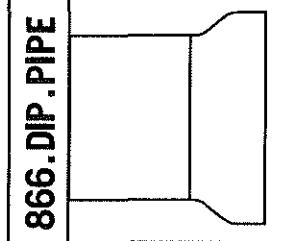
If it is required that the sleeve have both expansion (elongation) and contraction capability, the sleeve should be pulled apart approximately half of it's telescoped distance (the gap length B given in Table I). It is very important to thoroughly compact the soil around a partially extended Telescoping Sleeve before continuing the installation or pressurizing the pipeline.

The telescoping sleeve will not resist axial thrust forces when installed in this position.

THE SLEEVE WILL BECOME RESTRAINED ONLY WHEN THE TOTAL EXPANSION OR ELONGATION OF THE SLEEVE HAS BEEN ATTAINED.

As a Contraction Joint (To Allow Contraction of a Line)

A fully extended sleeve will allow for contraction in a line at the sleeve. The fully extended sleeve will withstand axial thrust loads. As noted above, the sleeve should be encased in polyethylene wrap to keep the surrounding soil out of the components. After the connecting pipe are joined to the sleeve unit, the joints should be pulled out to the fullest extent possible. The sleeve and adjacent piping should then be backfilled to prevent the sleeve from telescoping in as subsequent pipe are laid.



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Field Cut Pipe

The special pipe sections required for the telescoping sleeve can be fabricated in the field using the following procedure.

Determining End Piece Lengths For Closures

In order that the laying lengths of the end pieces of the telescoping sleeve may be calculated, the laying length of the closure piece required must be measured. This length (L) is determined by measuring from the end of the plain end to the base (or deepest shoulder) of the socket as shown in Figure 5.

With the required closure piece laying length known, the laying length of the pipe end pieces for the telescoping sleeve can be calculated. The combined laying length of both pieces will be shorter than the length measured for the closure, since, as installed, the extended telescoping unit will have a gap between the ends of the pipe inside the telescoping sleeve. The length of this gap must be subtracted from the combined length of both end pieces to determine the combined cut length required. The gap length (B), shown in Figure 6, is given in Table 1, Column B.

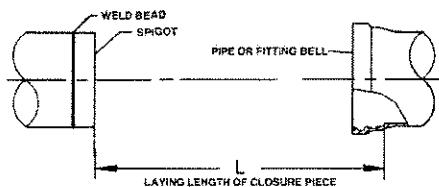


Figure 5.

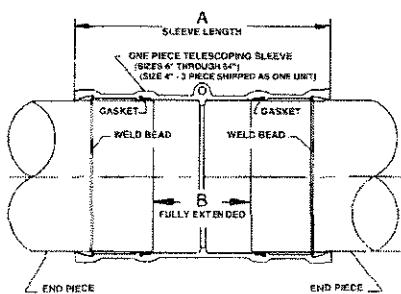


Figure 6a. TR FLEX.

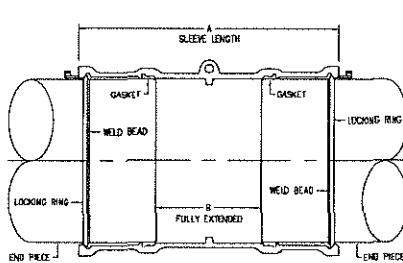
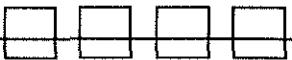
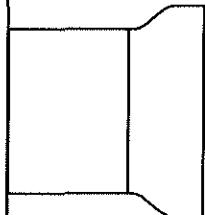


Figure 6b. HP LOK.



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TR FLEX® and HP LOK® Telescoping Sleeves



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Gap and Laying Lengths

Table 1.

SIZE Inches	A SLEEVE LENGTH Inches	B MAXIMUM GAP LENGTH Inches	C WELD BEAD OR BAR LOCATION FROM SPIGOT END Inches	D UNIT MINIMUM EXTENDED LAYING LENGTH Inches	E END PIECE MINIMUM LAYING LENGTH Inches
4	29.10	10.68	7.72	49.24	19.28
6	31.70	11.54	8.39	53.40	20.93
8	35.48	12.64	9.49	58.90	23.13
10	37.14	13.06	9.96	61.04	23.99
12	38.96	13.60	10.33	63.36	24.88
14	46.26	16.50	12.38	75.96	29.73
16	49.00	17.10	13.25	79.10	31.00
18	49.40	17.88	12.82	79.98	31.05
20	50.80	18.44	13.03	81.80	31.68
24	53.60	19.40	13.49	85.50	33.05
30 ^t	58.60	23.47	15.51	105.47	41.00
36 ^t	61.30	24.80	16.20	108.80	42.00
42 ^t	58.20	22.00	15.51	110.04	43.00
48 ^t	63.31	23.21	17.20	107.21	42.00
54 ^t	61.80	22.99	16.62	106.93	42.00
60 ^t	62.74	23.30	16.94	107.30	42.00
64 ^t	65.00	24.08	17.73	124.08	50.00

^t: HP LOK

NOTE: If a Telescoping Sleeve is to be used within two full pipe lengths of a bend, subtract an additional joint pull out from the lay length of the required closure piece. (i.e. in the example below with the 16" pipe connecting into a fitting bell the closure piece would be: 172.40" - .6" = 171.80" then divide this by 2 equaling a lay length for each piece of 85.90" instead of 86.20" as shown in Figure 7). This procedure prevents the bend from being over rotated or deflected.

Example:

A closure piece is required between a 16" TR FLEX Pipe Bell and TR FLEX Pipe Spigot. The laying length (L) of the required closure piece is measured to be 15'-9-1/2" or 189.50" long.

The gap length (B in Figure 6) of a 16" sleeve from Table 1 is 17.10" long. The combined laying length of the two pieces of pipe used in the telescoping sleeve must be 17.10" shorter than the measured closure length of 189.50" as follows:

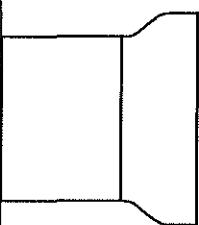
$$189.50" - 17.10" = 172.40"$$

It is usually best to position the telescoping sleeve in the middle of the unit; therefore, the laying length of each pipe would be half that value or,

$$172.40" \div 2 = 86.20"$$

For this example a bell x plain end piece and plain end x plain end piece, each with a laying length of 86.20", would be required as shown in Figure 7.

The minimum end piece laying length that can be produced is also given in Column E, Table 1, and the minimum laying length which can be produced of the telescoping sleeve assembled unit is given in Column D.



TR FLEX® and HP LOK® Telescoping Sleeves



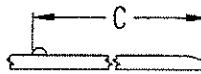
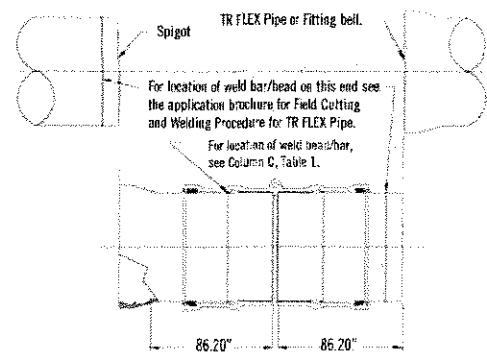
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Field Applied Bar

For field cut pieces, a bar must be welded around the pipe end at the location shown in Figure 7, (Column C, Table 1, Page 8). For field cutting and welding of TR FLEX® Pipe, follow the guidelines given in U.S. Pipe's brochure, Field Cutting and Welding Procedure for TR FLEX Pipe.

For field cutting and welding of HP LOK Pipe, follow the guidelines given in U.S. Pipe's brochure, Field Cutting and Welding Procedure for HP LOK Pipe.

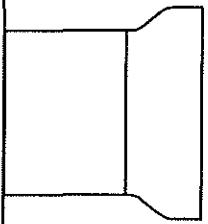


WELD LOCATION

Figure 7.

NOTE: *It is imperative that pipe cut in the field be within the O.D. tolerances as given in Table 1 of U.S. Pipe's brochure, Field Cutting and Welding Procedure for TR FLEX® Pipe.*

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TR FLEX® and HP LOK® Telescoping Sleeves



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Ordering Information

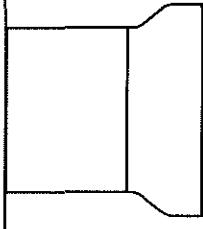
A standard Telescoping Sleeve Unit consists of two sections of pipe and a telescoping sleeve. Standard Telescoping Sleeve Units are furnished with pipe sections cut from one full length of Pipe. They are ordered by specifying a Telescoping Sleeve Unit and the diameter required.

Special Telescoping Sleeve Units are ordered by specifying the pipe diameter, the end configurations and the extended laying length required.

A Telescoping Sleeve (without the pipe sections) can be ordered by simply specifying a Telescoping Sleeve and the diameter required.

Field weldment bars, kits and instructions are available from U.S. Pipe. (See U.S. Pipe Brochure, Field Cutting and Welding Procedure for TR FLEX® Pipe) or Field Cutting and Welding Procedure for HP LOK Pipe.

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TR FLEX® and HP LOK® Telescoping Sleeves



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Products for Water, Wastewater and Fire Protection

	SIZE RANGE
Ductile Iron Pipe	
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-36" Ductile Iron
HP LOK® Pipe	30"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
Grooved Pipe	4"-36" Ductile Iron
USIFLEX® Boltless Ball Joint Pipe For Subaqueous Installations	4"-48" Ductile Iron

Restrained Joints

TR FLEX® Restrained Joint	4"-36" Ductile Iron
HP LOK® Restrained Joint	30"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350° Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELE FLEX® Assemblies	4"-24" Ductile Iron

Fittings

TYTON® Fittings	14"-24" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-36" Ductile Iron
HP LOK® Fittings and HP LOK® Telescoping Sleeves	30"-64" Ductile Iron
Mechanical Joint Fittings	30"-48" Ductile Iron
Flanged Fittings	30"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron

Miscellaneous Products

PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
GLASS Lined Ductile Iron Pipe for Wastewater Treatment Plants	4"-30" Ductile Iron
RING FLANGE-TYTE® Gaskets	4"-36"
FULL FACE FLANGE-TYTE® Gaskets	4"-64"
MJ Harness-Lok	4"-48" Ductile Iron
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.

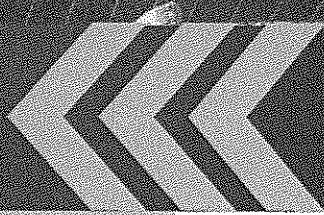
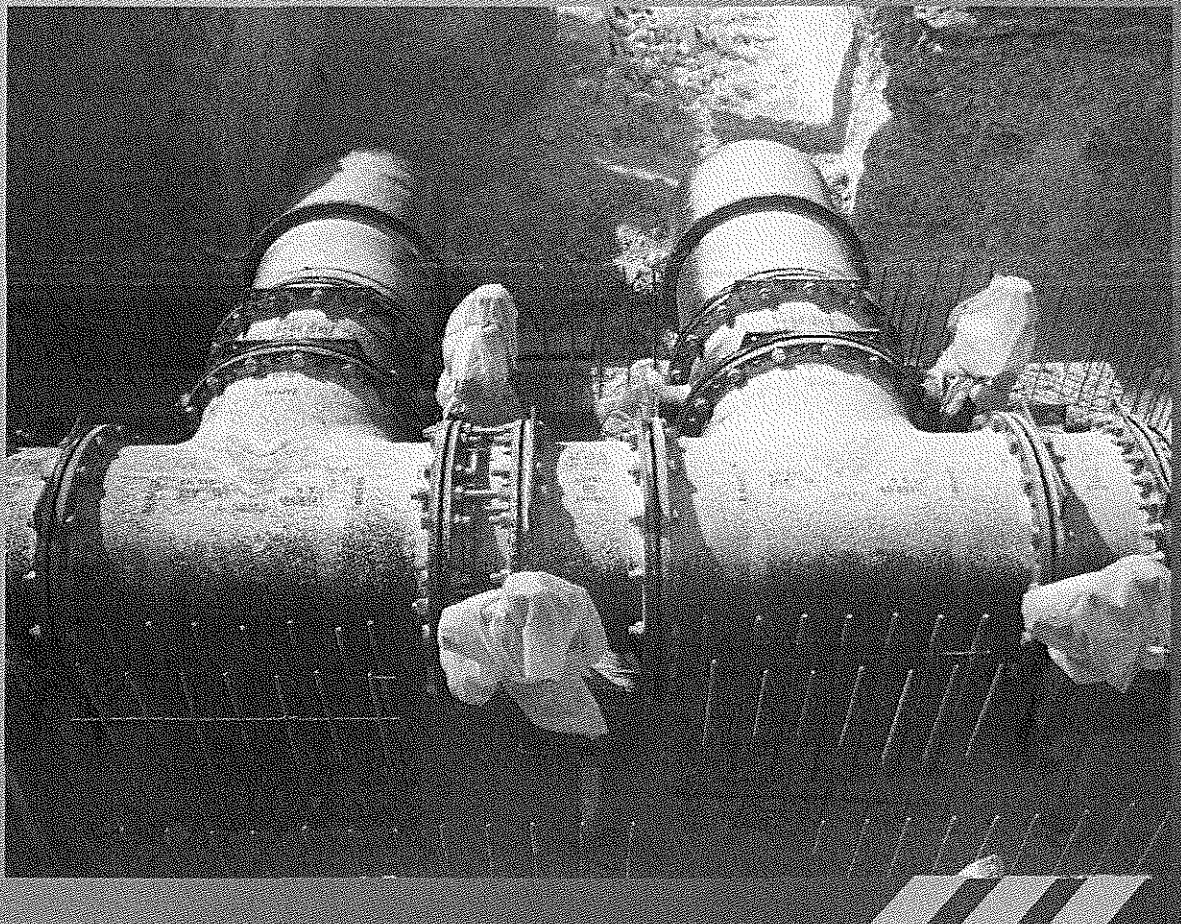
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GTC / 626A / 2014

*Construction of Mega Reservoir PRPS
at Umm Birka
Package A*



Technical proposal for supply of valves

SAINT-GOBAIN

08/07/2014

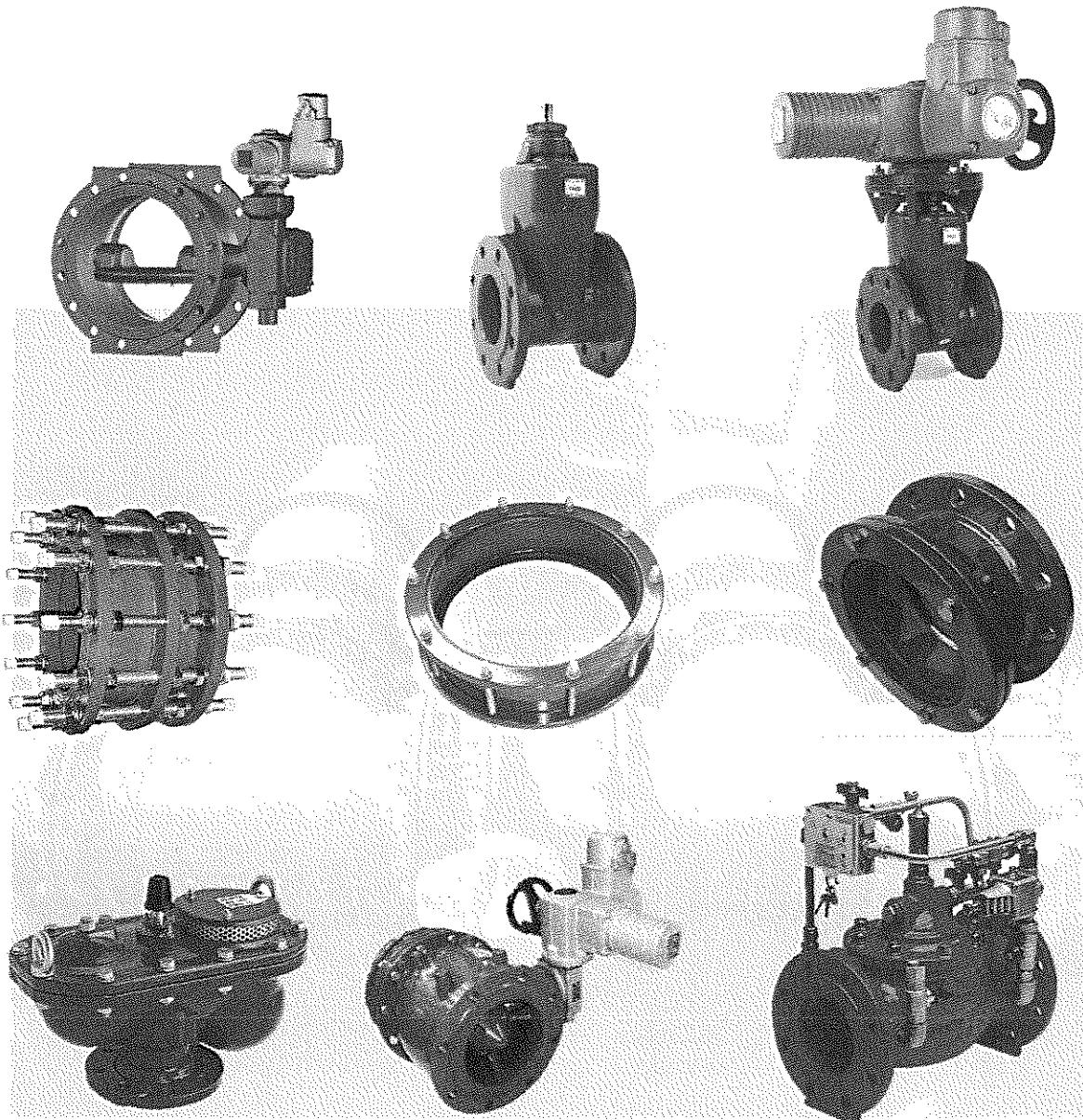
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GTC / 626A / 2014

*Construction of Mega Reservoir PRPS at Umm Birka
Package A*

VALVES



QATAR	MO 14 QAT 141 R 07/2014
GTC / 626A / 2014 <i>Construction of Mega Reservoir PRPS at Umm Birka Package A</i>	VALVES

SUMMARY

1. Isolating Valves :

- BUTTERFLY VALVES MOTORIZED REINFORCED VERSION DN 150-2000 PN 16 + EXTENSION SPINDLE + HEADSTOCK
- EURO 23 MANUAL REINFORCED VERSION DN 80-300 PN 16 +
EURO 23 MOTORIZED REINFORCED VERSION DN 200-300 PN 16 + MITRE GEAR

2. Couplings, adaptors and sleeves :

- DISMANTLING JOINT TYPE PO REINFORCED VERSION DN 100-2200 PN 16
- LINK GS REINFORCED VERSION DN 150-2200 PN 25
- QUICK GS REINFORCED VERSION DN 100-1600 PN 16

3. Pipeline Protection :

- AIR RELEASE VALVE TYPE VENTEX REINFORCED VERSION DN 80-150 PN 16
- NEEDLE VALVE MOTORIZED DN 800 PN 16
- PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00 REINFORCED VERSION DN 500 PN 16

4. Certificates :

QATAR	MO 14 QAT 141 R 07/2014
GTC / 626A / 2014 <i>Construction of Mega Reservoir PRPS at Umm Birka Package A</i>	ISOLATING VALVES

1. Isolating Valves :

- BUTTERFLY VALVES MOTORIZED REINFORCED VERSION DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK
- EURO 23 MANUAL REINFORCED VERSION DN 80-300 PN 16 +
EURO 23 MOTORIZED REINFORCED VERSION DN 200-300 PN 16 + MITRE GEAR

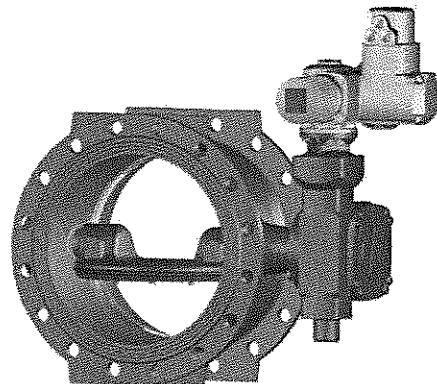
ISOLATING VALVES



Réf : MO 14 QAT 141 R
Date : 07/2014

BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK

BUTTERFLY VALVE MOTORIZED



Butterfly valves are used as isolating devices on aqueducts, waterworks and hydroelectric plants.

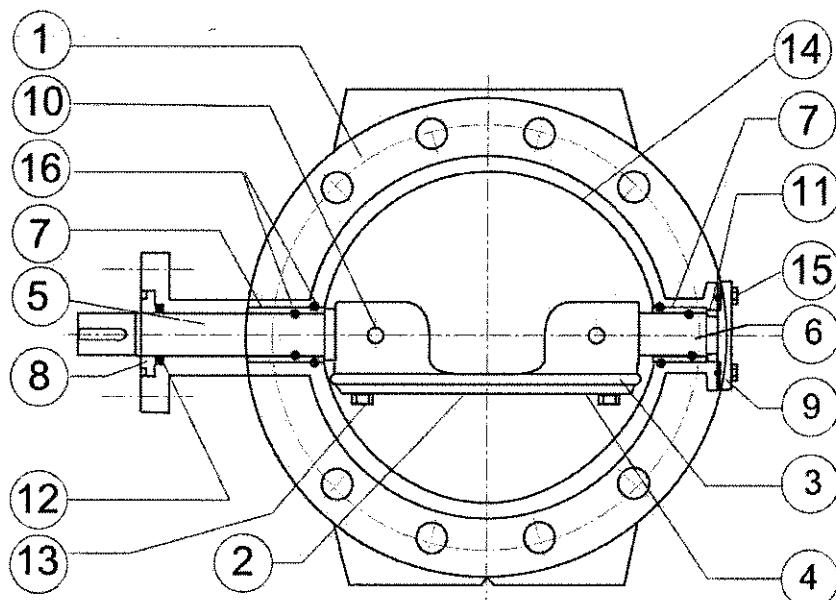
Butterfly valves have low head loss with valve in completely open position and warranty of perfect seal with valve in completely closed position. Moreover they can be used as safety valves.

RANGE

The EUROSTOP butterfly valve is available in different configuration: motorizable, motorized, and manual or buried service (for these three configurations see the specific TDS).

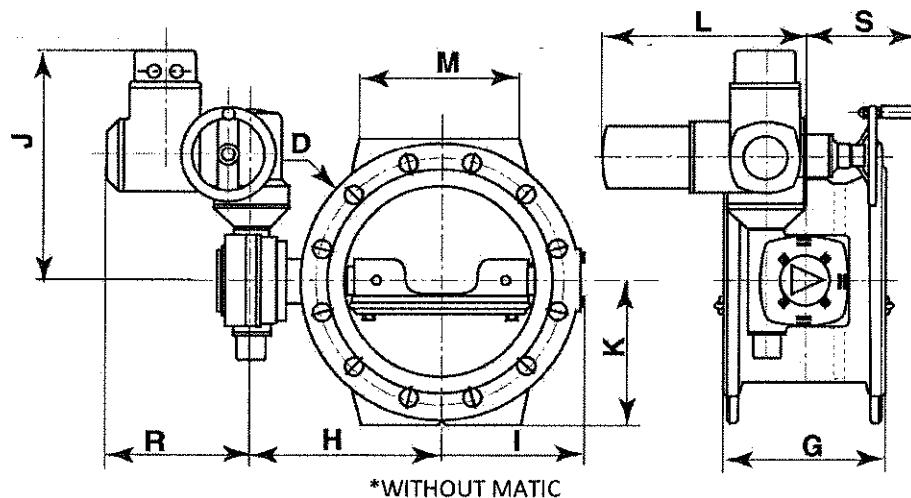
There's also the possibility to use it as safety valve with counterweight closing system (see the specific TDS).

MATERIAL AND COATING



Ref.	Description	Material	Coating
1	Body	Ductile Iron GS500-7	Epoxy powder Thickness mini 300 microns
2	Disc	Ductile Iron GS500-7	
3	Sealing ring	EPDM	-
4	Retaining ring	Stainless Steel AISI 316L	-
5	Shaft	Stainless steel DUPLEX EN 10088 1.4462 (X2CrNiMoN 22-5-3)	-
6	Spindle		-
7	Bearings	Bronze EN 1982 CuSn12	-
8	Ring	Gunmetal EN 1982 CuSn5Zn5Pb5	-
9	Rear cover	Steel type SR235JR	Epoxy powder Thickness mini 300 microns
10	Taper pin	Stainless steel EN 10088-3 X5CrNiCuNb 16-4 (630)	-
11	Lock nut	Gunmetal EN 1982 CuSn5Zn5Pb5	-
12	Sealing element	PTFE	-
13	Internal Screw	Stainless steel type A4	-
14	Body seat ring	Stainless steel EN 10088-2 X2CrNiMo 17,12,2 (316L)	-
15	External Screw	Stainless steel type A4	-
16	O-ring gasket	EPDM WRAS 60	-

DIMENSIONS AND MASS



DN	G	H	I	J	K	L	M	D	R	S	Mass
150	210	215	146	375	143	315	150	285	237	199	56
200	230	240	175	375	170	315	180	340	237	199	67
250	250	294	217	401	200	328	230	400	237	186	92
350	290	342	287	406	260	362	260	520	247	174	161
500	350	470	370	535	358	365	320	715	237	149	294
600	390	550	456	542	420	407	300	840	247	129	449
800	470	713	602	618	513	442	450	1025	247	94	855
900	510	764	653	748	563	482	550	1125	247	54	1125
1200	630	950	852	844	743	634	750	1485	285	79	2408
1400	710	1125	973	100	843	597	850	1685	247	-	3615
1600	790	1229	1119	1041	965	699	950	1930	285	14	4967
2000	950	1526	1367	1141	1173	784	1050	2345	285	-	8404

Dimension in mm

Mass in kg

ISOLATING VALVES



Réf : MO 14 QAT 141 R
Date : 07/2014
**BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK**

DOUBLE ECCENTRICITY

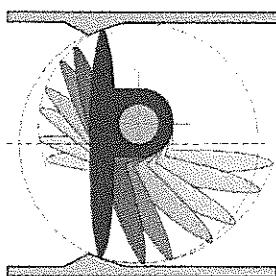
The disc shaft does not pass through the body-seat ring

- It provides continuous seating => better tightness

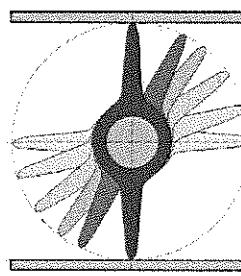
Berth positioning of the disk on the seat-ring is shorter than butterfly without eccentricity:

- Less friction between rubber and seat
- Less stress on rubber

DOUBLE ECCENTRICITY



WITHOUT DOUBLE ECCENTRICITY



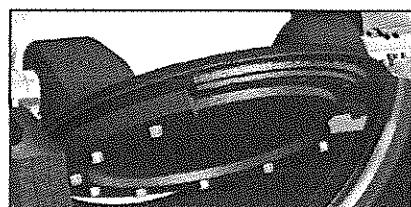
TECHNOLOGY OF AUTOMATIC GASKET

Design of exclusive BBJPA automatic gasket:

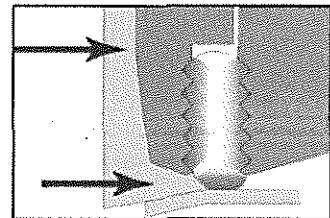
IN ADDITION TO DOUBLE EXCENTRATION:

- To guarantee the tightness in the 2 WAYS of flow
- To diminish rubber stress and friction
- To be easily replaceable
- The automatic gasket has been designed and developed by Saint-Gobain PAM

➤ A unique patented technology



Design with an EPDM automatic gasket:

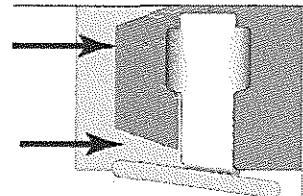


Classical Mechanical gasket: an old technology

Most of rubber is pressed between the disc and the retaining ring to fix it.
An adjustment of the gasket compression is necessary to enable it to get the tightness during factory test.
Life time is reduced due to permanent compression
Tightness on site is not guaranteed due to relaxation of rubber gasket.

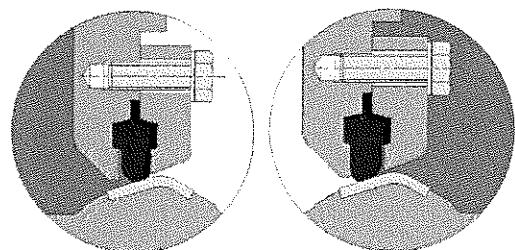
BBJPA Automatic gasket:

Only the inner ring is compressed between the disc and the retaining ring.
No adjustment required.
All other rubber surfaces are free of stress.
Space between rubbers enables water pressure to push the gasket seat tightness
Long-lasting system and 2 ways tightness

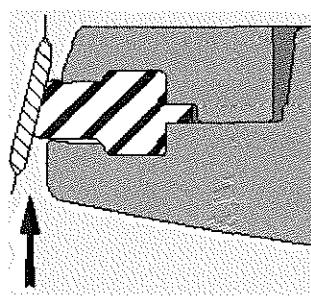
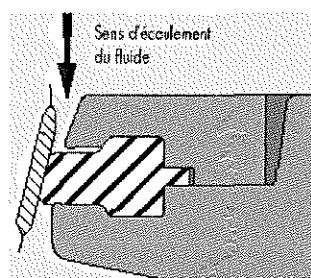


Unique gasket design gives BBJPA a unique tightness efficiency:

- Efficiency in the 2 WAYS OF FLOW
- Efficiency whatever the pressure is
- Efficiency in saving stress of rubber
- Efficiency in life time due to self-adjustment of the gasket



- Reduces friction
- Improves the operating torque
- Increases seal life time

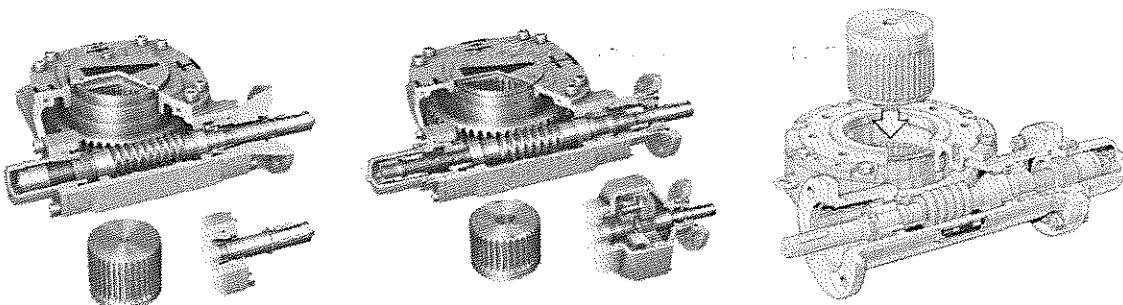


ISOLATING VALVES



Ref : MO 14 QAT 141 R
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**BUTTERFLY VALVES MOTORIZED
 REINFORCED VERSION
 DN 150-2000 PN 16 +
 EXTENSION SPINDLE + HEADSTOCK**

GEARBOX TYPE AND HANDWHEEL



GS 50.3 to 125.3

GS 160.3 and 250.3

GS 315 and 400

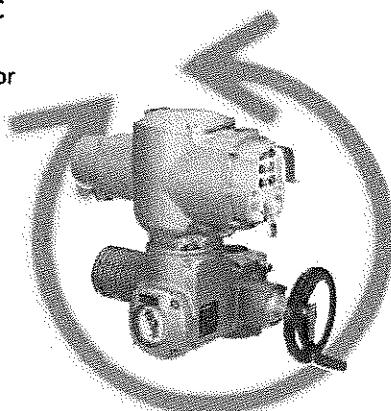
*Pictures represented without coatings. The real coatings will be in blue epoxy powder.

MOTORIZED:

DN	Gearbox AUMA Type	Actuator AUMA Type	ISO 5210	Operating Time (s)	Speed (rpm)	Operating Torque (Nm)
150	GS 50.3 - F10	SA 07.6	F 10	35	22	8
200	GS 50.3 - F10	SA 07.6	F 10	35	22	17
250	GS 63.3 - F10	SA 07.6	F 10	48	16	30
350	GS 80.3 - F12	SA 10.2	F 10	72	11	60
500	GS 100.3+VZ4.3 - F14	SA 07.6	F 10	98	32	33
600	GS 125.3+VZ4.3 - F16	SA 10.2	F 10	142	22	57
800	GS 160.3+GZ160.3 - F30	SA 10.2	F 10	147	45	64
900	GS 160.3+GZ160.3 - F30	SA 10.2	F 10	206	63	48
1200	GS 250.3+GZ250.3 - F35	SA 14.2	F 14	202	63	104
1400	GS 315+GZ30 - F40	SA 10.2	F 10	283	90	65
1600	GS 315+GZ30 - F40	SA 14.2	F 14	283	90	94
2000	GS 400+GZ35 - F48	SA 14.2	F 14	411	63	161

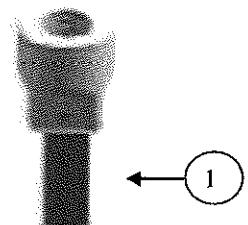
BASIC EQUIPMENT OF ACTUATOR AUMA SA WITH AUMA-MATIC

- Power supply: 415 V three-phase current - 50 Hz.squirrel cage AC motor
- Clockwise closure direction
- Motor duty type : short time duty S2-15 minutes
(According to IEC 34-1) code SA 60 starts/h
- Integral local / remote control type AUMA-MATIC
- Electronic position transmitter 4-20 mA
- Enclosure IP68 according to EN 60529

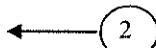


EXTENSIONS SPINDLES + HEADSTOCKS

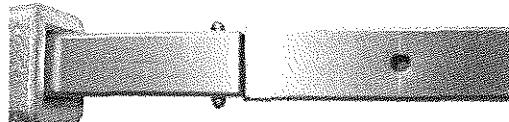
Extensions are delivered into two three parts: adjustable extension spindle, keywayed coupling. You must carry out their assemblies.



Item	Description	Material
1	Upside keywayed coupling for headstock attachment Ø20 for DN 500-600-800-900 Ø30 for DN 1200	Ductile malleable iron EN GJM 400-5 GTW 40 with normal galvanising
2	Adjustable extension spindle steel	Stainless steel V2A 1.4301 X5 CrNi 18-10
3	Downside keywayed coupling for valve attachment Ø20 for DN 500-600-800-900 Ø30 for DN 1200	Ductile malleable iron EN GJM 400-5 GTW 40 with normal galvanising

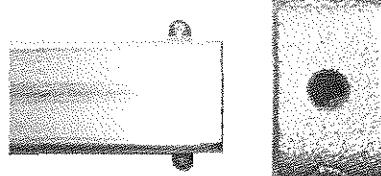
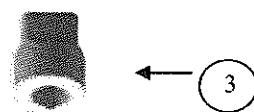


Size of the different extension:	
XXS	0.30 to 0.45m
XS	0.50 to 0.75m
L	1.20 to 2.15m
XL	1.50 to 2.75m
XXL	1.90 to 3.55m



Upside coupling

Fitment with double balls-spring system



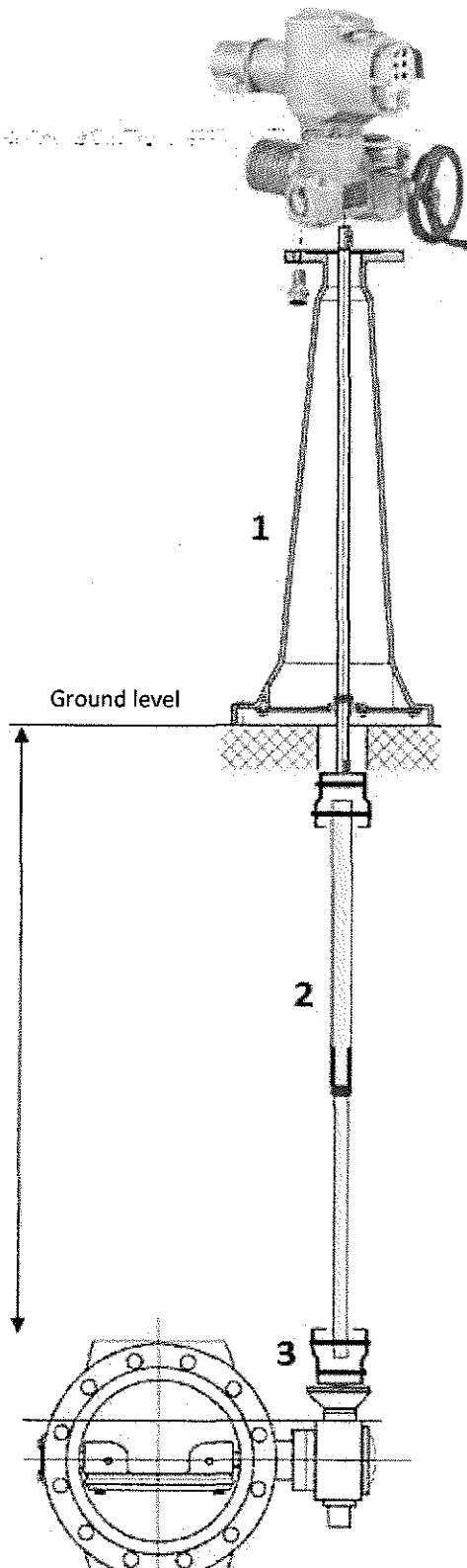
Downside coupling

ISOLATING VALVES



Réf : MO 34 QAT 141 R
Date : 07/2014
**BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK**

AUMA MATIC



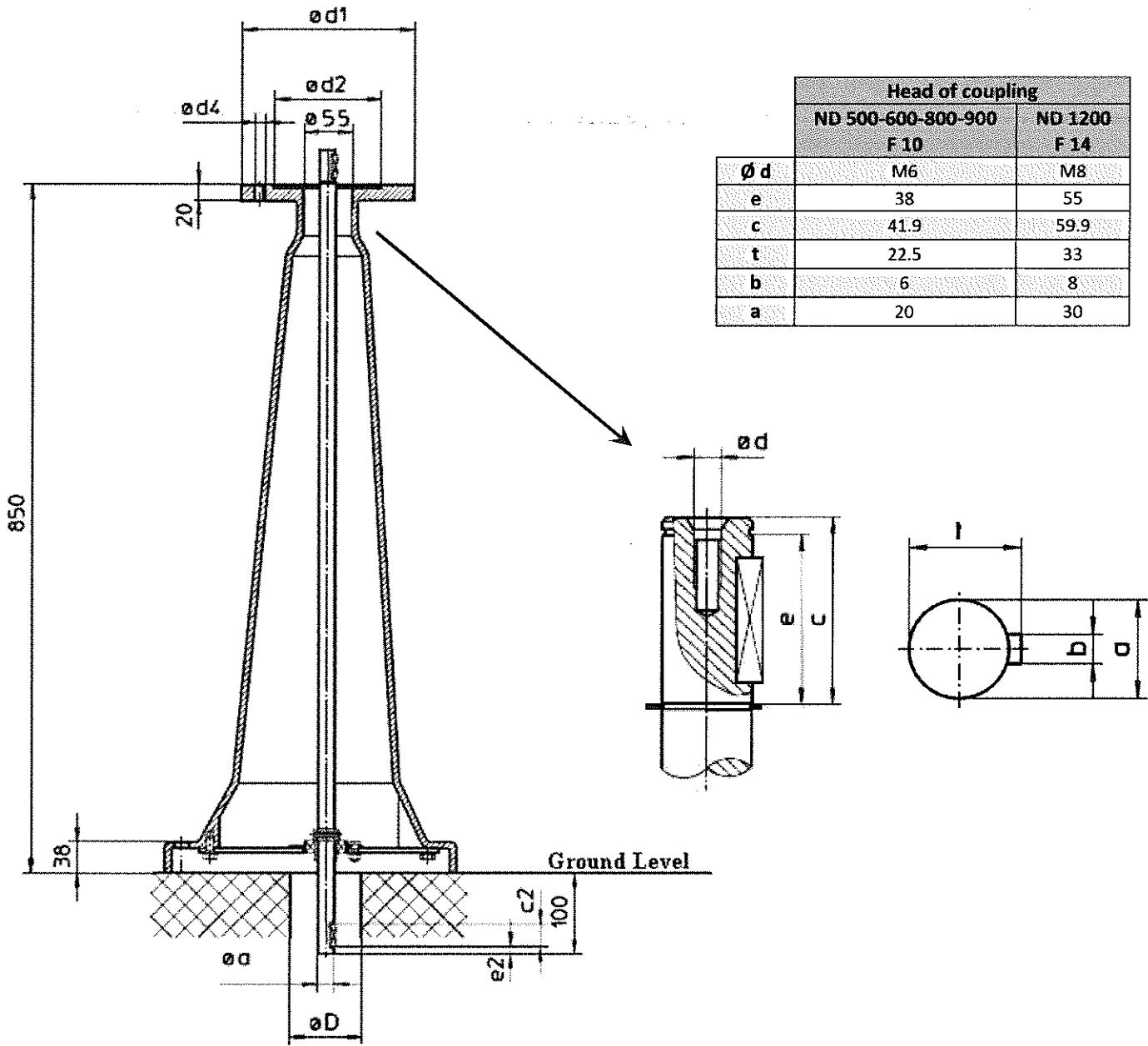
Butterfly valve

Item	Description
1	Headstock
2	Extension Spindle
3	Operating coupling keyed Ø20 (or Ø30 for DN 1200)

ISOLATING VALVES



Ref : MO 14 QAT 141 R
 Date : 07/2014
**BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK**



Valve attachment depending on DN		
	DN 500-600-800-900 F 10	DN 1200 F 14
$\varnothing d_1$	125	17
$\varnothing d_2$	70	100
$\varnothing d_4$	11.5	18
e2	9	7
c2	28	45
$\varnothing D$ min.	85	100

ISOLATING VALVES	 SAINT-GOBAIN	Ref : MO 14 QAT 141 R Date : 07/2014
BUTTERFLY VALVES MOTORIZED REINFORCED VERSION DN 150-2000 PN 16 + EXTENSION SPINDLE + HEADSTOCK		

APPLICABLE STANDARDS

TESTS

Hydraulic test

Every single butterfly valve is subjected to hydraulic final test with the purpose of verifying the accordance with the prescriptions ISO 5208:

- Body test at 1,5 time the PFA (open valve);
- Seat test at 1,1 time the PFA (closed valve).

Product test

- Control of manoeuvre torque (MOT and mST) as defined in the EN1074.
- Control of coating: test of thickness, holiday test, impact test, MIBK test.

CONFORMITY TO STANDARDS

Product:

- EN 1074 – 1 and 2
- EN 593
- ISO 10631

Plant test:

- ISO 5208

Flanges dimension:

- ISO 5752 **SERIES 14**

Flanges drilling:

- EN 1092-2
- ISO 7005-2

Suitability for potable water :

- Italian CM 102 of 02/12/78
- Conformity
- to foreign norms: KTW (Germany), WRC (U.K.), ACS (France)

MARKING

On the body like EN19:

- Nominal diameter in mm (DN);
- Nominal pressure in bar (PN);
- Type of ductile iron;
- Manufacturer's logo;
- Model code;
- Fusion date.

ISOLATING VALVES	PAMO SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014 BUTTERFLY VALVES MOTORIZED REINFORCED VERSION DN 150-2000 PN 16 + EXTENSION SPINDLE + HEADSTOCK
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On the label like EN19:

- Nominal diameter in mm (DN);
- Nominal pressure in bar (PN);
- Maximum operating pressure (PFA);
- Closing direction;
- Model code;
- Manufacturing order, Order confirmation;
- Manufacturer's logo.

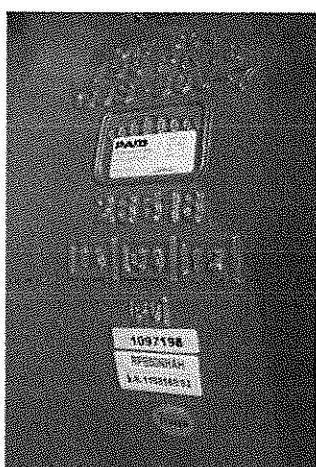
On the disc:

- Nominal diameter in mm (DN);
- Nominal pressure in bar (PN);
- Type of ductile iron;
- Manufacturer's logo;
- Model code.

The marking of the valves manufactured by Saint-Gobain refers to the EN 1074-2 and EN 19 international standards.

Markings are either integral markings, cast in the body, or markings made on plates, securely fixed to the body, in accordance with the EN 19 standard specifications.

EN 19 specifications		Requirements	Saint-Gobain valves process
Table 1 – Valve markings			
1	DN	EN 19 § 4.2.1	Integral
2	PN	Mandatory markings	Integral
3	Material	Shall be integral	Integral
4	Manufacturer's name or trade mark	markings or on a marking plate	Plate
11	Reference to standard	EN 19 § 4.3 Supplementary markings	Plate
12	Melt identification		Integral
16	Quality Test		Printed on body
18	Manufacturing date	Items 7 to 21 in Table 1 are optional	Plate
21	Closing direction		Plate + sticker on body



VALVE SELECTION

The butterfly valves are generally used as isolating devices type on/off. In some particular case, in which there are low differences of pressure and low flow rate variation can be used like regulating devices, considering the hydraulic parameters necessary to avoid the cavitation risk.

To do the right dimensioning of butterfly valve it's necessary to know the followings parameters:

- Upstream hydrostatic pressure (that is the hydrostatic pressure with valve in closed position)
- The maximum speed in water pipe (generally expressed in l/s) or the nominal diameter and the project flow rate from which it is gained the speed $V=Q/A$

Moreover it's necessary to control that the maximum speed in water pipe have to be equal or inferior to 5m/s, and the exercise temperature have to be between 0° C and 40° C.

HYDRAULIC FEATURES

The head loss Δh are variable in function of valve open degree and can be calculated with the following expression:

$$\Delta h = \frac{\zeta \cdot v^2}{2 \cdot g}$$

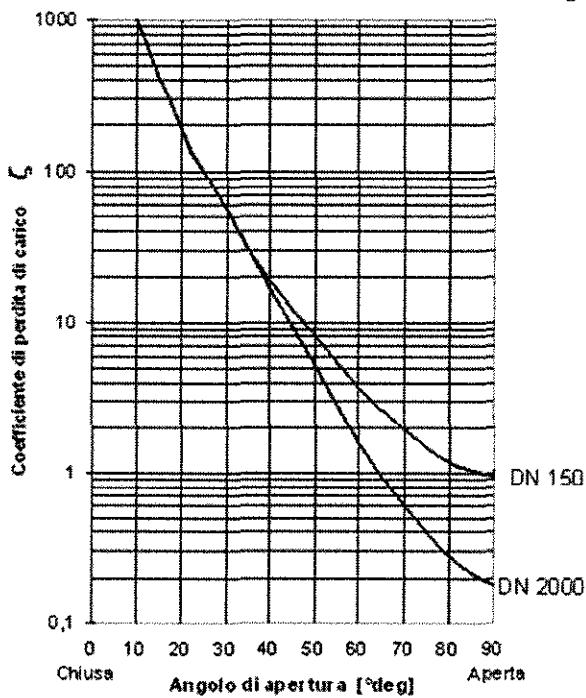
Δh = head loss [m]

ζ = head loss coeff. [dimensional]

v = nominal speed [m/s]

g = 9,81 [m/s²]

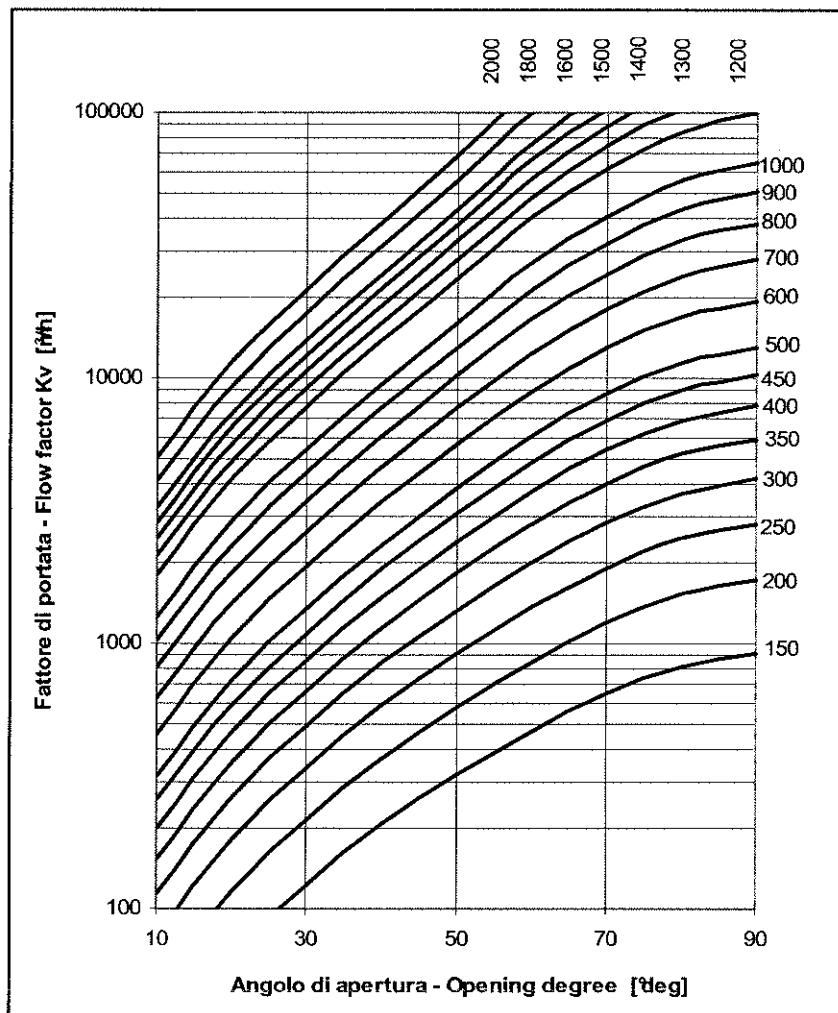
The head loss coefficient can be estimated from this diagram:



Determines the head loss Δh it's possible to calculate the flow rate Q in m^3/h with the following expression (the same expression can be used to, having the project flow rate Q , to determinate the head loss Δh without using the head loss coefficient):

$$Q = Kv \sqrt{\frac{\Delta h}{10.2}}$$

In which 10,2 is a corrective factor in meters, and Kv is the flow rate coefficient in m^3/h , determinable from the following diagram in function of valve open degree:



Example:

Valve DN 600 mm - $\Delta h = 3$ m

From the diagram with valve open to 100% the coefficient Kv is $20000 m^3/h$. Using this date in the flow rate expression:

$$Q = 20000 \sqrt{3/10.2} = 10850 m^3/h$$

ISOLATING VALVES

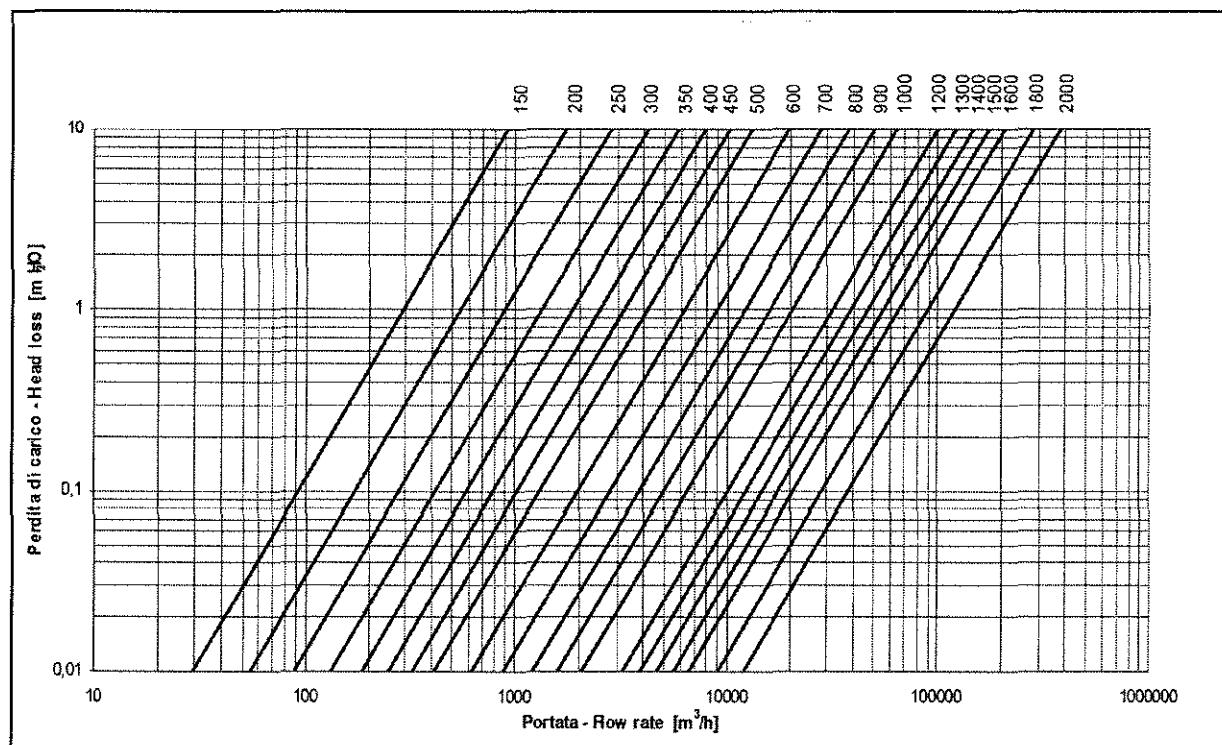


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BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK

Otherwise it's possible to calculate the head loss with valve completely open, having the project flow rate Q , in function of DN, using the following diagram:



INSTRUCTIONS FOR USE

Storage

The butterfly valve will have to be held (if possible) in covered places, the most possible protected from the sun (maximum allowable temperature 70°C in accordance to EN 1074), from the rain and generally from the atmospheric agents. Moreover it will have to be avoided that the seal of the same air valves come to contact with powder or earth.

Installation

The butterfly valves are generally installed with retaining ring mounted in the opposite way respect to the direction of flow rate to permit the substitution of gasket without dismounting the valve from pipeline. In any case it's possible to install the butterfly valve with flow rate in opposite direction and also, if required, in vertical position. We recommend installing the butterfly with the operating device on the hydraulic right side of pipeline.

It's possible to install the butterfly valve both in chamber valve that underground (choosing the right configuration).

We recommend inserting a dismantling joint for the operation of maintenance.

ISOLATING VALVES



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BUTTERFLY VALVES MOTORIZED
REINFORCED VERSION
DN 150-2000 PN 16 +
EXTENSION SPINDLE + HEADSTOCK

Maintenance

The butterfly valve does not require a particular maintenance; all parts subjected to wear are perfectly auto-lubricating. In any case, if for a long time will be not used, it's necessary to evaluate the functioning of valve doing (at least one time for year) some manoeuvre of opening-closing.

All the maintenance operation have to be done after the total emptying of pipeline (no flow rate and pressure) to avoid every risk to the people during this operation.

In presence of particularly exercise condition or damage due to external cause, it will be necessary some maintenance operation. In this case the particular shape of EUROSTOP butterfly valve permits the simple gasket substitution without the dismounting of valve from pipeline (if the dismounting joint is present).

ACCESSORIES

To adaptate the butterfly valves to the differente exercise and installation conditions requireds, they can be equipped with particular accessoires utilizable in combination with control devices:

- Please refer to "Reference Help Accessories"

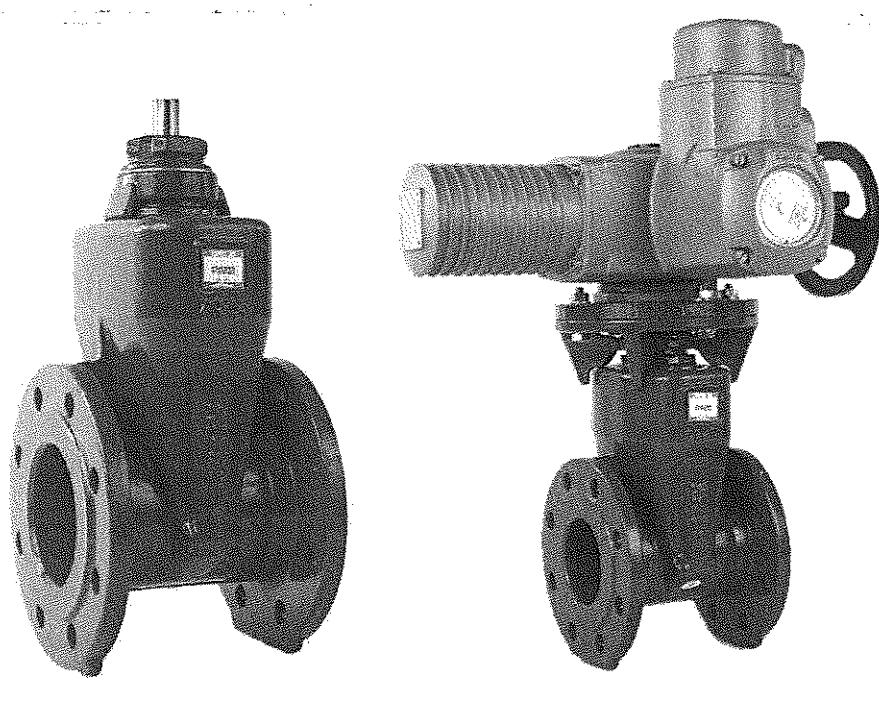
The technical features in this document are not contractual and can be changed without preliminary notification due to the continuous technical progress of product.

ISOLATING VALVES



Réf : MO 14 QAT 141 R
Date : 07/2014
EURO 23 MANUAL REINFORCED VERSION
DN 80-300 PN 16 +
EURO 23 MOTORIZED REINFORCED VERSION
DN 200-300 PN 16
+ MITRE GEAR

EURO 20 TYPE 23 REINFORCED VERSION



MANUAL

MOTORIZED

The Euro 20 gate valves are equipped with gates fully rubber encapsulated from DN 65 up to 250 and must be used only in full opening or closing position.

They are designed for use on water supply and distribution mains, irrigation systems, fire fighting system and general systems in industrial sites.

They can cut the water flow in a pipe and therefore facilitate the network maintenance.

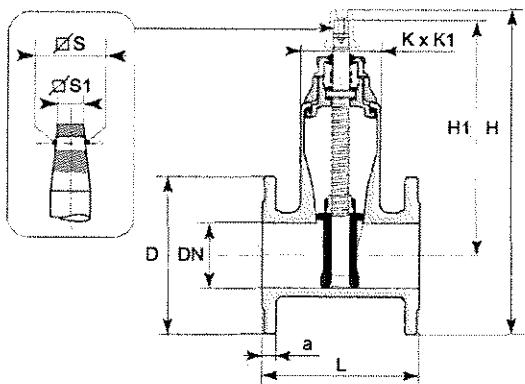
Their main features are:



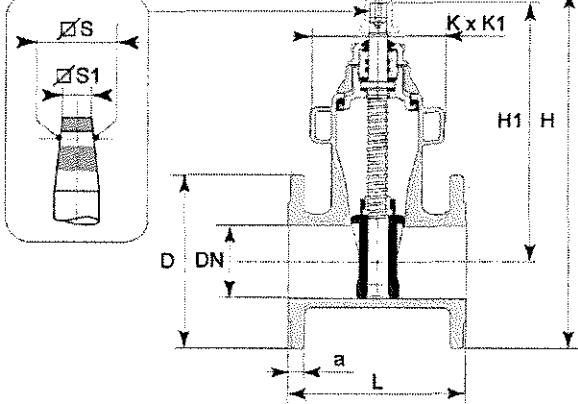
- Titular of the quality Standard
- In accordance with ISO & NF standards, in particular, possibility to replace the bush seals under full working pressure, valve totally opened
- Coating and materials neutrality concerning drinking water
- Full bore to nominal diameter
- Corrosion resistance secured by the material and epoxy coating choice
- Ears of gripping to facilitate handling and the installation
- No current maintenance needed
- The operating torque is much lower than required by the standards
- Easy to maintain

DIMENSION AND MASS

DN 80 to 150



DN200-300

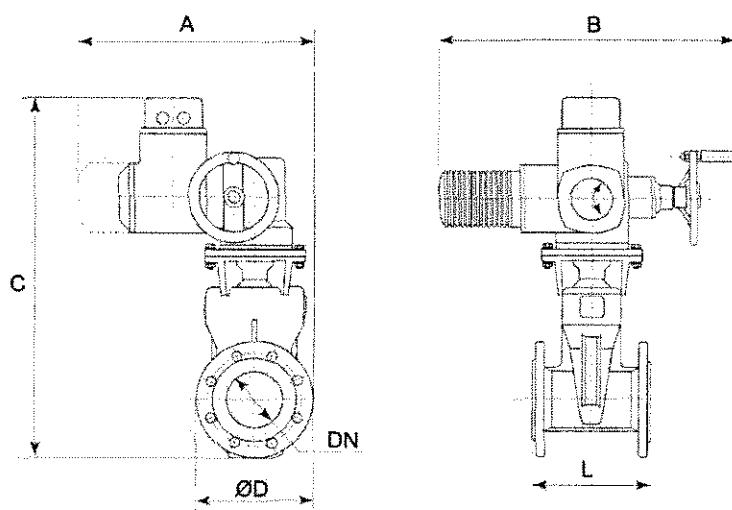


DN	L	H1	H	D	KxK1	a	Nb (*)	Screw CC		Mass
								S x S	S1 x S1	
80	180	275,0	361,0	200	105 x 174	19	17	18,5	17	15,6
100	190	322,0	419,5	225	111 x 194	19	23	20,6	19	19,7
150	210	410,0	535,0	285	136 x 257	19	32	20,6	19	33,3
200	230	515,0	745,0	340	266 x 382	20	33	25,7	24,3	66,0
250	250	595,0	855,0	400	285 x 470	22	41,5	25,7	24,3	108,0
300	270	705,0	1010,0	455	305 x 538	24,5	50	25,7	-	155,0

Nb (*)= Number of turns to close

Dimensions in mm

Mass in kg

Dimensions
with actuator :

DN	D mm	L mm	Type of motor	A	B	C	Reference PN16	Mass kg
				mm	mm	mm		
200	340	230	SA 14.2	635	713	965	REB20BHAH	130,0
250	400	250	SA 14.6	665	720	1085	REB25BHAH	165,0
300	455	270	SA 14.6	693	720	1198	REB30BHAH	199,0

ISOLATING VALVES



Réf :

MO 14 QAT 141 R

Date :

07/2014

EURO 23 MANUAL REINFORCED VERSION

DN 80-300 PN 16+

EURO 23 MOTORIZED REINFORCED VERSION

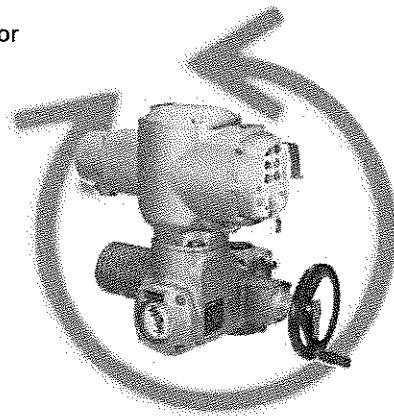
DN 200-300 PN 16

+ MITRE GEAR

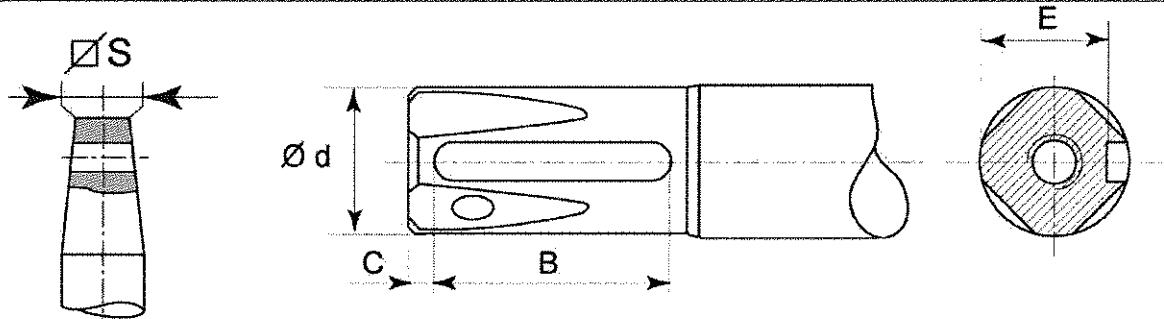
BASIC EQUIPMENT OF ACTUATOR AUMA SA WITH AUMA-MATIC

DN	Actuator AUMA Type	ISO 5210	Operating Time (s)	Speed (rpm)	Operating Torque (Nm)
200	SA 14.2	F 14	90	22	200
250/300	SA 14.6	F 14	113	22	250

- Power supply: 415 V three-phase current - 50 Hz.squirrel cage AC motor
- Clockwise closure direction
- Motor duty type : short time duty S2-15 minutes
(According to IEC 34-1) code SA 60 starts/h
- Integral local / remote control type AUMA-MATIC
- Electronic position transmitter 4-20 mA
- Enclosure IP68 according to EN 60529

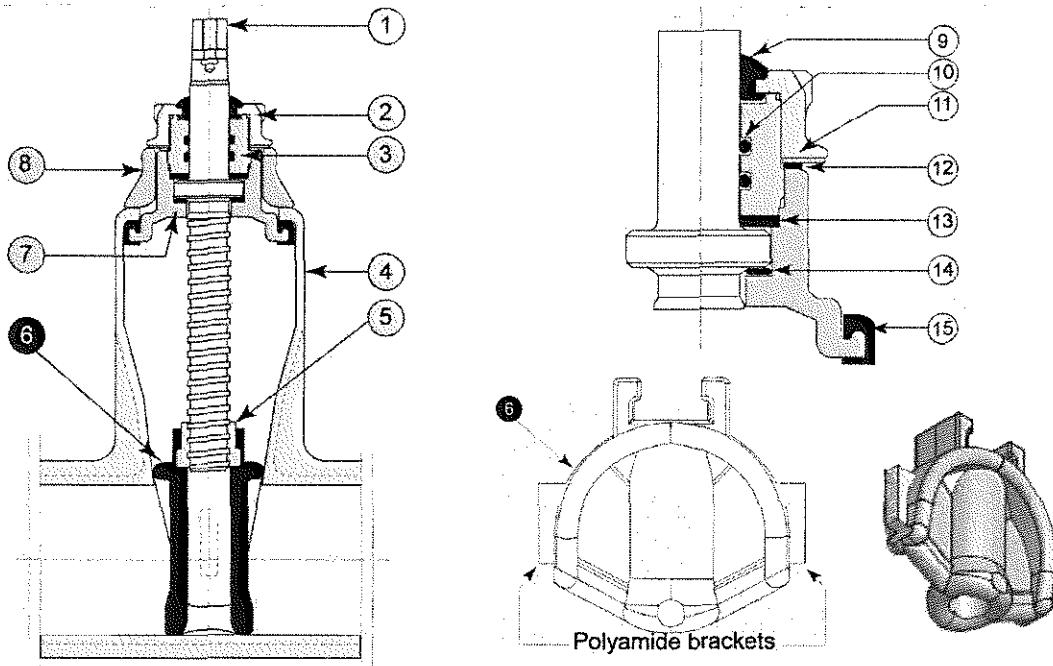


DETAIL OF KEY DIMENSIONS OF THE OPERATING STEM (CLOCKWISE)



DN	Square S	d	B	C	E	Key
200	24.3	28 f 8	45	5	24,0	8 x 7 x 45
250	27.3	32 f 8	50	5	27,0	10 x 8 x 50
300	27.3	32 f 8	50	5	27,0	10 x 8 x 50

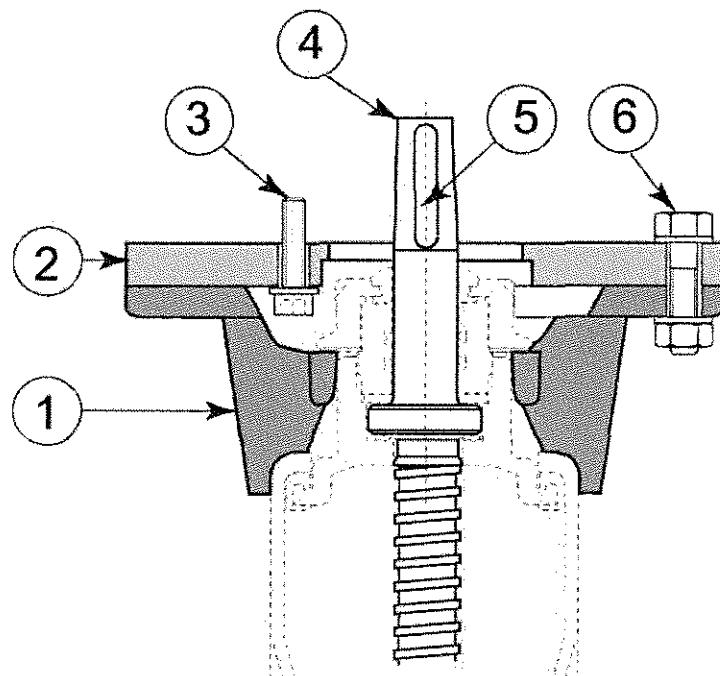
MATERIAL AND COATING

Manual :


Item	Designation	Material	Coating
1	Operating stem	Stainless steel type X2CrNiMo 17-12-2	-
2	Bearing nut	Ductile Iron GS EN GJS 400-15 or 500-7	EVA (Ethylene Vinyl Acetate) 300 microns mini
3	Bush	Brass type CuAl10Ni3Fe2	-
4	Body	Ductile Iron GS EN GJS 400-15 or 500-7	Epoxy powder mini 300 microns
5	Operating nut	Brass type CuAl10Ni3Fe2	-
6	Gate	Ductile iron acc. EN1563 and EN681-1	EPDM on ductile iron and polyamide brackets
7	Bonnet	Ductile Iron GS EN GJS 400-15 or 500-7	Epoxy powder mini 300 microns
8	Yoke	Ductile iron	EVA (Ethylene Vinyl Acetate) 300 microns
9	Van O Fra	Chloroprene	-
10	Seal bush	Elastomer Nitrile NBR WRC 70	-
11	Lock washer	Stainless steel type Z6 CN18.8	-
12	Yoke-Bonnet- gasket	Nitrile	-
13	Bearing bonnet joint	Polyamide type PA 6-6	-
14	Thrust washer	Polyamide type PA 6-6	-
15	Body bonnet gasket	Elastomer EPDM acc. EN681-1	-

MATERIAL AND COATING

Motorized :



Rep.	Désignation	Matière	Revêtement
1	Yoke - Flange	Ductile iron	Epoxy 250 microns
2	Adaptor	Carbon steel	Epoxy 250 microns
3	4 bolts CHC M10/30 4 washers M10/2	Steel	Zinc plated
4	CC operating stem	Stainless steel type X20Cr13 according to EN10088-3	
5	Key	Steel	
6	4 bolts H 10/45 8 washers M10/2	Steel	Zinc plated

Dimensions in mm

ISOLATING VALVES



Réf :

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EURO 23 MANUAL REINFORCED VERSION

DN 80-300 PN 16 +

EURO 23 MOTORIZED REINFORCED VERSION

DN 200-300 PN 16

+ MITRE GEAR

HYDRAULIC CHARACTERISTICS

HEADLOSS

EXPRESSION BY Kv

The headloss ΔP is expressed by the flow coefficient Kv that is the flow at a temperature of 20°C crossing the valve by triggering a headloss of 1 bar.

Those figures are tied by the simple following relation:

$$Kv = \frac{Q}{\sqrt{\Delta P}}$$

with Kv = flow coefficient in m³/h.

Q = flow in m³/h.

ΔP = headloss in the valve in bar.

DN	80	100	150	200	250	300
Kv	600	1000	2900	6000	10000	16000

HEADLOSS

EXPRESSION BY K α

The headloss ΔH of a pipe, the flow speed of the fluid and the headloss coefficient $K\alpha$ in the pipe are tied by the following formula:

$$\Delta H = K\alpha \frac{V^2}{2g}$$

with ΔH = headloss in mCE

V = fluid speed in m/s

g = acceleration due to gravity in m/s²

$K\alpha$ = headloss coefficient without dimension

Values of $K\alpha$ for gate-valves EURO 20 fully open:

DN	80	100	150	200	250	300
K α	0.170	0.140	0,090	0.065	0.050	0.040

ISOLATING VALVES	 SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014 EURO 23 MANUAL REINFORCED VERSION DN 80-300 PN 16 + EURO 23 MOTORIZED REINFORCED VERSION DN 200-300 PN 16 + MITRE GEAR
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NORMS CONFORMITY

- | | |
|-------------------------|--|
| Product | <ul style="list-style-type: none"> ISO 7259 EN 1074 1-2 |
| Tests in plants | <ul style="list-style-type: none"> ISO 5208 : 1993 NF EN 12 266-1 |
| Face to face dimensions | <ul style="list-style-type: none"> NF EN 558 ISO 5752 serial 15 for type 21 ISO 5752 serial 14 for type 23 BS? |
| Flange drilling | <ul style="list-style-type: none"> NF EN 1092-2 ISO 7005-2 DIN 2501 BS 5163 |
| Marking | <ul style="list-style-type: none"> EN 19 |

In some countries, gate valves are used clock wise closing (FSH) for surface pipes and anti-clock wise closing (FAH) for buried pipes.

The materials of the components and the epoxy coating satisfy the French and European standards in matter of potable water.

MARK NF (type 21 and type 23)

SG Pam is authorized by CSTB to affix the NF Mark on this product. The product is in compliance with the following complementary standards and specifications:



- | | |
|------------------------------------|---|
| NF EN 1074-1 | Valves for water supply – Fitness for purpose requirements and appropriate verification tests – Part 1 : General requirements |
| NF EN 1074-2 | Valves for water supply – Fitness for purpose requirements and appropriate verification tests – Part 2 : Isolating Valves |
| NF S 61-211/ CN and
NF EN 14339 | Fire plugs |
| NF S 61-213/ CN and
NF EN 14384 | Fire hydrants |
| NF 197 | Certification Rules of the NF Mark – Valves – Hydraulic Fountain Fittings |

ISOLATING VALVES



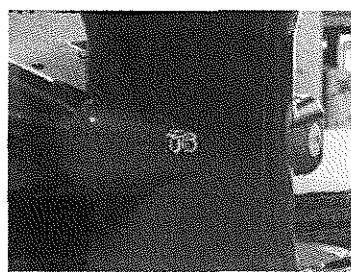
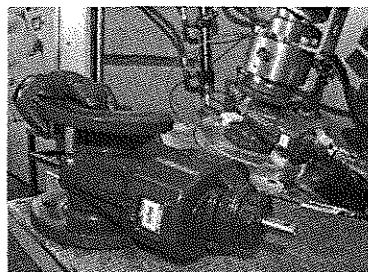
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 DN 80-300 PN 16 +
EURO 23 MOTORIZED REINFORCED VERSION
 DN 200-300 PN 16
 + MITRE GEAR

MARKING

The marking of the valves manufactured by Saint-Gobain refers to the EN 1074-2 and EN 19 international standards.

Markings are either integral markings, cast in the body, or markings made on plates, securely fixed to the body, in accordance with the EN 19 standard specifications.

EN 19 specifications		Requirements	Saint-Gobain valves process
Table 1 – Valve markings			
1	DN	EN 19 § 4.2.1 Mandatory markings	Integral
2	PN		Integral
3	Material	Shall be integral markings or on a marking plate	Integral
4	Manufacturer's name or trade mark		Plate
11	Reference to standard	EN 19 § 4.3 Supplementary markings	Plate
12	Melt identification		Integral
16	Quality Test		Printed on body
18	Manufacturing date	Items 7 to 21 in Table 1 are optional	Plate
21	Closing direction		Plate + sticker on body



ISOLATING VALVES	 SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014	EURO 23 MANUAL REINFORCED VERSION DN 80-300 PN 16 + EURO 23 MOTORIZED REINFORCED VERSION DN 200-300 PN 16 + MITRE GEAR
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INSTALLATION

The gate-valves EURO 20 can be installed as follows:

- on surface
- buried:
 - under direct backfill (with ground correctly compacted) and placed under surface boxes
 - located in chambers under valve boxes.

The gate-valves can have four positions:

- on horizontal pipe main:
 - standing (each time it is possible),
 - overturned (to avoid for sizes superior to 300),
 - laid down,
- on vertical pipe main :
 - in an horizontal position

The gate-valve EURO 20 New Generation exists under several types, the most common is the EURO 21 with flanges long pattern.

To install these valves you can use

- Ultra QUICK, or Maxi Quick for installation on all types of materials (except PE)
- Anchored or not anchored QUICK GS for installation on ductile iron pipes
- Anchored or not anchored QUICK PVC for installation on PVC tubes
- QUICK PE fus for electro fusion on PE tubes

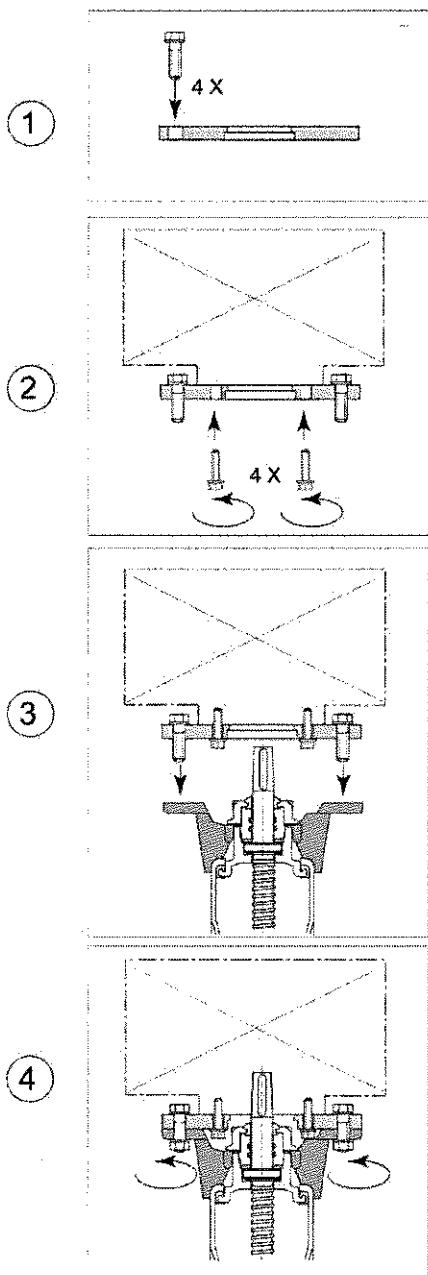
It is better to use metal reinforced gaskets, the installation of which is relatively simple and expulsion strength of the washer is tested.

On the EURO 20 type 23, the space between the pipe and the connecting flange doesn't allow the use of bolts. It is advised to use threaded stems and the bolts to adapt the length in function of used flanges or joints.

MAINTENANCE

The gate-valves EURO 20 need no particular maintenance.

The replacing of tightness joint of the operating screw support can be made, the valve under pressure, by loosening the operating bolts when the position is fully open.

ASSEMBLY OF THE MOTOR

1. Put the 4 bolts H

2. Assembly the adaptor on the motor with the 4 CHC bolts

3. Assembly the motor/adaptor on top of the operating stem of the valve.

4. Tighten the bolts.

ISOLATING VALVES	 SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014 EURO 23 MANUAL REINFORCED VERSION DN 80-300 PN 16 + EURO 23 MOTORIZED REINFORCED VERSION DN 200-300 PN 16 + MITRE GEAR
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**MITRE GEAR AND VISUAL POSITION INDICATOR
REINFORCED CONSTRUCTION**

Type of connections	EURO 20 type 23 complying with ISO 7259, EN 1074-2, ISO 5752 series 14 (short pattern), EN 558-1 series 14 Flanges according to ISO 253, ISO 7005-2, PN16 table9, EN 1092-2, PN16 table9
Type of gate valve	Isolating gate valves, installation in valve chamber Wedge type, resilient seated, full bore, non-rising stem design Clockwise closing
Hydrostatic test pressure	According to ISO 5208:1993, EN 12266-1:2003 Refer to QCP, Resilient seated gate valves, reference RRSGV05rev0 Body test pressure : 1,5 PFA Seat test pressure : 1,1 PFA
Pressure rating	PFA 16 (refer to BOQ)
Valve marking	<p>Cast on body</p> <ul style="list-style-type: none"> • Nominal diameter • Pressure rating <p>On identification label</p> <ul style="list-style-type: none"> • Reference of valve • Closing direction, nominal diameter, flange drilling • Reference to the involved standard <p>Painted mark</p> <ul style="list-style-type: none"> • The letter T indicates that the gate-valve has satisfied the hydraulic tests made at the end of the manufacturing process
Surface protection (Inside and outside protection, including sealing surface of flange)	Non-toxic fusion bonded epoxy powder coating
Operation features:	Handwheel and extension spindle for T-key remote control. They are supplied separately. Clockwise closing
Dry film thickness	Body and flange : local thickness : minimum of 300µm. Definition of local thickness : see factory coating check plan Excluded Areas : gasket housing, flange- holes, local thickness : minimum of 150µm
Non-toxicity certificate	Yes
Valve packing	Wooden crates

ISOLATING VALVES



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EURO 23 MANUAL REINFORCED VERSION

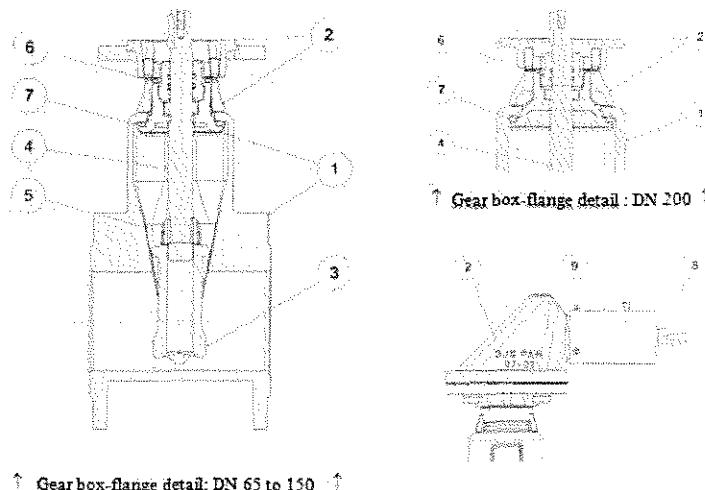
DN 80-300 PN 16+

EURO 23 MOTORIZED REINFORCED VERSION

DN 200-300 PN 16

+ MITRE GEAR

GATE VALVE SECTIONAL SKETCH



MARK	DESCRIPTION	MATERIALS
1	Body and bonnet	<ul style="list-style-type: none"> Ductile iron according to ISO 1083 grade ISO1083/JS/ 400-15 or 500-7 EN 1563 grade EN-GJS-400-15 or 500-7
2	Yoke-nut flange, yoke, gear body	
3	Wedge	<ul style="list-style-type: none"> Ductile iron according to ISO 1083 grade ISO1083/JS/ 400-15 or 500-7 EN 1563 grade EN-GJS-400-15 or 500-7 Coated with EPDM (with non-toxicity certificate) and polyamide on guiding surfaces
4	Stem	<ul style="list-style-type: none"> Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404 Thrust collar and stem made in one single part
5	Wedge nut (operating nut)	<ul style="list-style-type: none"> Aluminium bronze to EN 1982 grade CuAl10Ni3Fe2 material CB332G including the reference: "possibility to be use with sea water"
6	Bearing Stem sealing in bearing	<ul style="list-style-type: none"> Aluminium bronze to EN 1982 grade CuAl10Ni3Fe2 material CB332G including the reference: "possibility to be use with sea water" Two NBR O-rings (with non-toxicity certificate)
7	Body / bonnet gasket Body/bonnet assembly	<ul style="list-style-type: none"> EPDM (with non-toxicity certificate) The valve design provides an autoclave bonnet, so no outside body / bonnet bolting is necessary
8	Input drive shaft Drive shaft bushing Bevel gears life lasting grease	<ul style="list-style-type: none"> Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404 Self-lubricating composite material fabricated steel to EN 10083-1 grade C45E material 1.1191 (formerly XC48 acc. to NF A35-552) Klübersynth VR 69-252
9	Position indicator body	<ul style="list-style-type: none"> Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2, material 1.4404

ISOLATING VALVES



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EURO 23 MANUAL REINFORCED VERSION

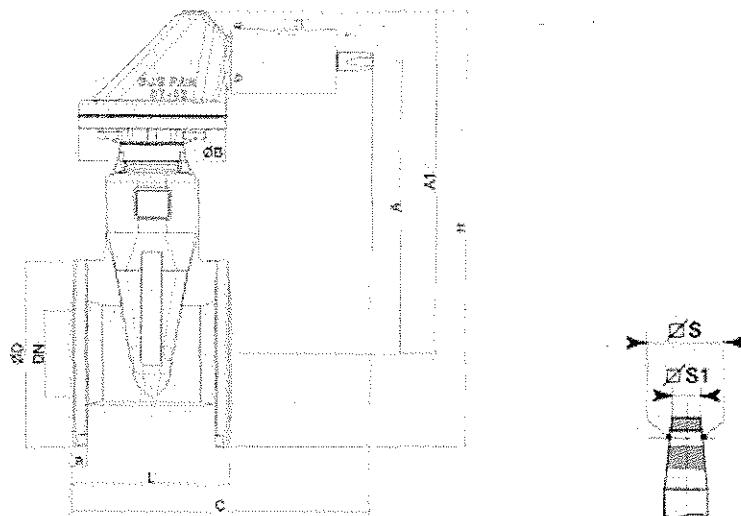
DN 80-300 PN 16 +

EURO 23 MOTORIZED REINFORCED VERSION

DN 200-300 PN 16

+ MITRE GEAR

OUTLINE DIMENSIONAL SKETCH



DN	S1	S
80	17.3	18.5
150	19.3	20.6

DN	L	D	a	B	H	A	A1	C	Nb of turns to close	Weight
80	180	200	19	175	475	314	375	352	17	28
150	210	285	19	175	642.5	439	500	367	32	46

- Dimensions in mm, weight in kg.
- Face to face dimensions to ISO 5752-EN 558 series 14
- Unless an alternative specification is agreed at the time of ordering, the above specification shall be that which is supplied.

**OPEN / CLOSED VISUAL POSITION INDICATOR
FOR ISOLATION MITRE-GEARED EURO 23 GATE VALVE
REINFORCED VERSION**

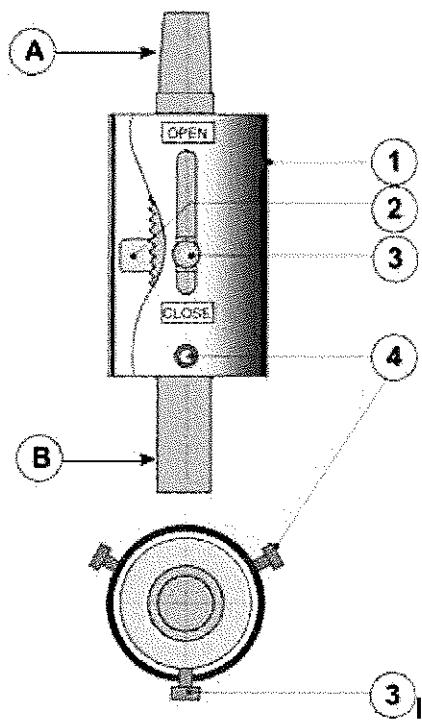
Position indicator description

The Mitre Gear input shaft is lengthened and threaded to operate the indicator. A threaded nut with pointer is moving along the stem. The pointer is positioned inside a slot of the tube. When the stem is operated to open or close the valve, the nut is guided by the pointer and thus moves either up or down depending on the direction of operation. The slot in the tube is length- calibrated to show the valve is either in the "fully open" or "fully closed" position.

The pointer stroke, included in the slot length [mm] = 1.5 x number of turns to operate.

OUTLINE SKETCH

Mark	Designation and material
A/B	Valve mitre gear box shaft Stainless steel AISI 316L EN 10088-3 Grade X2CrMo17-12-2 material 1.4404 A : handwheel side B: valve gear box side
1	Indicator tube Stainless steel AISI 316L EN 10088-3 Grade X2CrMo17-12-2 material 1.4404
2	Indicator nut Copper alloy UE 7 EN 1982, EN 12164 Grade Cu Sn7 Zn4 Pb7
3	Pointer Stainless steel A4
4	Tube fixing screws Stainless steel A4



QATAR	MO 14 QAT 141 R 07/2014
GTC / 626A / 2014 <i>Construction of Mega Reservoir PRPS at Umm Birka Package A</i>	COUPLINGS, ADAPTORS AND SLEEVES

2. Couplings, adaptors and sleeves

- DISMANTLING JOINT TYPE PO REINFORCED VERSION DN 100-2200 PN 16
- LINK GS REINFORCED VERSION DN 150-2200 PN 25
- QUICK GS REINFORCED VERSION DN 100-1600 PN 16

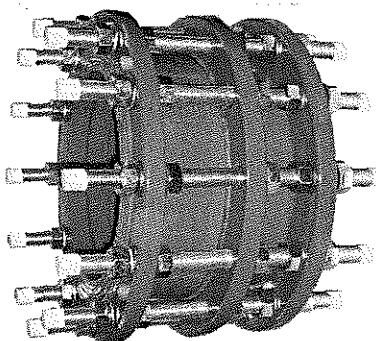
COUPLINGS, ADAPTORS
AND SLEEVES



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DISMANTLING JOINT TYPE PO
REINFORCED VERSION
DN 100-2200 PN 16

DISMANTLING JOINT TYPE PO REINFORCED VERSION



OVERVIEW

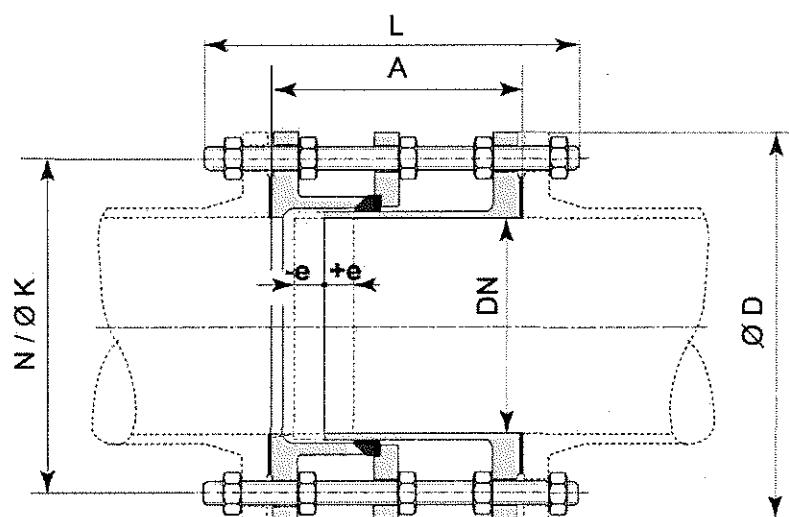
The self-restrained dismantling joint **Type PO** for **flanged valves** allows the installation or removal of equipment between two fixed flanges of a pipeline.

The sliding system can reach a 50 mm displacement to ease the removal of the equipment.

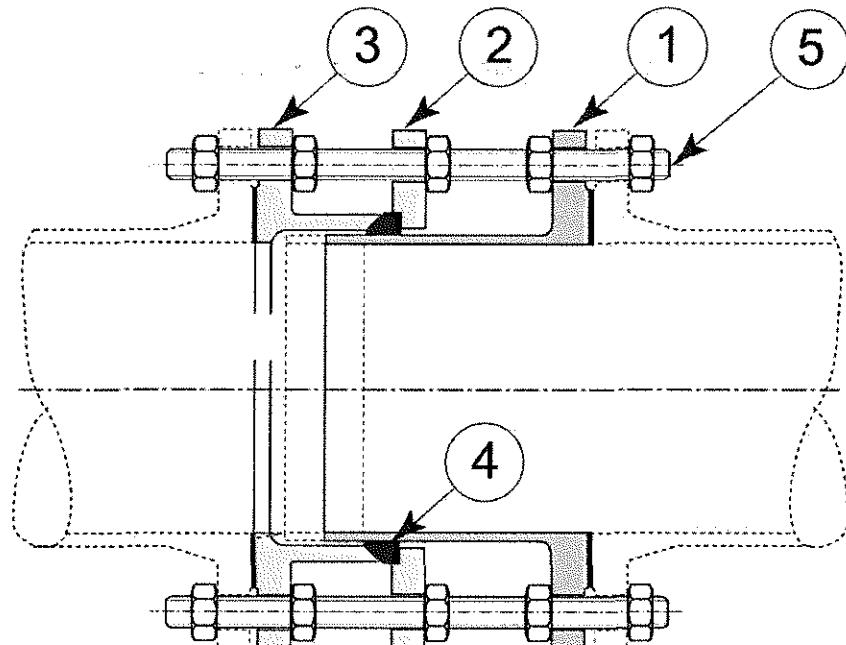
For this type of self-restrained dismantling joint the locking of the valve to the pipeline is made by the tie bars and the gland.

REFERENCES

DN	PFA 16 bar
100	163561
150	163607
200	MDB20DAAP
250	MDB25DAAP
300	MDB30DAAP
350	
500	MDB50DAAP
600	160962
700	
800	MDB80DAAP
900	MDB90DAAP
1000	MDC10DAAP
1200	MDC12DAAP
1400	MDC14DAAP
1600	MDC16DAAP
2000	
2200	

DIMENSIONS AND MASS**TYPE PO PFA 16**Stroke : $\pm e$ in mm

DN	A	Φ D	Φ K	Qty. Tie bars			Mass (kg)	+ e	- e
				N	M	L			
100	200	220	180	8	M16	330	20	25	25
150	200	285	240	8	M20	340	34	25	25
200	220	340	295	12	M20	360	48	25	25
250	230	405	355	12	M24	390	74	25	25
300	250	460	410	12	M24	410	92	25	25
350	260	520	470	16	M24	430	126	20	25
500	280	715	650	20	M30	480	240	25	25
600	300	840	770	20	M33	510	330	15	25
700	300	910	840	24	M33	500	366	20	25
800	320	1025	950	24	M36	530	482	15	25
900	320	1125	1050	28	M36	540	546	15	25
1000	340	1255	1170	28	M39	570	715	15	25
1200	360	1485	1390	32	M45	630	1112	25	25
1400	380	1685	1590	36	M45	660	1352	25	25
1600	420	1930	1820	40	M52	720	1936	25	25
2000	450	2345	2230	48	M56	780	2990	25	25
2200									

MATERIALS AND COATING

Part number	Description	Material
1	Fixed body	Steel EN 10025 S235JRG2
2	Gland	Steel EN 10025 S235JRG2
3	Sliding body	Steel EN 10025 S235JRG2
4	Gasket	EPDM rubber
5	Tie bars	Steel EN 10025 S235JRG2 or S335J2G3 grade 4/6

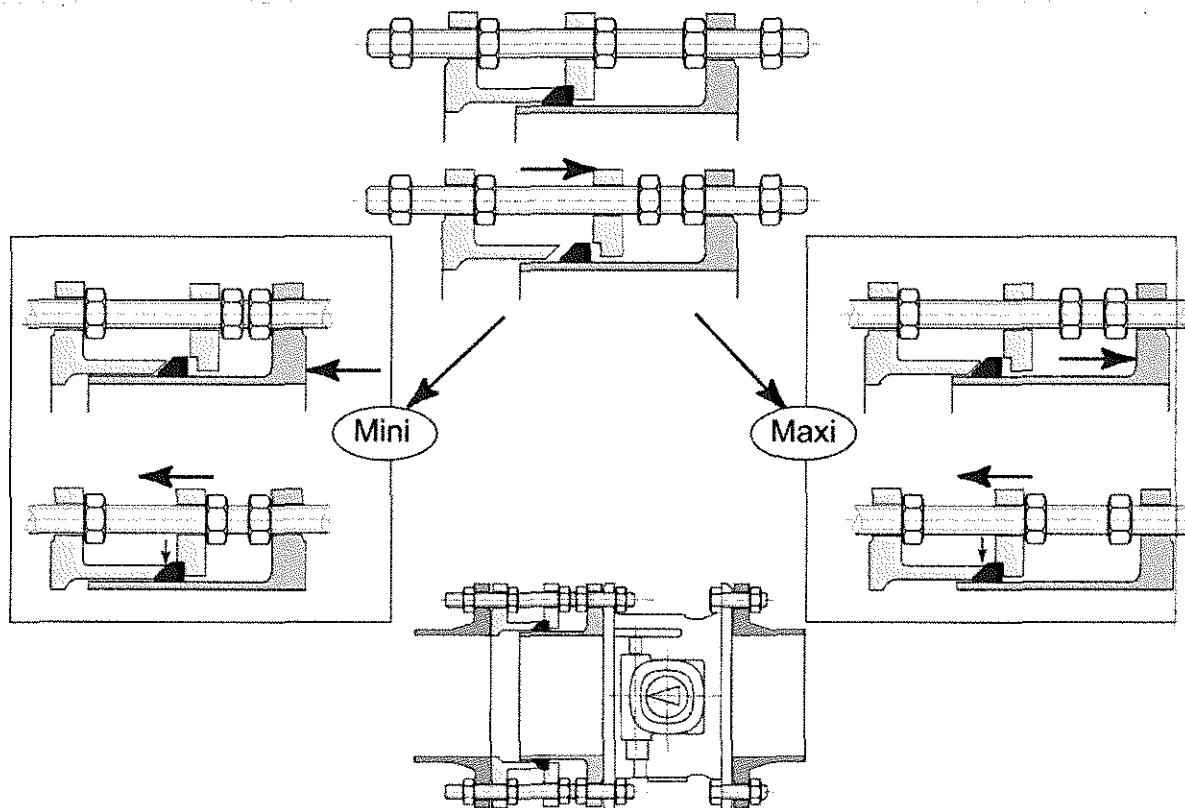
Part number	Type	Thickness
1-2-3	Epoxy Coating	300 µ
5	Hot dipped galvanized	40µ

COMPLIANCE TO STANDARDS**For the PO self-restrained dismantling joint**

This equipment comply with the standard NFE 29220, especially concerning the flanges dimensions according to the EN 1092-1 or 2 and ISO 7005.

The full-flange sliding body: the flange is according to ISO 7005 standard.

The stroke range is higher than those demanded in the NFE 29220.

INSTALLATION**ASSEMBLY AND START UP****Description**

The self-restrained dismantling joint type "PO" allows the installation and removal of valves pieces or flanged pipes. An active adjustment length until ± 25 mm is possible during the assembly. The transmission of the forces is carried out by the threaded rods on the counter flange.

Transport

The transport of the pieces must be done professionally in order to avoid damages on the material.

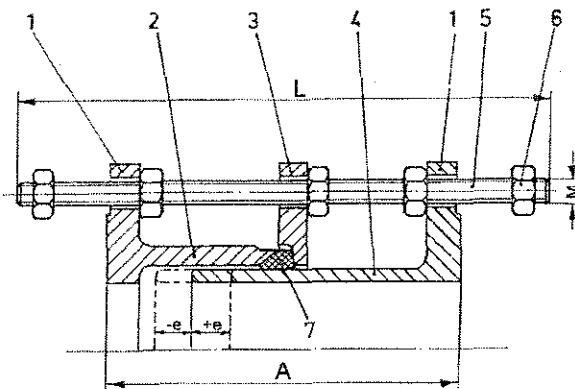
Storing

The self-restrained dismantling joint must be protected from bad weather and pollution. During a long storage period a protection against UV is necessary.

Assembling in the pipe network

It is necessary to control that the flanges to be connected are clean and not damaged. The flanges must be installed in parallel and centered.

Assembly



- To fix the first flange with the flange of the pipe or the valve. The two flanges must be centered and parallel. The flat tightness seals (to be provided by the customer) will also be installed centered.
- The nuts of the first connection are to be tightened (tightening torque according to information given by the supplier of the joint).
- Assembly of the second connection taking into account the necessary mini and maximum length of the dismantling joint (A).
- After the assembly of two connections, it is necessary to push the tightness seal (7) against the external pipe (2).
- Then it is necessary to tighten the nuts with the ring of tightening (3). Once the assembly of the pipe finished and the length of the dismantling joint defined, it is necessary to tighten the nuts in cross.
- The dismantling joint is now ready for operation and can receive the axial thrust of the pipe.

DIMENSIONS	TIE RODS	TIGHTENING TORQUE TO THE TIGHTENING RING ($\pm 10\%$)	
		PN16	PN16
100	M16		42 Nm
150	M20		82 Nm
200	M20		82 Nm
250	M24		140 Nm
300	M24		140 Nm
350	M24		140 Nm
500	M30		280 Nm
600	M33		380 Nm
700	M33		380 Nm
800	M36		640 Nm
900	M36		640 Nm
1000	M39		780 Nm
1200	M45		1200 Nm
1400	M45		1200 Nm
1600	M52		1900 Nm
2000	M56		
2200			

COUPLINGS, ADAPTORS
AND SLEEVES

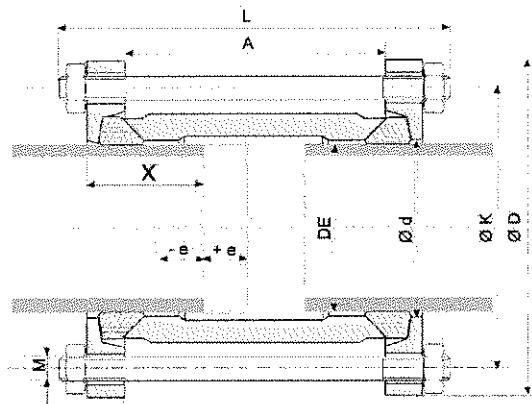
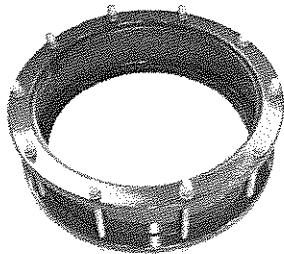


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LINK GS REINFORCED VERSION
DN 150-2200 PN 25

LINK GS REINFORCED VERSION



DIMENSION AND MASS

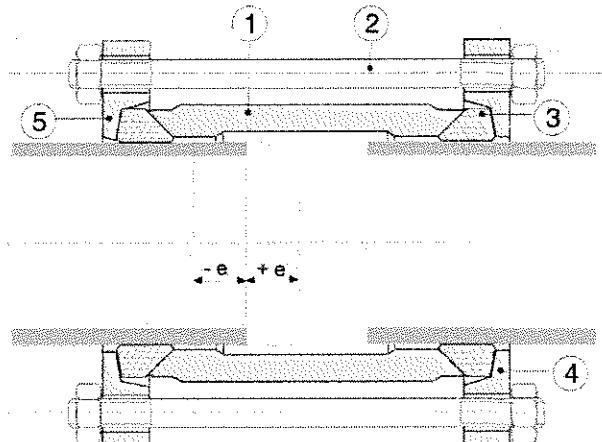
DN	DE	A	D	X	d	e	Quantity	M	L	Reference	Mass
150	170 +1/-2,5	96		40	175				170	205105	15
200	222 +1/-2,5	96		40	227				170	205106	21
250	274 +2/-5	116		50	280				200	208372	25
300	326 +2/-5	116	435	50	332	15	6	16	230	205108	34
350	378 +2/-5	134	485	50	384	20	8	16	230	163981	42
500	532 +2/-5	154	640	55	538	25	10	16	250	164028	62
600	635 +3/-6	174	765	60	643	25	12	20	290	164045	104
800	842 +2/-7	204	975	70	850	35	16	20	320	164071	144
1000	1048 +2/-7	220	1180	70	1056	35	16	20	340	-	186
2000	2082 +1/-9,5	380	2255	120	2092	75	28	30	530	-	740
2200											

Dimensions in mm

Mass in kg

TIGHTENING TORQUE	
Tie rods	Nm
M16	55 ±4
M20	110 ±10
M30	380 ±20

MATERIALS AND COATINGS



ITEM	DESCRIPTION	MATERIAL	COATING
1	Body	Stainless EN 10025 S235JRG2	Epoxy mini 300 microns
2	Rods, Washers	Stainless EN 10025 S235JRG2 or S355J2G3 Class 6/8	Hot dipped galvanised 40µ
3	Sealing Ring	Elastomer type EPDM	
4 and 5	Flange Ring	Stainless EN 10025 S235JRG2	Epoxy mini 300 microns

INSTALLATION

- DE margin for assembly pipe: see table Dimensions $DE \pm$ (margin for not ovalized pipe). Check that the pipe to input in the Link is not ovalized more 3 mm and that the DE dimension with ovalization is not out of the margin. If not, it is necessary to proceed to re-rounding pipe: see catalogue WATER MAINS for DUCTILE IRON PIPES and FITTINGS.
- Positioning on pipe: Installation on dimension $X = \pm e$ (see table Dimensions).
- Angular deflection in degree: ± 2 by pipe (± 4 for the 2 pipes).



This coupling will only be installed in a valve chamber.
Don't install it in buried version.

ASSEMBLY AND START UP

Description

The coupling type PS allows the assembly of two spigots

Transport

The transport of the pieces must be done professionally in order to avoid damages on the material.

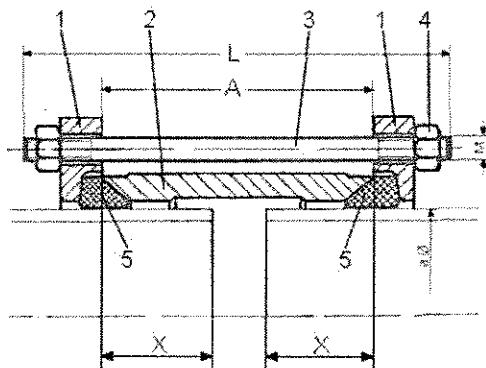
Storing

The coupling must be protected from bad weather and pollution. During a long storage period a protection against UV is necessary.

Assembling in the pipe network

It is necessary to control that the pieces (pipes) to be connected are clean and not damaged.

Assembly



- To remove the two tightening rings and the tightening seals.
- It is necessary to write the measurement X on the spigot.
- The tightening flanges (1) and the tightening seals (5) slip on the pipes spigots.
- To position the coupling type PS (2) in the space between the two spigots by respecting distance X on the two sides.
- The assembly joint-pipe-joint will be perfectly centered compared to the two spigots to be connected.
- To bring closer the two tightening flanges (1) as well as the two tightening seals (5) towards the pipe of the coupling (2) by centering them.
- To tighten in cross of the tie rods so that centering is optimal to obtain homogeneous tightening.
- Tightening must be progressive to obtain the required tightening torque.
- The coupling is then ready for operation.

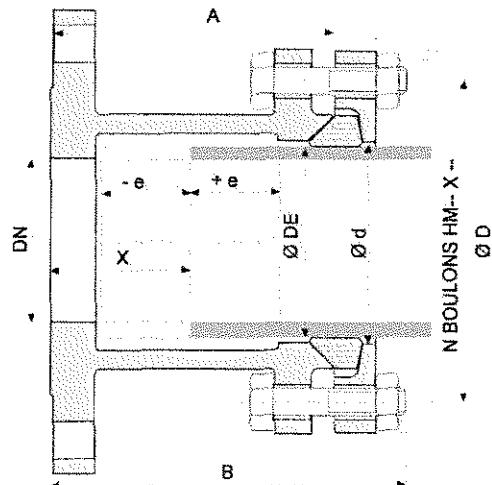
MEASUREMENT X FOR PS			
Dimensions	X (mm)	Dimensions	X (mm)
DN150	40	DN600	60
DN200	40	DN800	70
DN250	50	DN1000	70
DN300	50	DN2000	
DN350	50	DN2200	
DN500	55		

COUPLINGS, ADAPTORS
AND SLEEVES



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QUICK GS REINFORCED VERSION
DN 100-1600 PN 16

QUICK GS REINFORCED VERSION



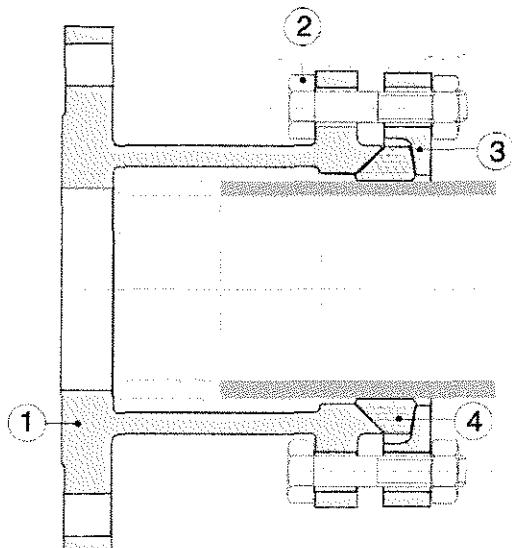
DIMENSION AND MASS

DN	DE	A	B	D	d	X	e	Qty of bolts	Thread M	Weight
100	118 +1/-2,5	140	185	220	123	70	40	4	16	15
350	378 +2/-5	180	235	495	382	90	50	8	16	64
500	532 +2/-5	180	235	655	536	90	50	10	16	100
1600	1668 +2,5/-8	350	425	1850	1675	210	50	24	24	703

Dimensions in mm

Mass in kg

Tightening torque	
Nuts	Nm
M16	55 ±4
M24	190 ±10

MATERIALS AND COATINGS

ITEM	DESCRIPTION	MATERIAL	COATING
1	Body	Steel EN 10025 S235JRG2	Epoxy mini 300 microns
2	Bolts, Washers	Steel EN 10025 S235JRG2 or S335J2G3 Class 6/8	Hot dipped galvanised 40μ
3	Flange Ring	Steel EN 10025 S235JRG2	Epoxy mini 300 microns
4	Sealing Ring	Nitrile Rubber	-

INSTALLATION

- DE margin for assembly pipe: See table Dimensions $DE \pm$ (margin for not ovalized pipe). Check than the pipe to input in the Quick is not ovalized more than 3 mm and that the DE dimension with ovalization is not out of the margin. If not it is necessary to proceed re-rounding pipe: see catalogue WATER MAINS for DUCTILE IRON PIPES and FITTINGS.
- Possible adjustment: Dimension $X \pm e$ (40mm DN50-250; 50mm DN 300-2000)
- Angular deflection in degree + or - 4 degrees
- Flanges: dimensions in conformity with ISO 7005-2, ISO 2531, EN1092-2.

ASSEMBLY AND START UP

Description

The flange adaptor type PV allows the connection between a flange and a spigot

An adjustment of the pipe length is possible in the adjustment area ($\pm e$).

During the fitment of the pipe (measurement X) in central position the flange adaptor enables an angle of 4°.

Transport

The transport of the pieces must be done professionally in order to avoid damages on the material.

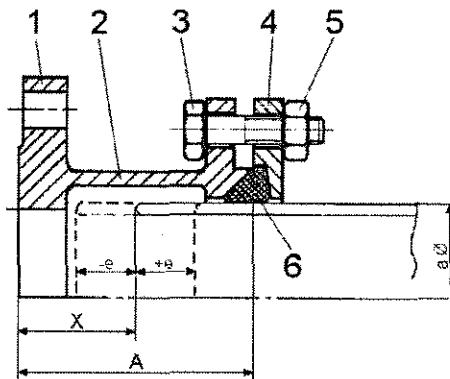
Storing

The flange adaptors must be protected from bad weather and pollution. During a long storage period a protection against UV is necessary.

Assembling in the pipe network

It is necessary to control that the flanges to be connected are clean and not damaged. The pipe to be connected must be perfectly round.

Assembly



- Implementation of the connection (screws and flat tightening seals to be supplied on site).
- To unscrew the tightening flange (4) and the tightening seal (6).
- It is necessary to write the measurement X on the spigot of the pipe.
- The tightening flange (4) and the tightening seal (6) slip on the spigot of the pipe.
- It is necessary to slip the pipe right into the flange adaptor; if possible it would be necessary to make the assembly in average position.
- To slip the tightening seal and the tightening ring against the supporting ring (3).
- To connect supporting ring and tightening ring with the supplied nuts, by tightening the nuts in cross.
- The flange adaptor is then ready for operation.

Type PV PN16		
DN	Measurement X (mm)	Adjustment $\pm e$
100	70	40
350	90	50
500	90	50
1600	210	50

QATAR	MO 14 QAT 141 R 07/2014
GTC / 626A / 2014 <i>Construction of Mega Reservoir PRPS at Umm Birka Package A</i>	PIPELINE PROTECTION

3. Pipeline Protection:

- AIR RELEASE VALVE TYPE VENTEX REINFORCED VERSION DN 80-150 PN 16
- NEEDLE VALVE MOTORIZED DN 800 PN 16
- PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00 REINFORCED VERSION DN 500 PN 16

PIPELINE PROTECTION



Réf : MO 14 QAT 141 R
Date : 07/2014

AIR RELEASE VALVE
REINFORCED TYPE VENTEX
DN 80-150 PN 16

AIR RELEASE VALVE REINFORCED TYPE VENTEX



The air valves protect the main:

The device evacuates great air amounts during the filling of the main:

- allows the inlet of great air amounts (in order to avoid a vacuum effect) during the emptying of the main
- evacuates small air amounts that are accumulated in the high points of the main during normal working conditions

RANGE

Air Valves Type VENTEX exist in a range stretching from DN 50 to 200, for pressure PFA 10, PFA 16 and PFA 25

FAST CHOICE OF VENTEX

Allows during the emptying of the main with a speed 1m/s

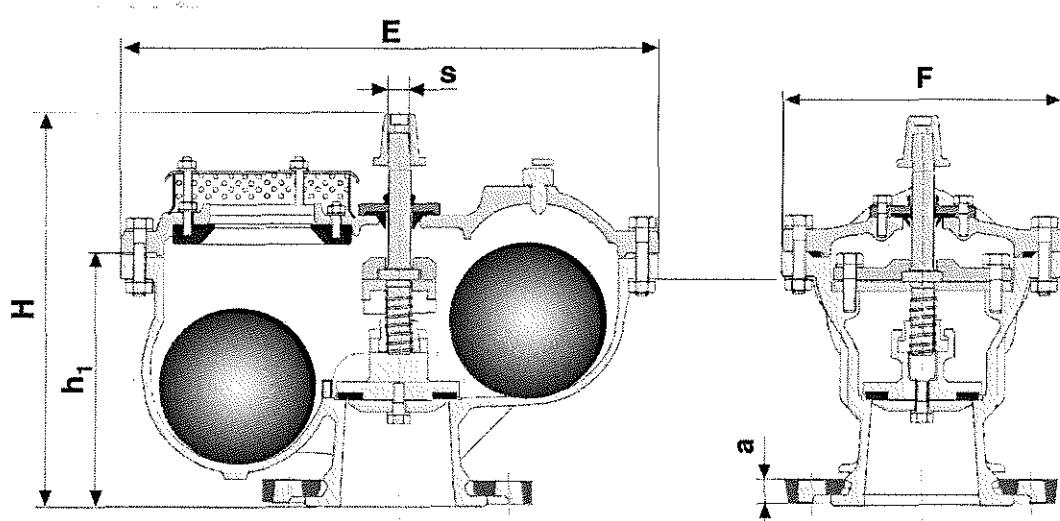
Air Valve	DN 80	DN 150
Main	DN 300-600	DN 700-900

This Ventex choice allows, in case of break main, to limit maximal pressure drop 0,3 bar for a flow rate with a part full gravity pipeline on a given slope : See paragraph PERFORMANCES.

PRODUCT CODES

DN	PFA 16 Handwheel
80	181726
150	178945

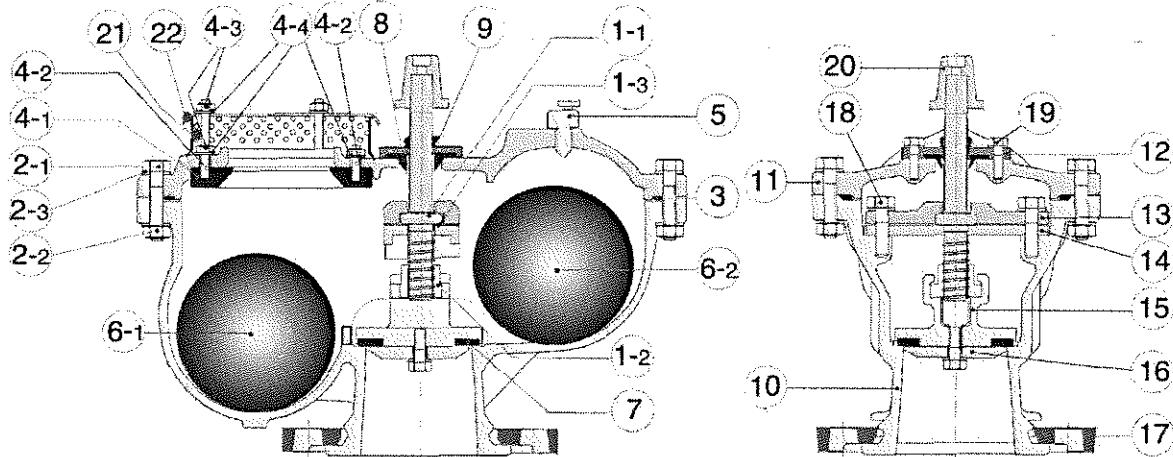
DIMENSIONS AND MASS



Double air valve	E mm	F mm	H mm	h1 mm	a mm	s mm	Mass kg
80	467	244	300	215	20	14	40
150	656	405	492	285	24	17	115

Working pressure (bar)	16
Diameter (mm)	2.4

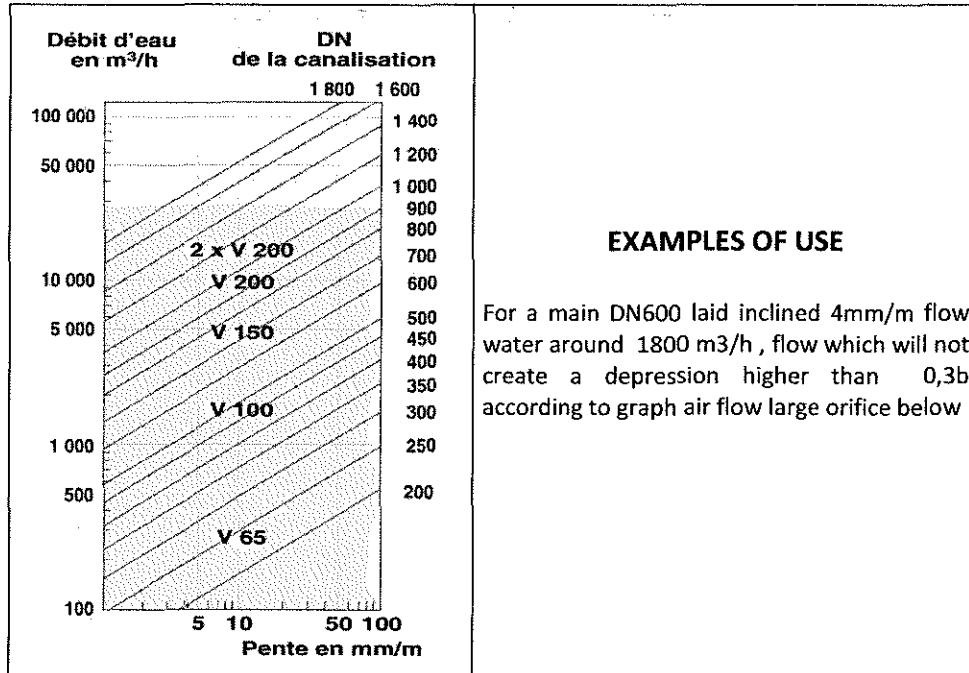
MATERIAL SPECIFICATION



MARK	DESIGNATION	MATERIAL
10, 11, 12, 13, 14, 15, 16, 17	Body, Bonnet, fixing flanges, Shutter	FGS 400/15 coated epoxy 300 µ mini
1-1	Operating stem	Stainless steel X5CrNiCuNb 16-4 type
1-2	Operating nut	Cu Al 10 Ni3 Fe2 alu-bronze type
1-3	Locked wash	Polyamide type 6-6
2-1 ; 2-2 , 2-3	Body-bonnet: bolts and washes	Stainless steel A4
3	Body-bonnet gasket	EPDM Rubber
4-1	Large orifice seat	NBR rubber encapsulated SG 400/15 ductile iron
4-2+4-3+4-4	Seat : bolts and washes	Stainless steel A4
5	Nozzle and nozzle control	Cu Al 10 Ni3 Fe2 alu-bronze type
6-1 and 6-2	Float balls	EPDM rubber encapsulated Core in steel DC03 or DC04 to EN 10130 and DD11 or DD13 to EN 10111 steel type
7	Shutter gasket	EPDM Rubber
8	Ring VAN O FRA	EPDM Rubber G 7005
9	V Ring	NBR Rubber
18, 19	Operating system bolts and washes	Stainless steel A4
20	Operating square (or hand wheel)	FGS 400/15 coated polyurethane
21	Baffle	Stainless Steel Z6 CN 18-8 type
22	Baffle cover	Steel S235JR type coated Epoxy 300 µ

PERFORMANCES

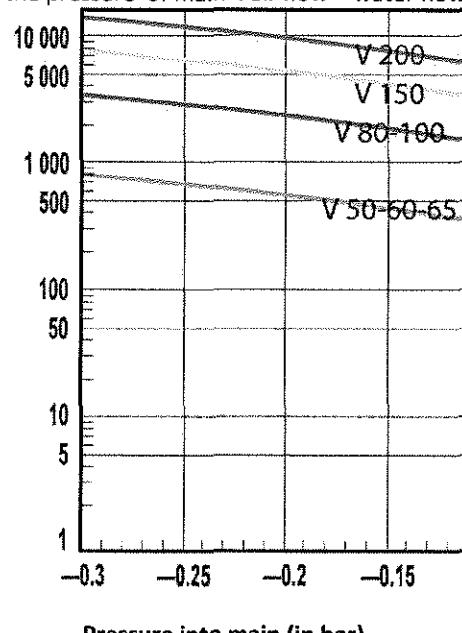
WATER FLOW IN CASE OF BREAK MAIN



AIR FLOW LARGE ORIFICE

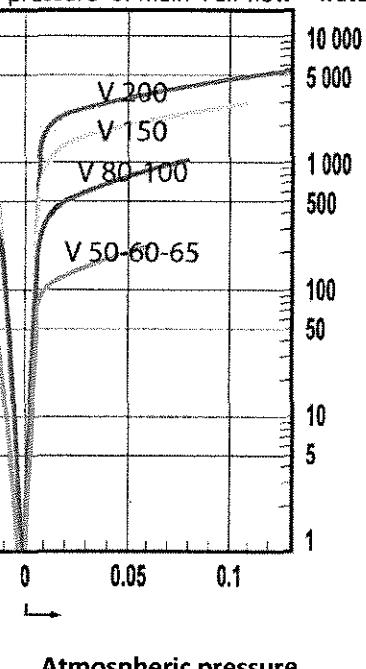
Air Flow input by large orifice in m³/h

(with the pressure of main : air flow = water flow)



Air Flow output by large orifice in m³/h

(with the pressure of main : air flow = water flow)



PIPELINE PROTECTION



Réf : MO 14 QAT 141 R
Date : 07/2014

AIR RELEASE VALVE
REINFORCED TYPE VENTEX
DN 80-150 PN 16

NOZZLE AIR FLOW

Constant Flow from 1 bar (10MCE)

PFA in Bar	16
DN en mm	80-150
Ø nozzle in mm	2,4
Air flow in m ³ /h	3,2

HYDRAULIC

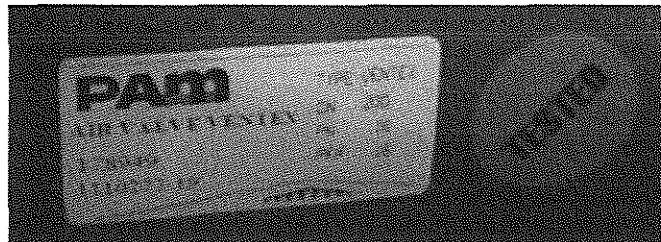
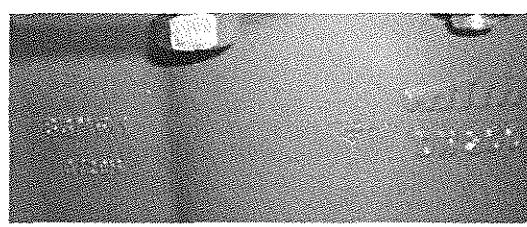
Small and large Float balls: External leakage
No leakage in low pressure from 0,3 bars

MARKING

The marking of the valves manufactured by Saint-Gobain refers to the EN 1074-2 and EN 19 international standards.

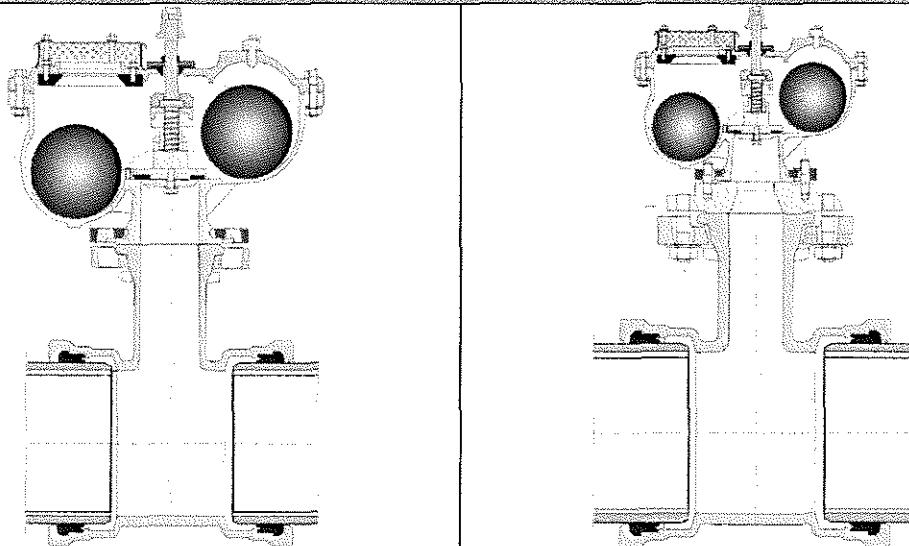
Markings are either integral markings, cast in the body, or markings made on plates, securely fixed to the body, in accordance with the EN 19 standard specifications.

EN 19 specifications		Saint-Gobain valves process	
Table 1 – Valve markings			
1	DN	EN 19 § 4.2.1 Mandatory markings Shall be integral markings or on a marking plate	Integral
2	PN		Integral
3	Material		Integral
4	Manufacturer's name or trade mark		Plate
11	Reference to standard	EN 19 § 4.3 Supplementary markings Items 7 to 21 in Table 1 are optional	Plate
12	Melt identification		Integral
16	Quality Test		Printed on body
18	Manufacturing date		Plate
21	Closing direction		Plate + sticker on body

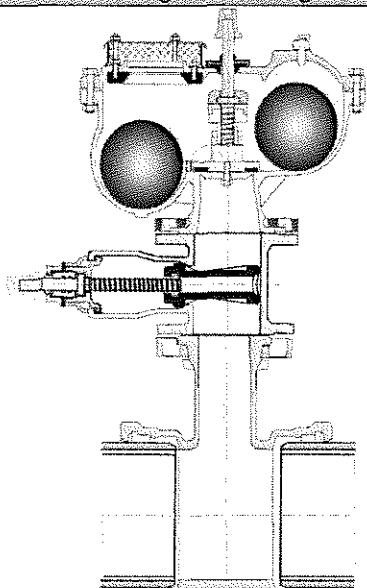


INSTALLATION**MOUNTING ON TEE****MOUNTING WITH REDUCTION FLANGE**

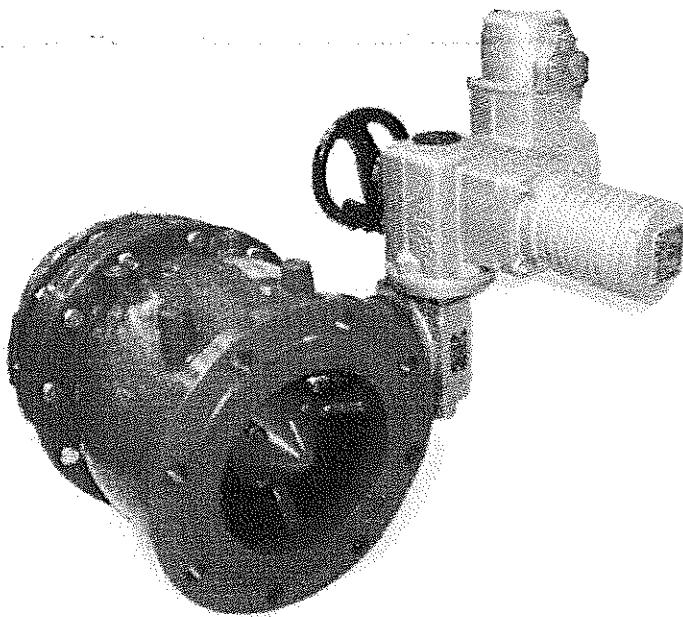
Central operating system allows, without water cut of sector,
the regular maintenance of Ventex in particular change of the floats ball

**MOUNTING WITH GATE VALVE**

Only for a repairing without water cut: operating
system or shutter gasket insert gate valve



Gate valve Type Euro 23 for PFA 10,16
Gate valve Type RVOM for PFA 25

NEEDLE VALVE MOTORIZED

The needle valve is able to modulate the flow-rate of water while providing gradual operation even when large reductions in flow and high head losses are needed. The possibility of using actuators with a continuous regulation scale allows the use of control systems to provide multiple functions.

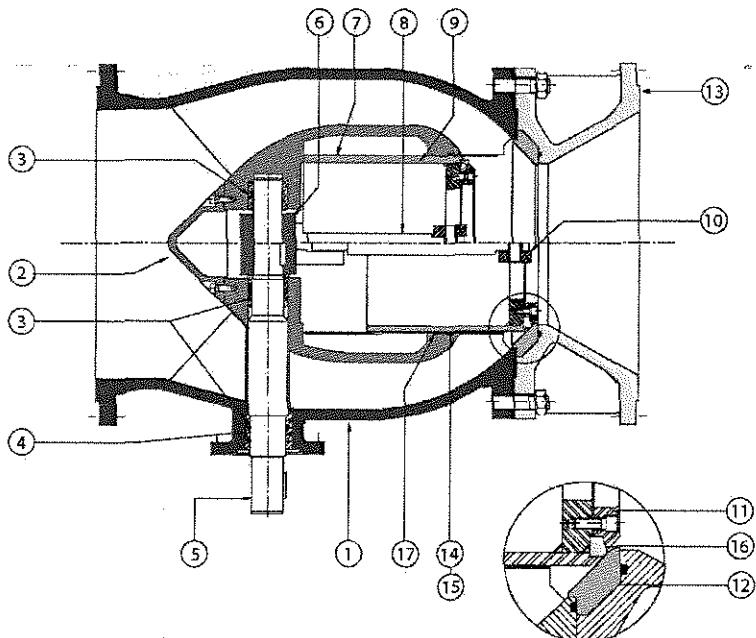
The needle valve controls the water flow through the axial movement of a shutter operated by connecting-rod and crank mechanism.

The shutter runs in a pressure-compensated chamber specially shaped to avoid vibrations and anomalous hydrodynamic loads.

Closure is in the flow direction, so as the speed of the fluid (or the pressure difference) increases, the system tends to become even more stable.

The internal profile of the valve is designed to minimize cavitation. The flow of water is channelled into round-section passage which gradually becomes narrower from the intake to the sealing seat.

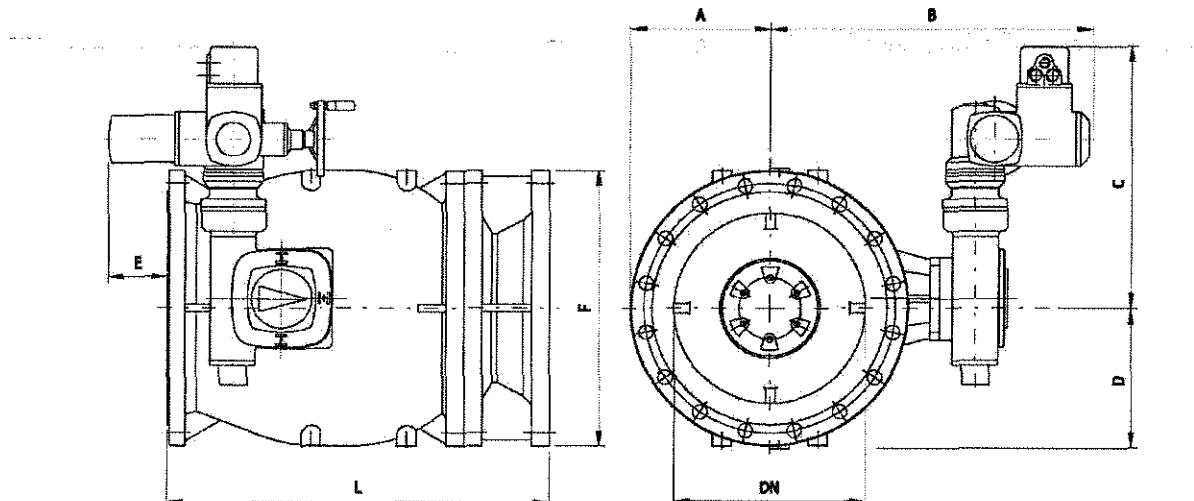
The hydrodynamic profile of the passage is optimised throughout the part where the water speed gradually rises, and allows pressure drops to be kept low for opening above 40%.

CONSTRUCTION FEATURES


Item	Description	Material
1	Body	Ductile iron according to ISO 1083 grade ISO1083/JS/500-7 EN 1563 grade EN-GJS-500-7
2	Nose cone	
3	Bush	Bronze to EN 12163 grade CuSn8 material CW453EK
4	O-Ring	NBR
5	Shaft	Duplex stainless steel to EN 10088-3 grade X2CrNiMo22-5-3 material 1.4462
6	Link Block	Ductile Iron GS 500-7 covered by epoxy powder 300µ
7	Shutter Seat	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
8	Rod	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
9	Shutter	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
10	Fork	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
11	Seal Retaining Ring	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
12	Body Seat	Stainless steel to EN 10088-3 grade X2CrNiMo17-12-2 material 1.4404
13	Diffuser	Ductile iron according to ISO 1083 grade ISO1083/JS/500-7 EN 1563 grade EN-GJS-500-7
14	O-Ring	NBR
15	Back-up Ring	Lubriflon
16	Sealing Ring	EPDM rubber
17	Slide Ring	PTFE + Carbon

Internal and external coating: (fusion bonded) epoxy powder, 300 microns minimum thickness - RAL 5005.

DIMENSIONS AND MASS



Dimensions without AUMATIC

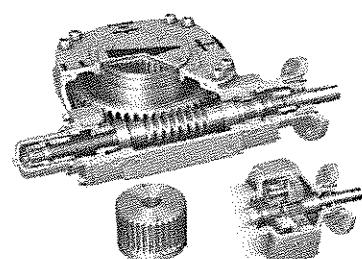
DN	A	B	C	D	E	F	L	Mass
	mm							kg
800	543	913	723	543		1085	1600	2712

GEARBOX AND ACTUATOR

DN	PN	ISO 5211	AUMA GEARBOX	AUMA ACTUATOR
800	16	F25	GS 160.3+GZ160.3 - F25	SAR 07.6

PAM butterfly valves are equipped with a high performance AUMA Gearbox:

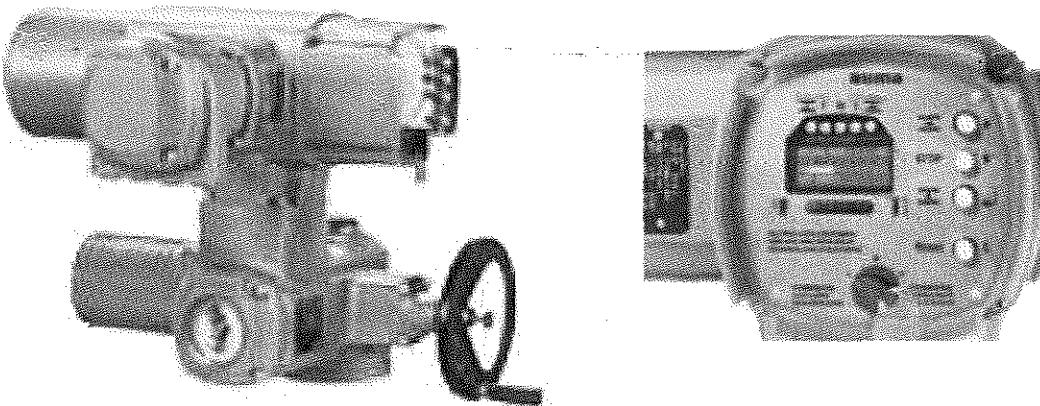
- Worm-wheel gear.
- Life time: tested for opening-closing.
- Life time lubrication.
- Primary and secondary gearbox if required.
- IP 68-8 protection rate.
- Body in ductile iron.



GS 160.3

*Pictures represented without coatings.
The real coatings will be in blue epoxy powder.

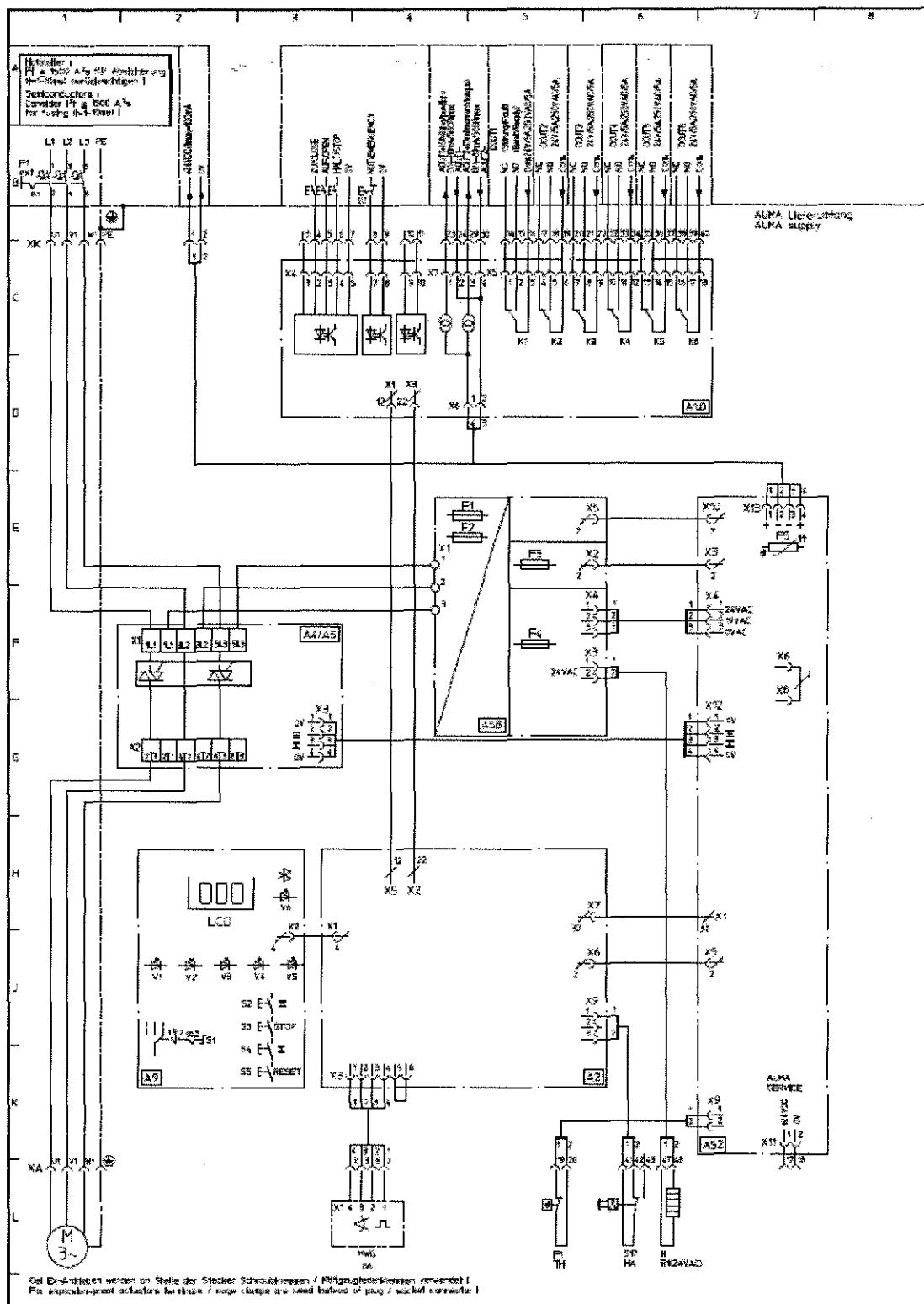
ACTUATOR AUMA SAR WITH AUMATIC



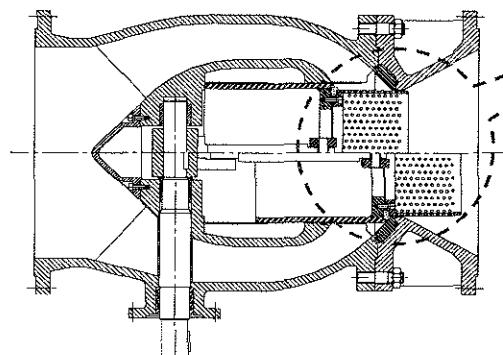
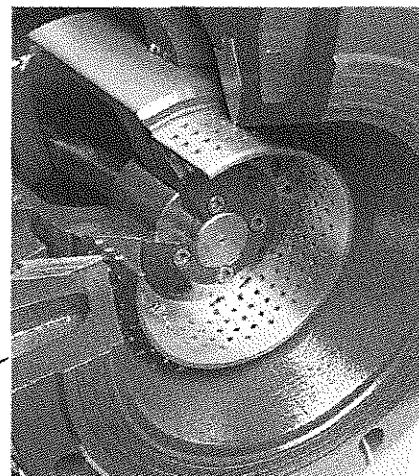
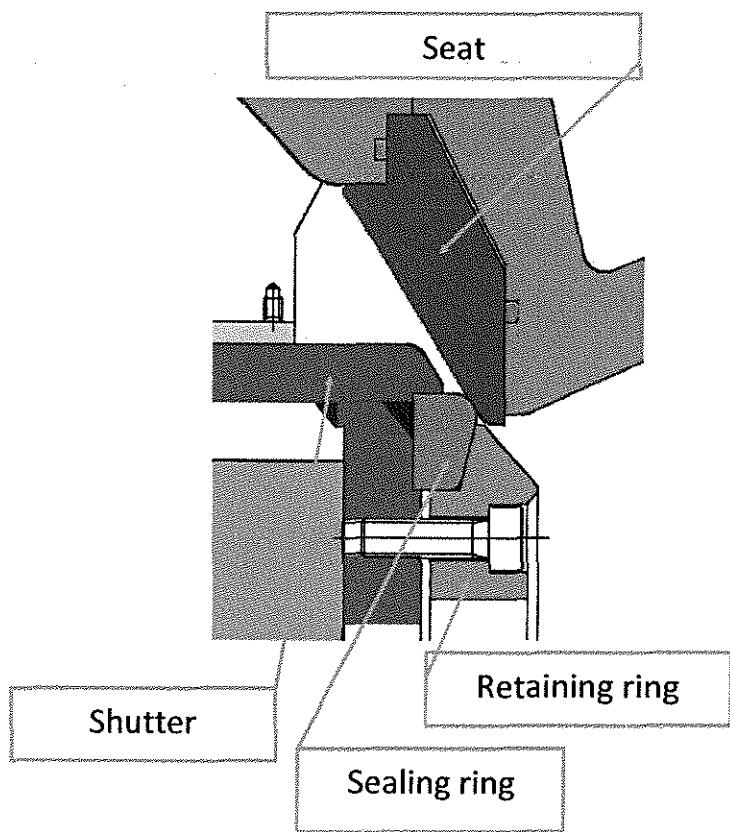
Motor	415V 3ph – 50 Hz: AC motor class F with motor protection by 3 thermostats (in the windings)
Type of duty	short-time duty S4-25% Non-intrusive version MWG Integral local / remote control type AUMATIC Modulating duty according to VDE530 / IEC 34 S4 25%, code SAR 1200 starts/h
Closure direction	Clockwise
Current consumption	Current consumption of controls depending on mains voltage: For permissible variation of the mains voltage 10 % 100 to 120 V AC = max. 740 mA; 208 to 240 V AC = max. 400 mA; 380 to 500 V AC = max. 250 mA; 515 to 690 V AC = max. 200 mA For permissible variation of the mains voltage ±30 %: 100 to 120 V AC = max. 1,200 mA; 208 to 240 V AC = max. 750 mA; 380 to 500 V AC = max. 400 mA; 515 to 690 V AC = max. 400 mA
Overvoltage category	Category III according to IEC 60364-4-443
Switchgear	Thyristor unit for mains voltage up to 500 V AC (recommended for modulating actuators) for AUMA power classes B1, B2 and B3
Control	Via digital inputs OPEN, STOP, CLOSE, EMERGENCY (via opto-isolator, OPEN, STOP, CLOSE with one common), respect minimum pulse duration for modulating actuators.
Control voltage/ current consumption for inputs	24 V DC, current consumption: approx. 10 mA per input. All input signals must be supplied with the same potential.
Status signals (output signals)	6 programmable outputs contacts: <ul style="list-style-type: none">• 5 potential-free NO contacts without common 1 potential free contact, max. 250 V AC, 1 A (resistive load), default configuration: End position CLOSED, end position OPEN, selector switch REMOTE, torque fault CLOSE, torque fault OPEN• 1 potential-free change-over contact, max. 250 V AC, 5 A (resistive load), default configuration: Collective fault signal (torque fault, phase failure, motor protection tripped) Analogue output signal for position feedback<ul style="list-style-type: none">• Galvanically isolated position feedback signal 0/4 – 20 mA (load max. 500 Ω)
Voltage output	Auxiliary voltage 24 V DC, max. 100 mA for supply of control inputs, galvanically isolated from internal voltage supply
Local controls	Selector switch LOCAL - OFF - REMOTE (lockable in all three positions) Push buttons OPEN, STOP, CLOSE, RESET <ul style="list-style-type: none">• Local Stop: The actuator can be stopped via push button Stop of local controls if the selector switch is in position REMOTE. Not activated when leaving the factory. 6 indications lights: <ul style="list-style-type: none">• End position and running indication CLOSED (yellow), torque fault CLOSE (red), motor protection tripped (violet), torque fault OPEN (red), end position and running indication OPEN (green), Bluetooth (blue) Graphic LC display, illuminated
Application functions	Switch-off mode adjustable <ul style="list-style-type: none">• Limit or torque seating for end position OPEN and end position CLOSED Torque by-pass, adjustable up to 5 seconds (no torque monitoring during start-up time) Start and end of stepping mode as well as ON and OFF times (1 to 1,800 s) can be set individually for directions OPEN and CLOSE. Any 8 intermediate positions between 0 and 100 %, reaction and signal behaviour programmable Programmable timer function
Bluetooth communication interface	Bluetooth class II chip, version 2.0 with a range up to 10 m in industrial environments. Supports the SPP Bluetooth profile (Serial Port Profile). Programming software: AUMA ToolSuite, commissioning and diagnostic tool for Windows-based PCs, PDAs and smartphones

Safety functions	EMERGENCY operation, programmable behaviour <ul style="list-style-type: none"> Digital input low active Reaction can be selected: Stop, run to end position CLOSED, run to end position OPEN, run to intermediate position <ul style="list-style-type: none"> Torque monitoring can be by-passed during EMERGENCY operation. Thermal protection can be by-passed during EMERGENCY operation (only in combination with thermoswitch within actuator, not with PTC thermistor).
Monitoring function	Valve overload protection (adjustable), results in switching off and generates fault signal Motor temperature monitoring (thermal monitoring), results in switching off and generates fault indication Monitoring the heater within actuator, generates warning signal Monitoring of permissible on-time and number of starts (adjustable), generates warning signal Operation time monitoring (adjustable), generates warning signal Phase failure monitoring, results in switching off and generates fault signal Automatic correction of rotation direction upon wrong phase sequence (3-ph AC current)
Diagnostic function	Electronic device ID with order and product data Logging of operating data: A resettable counter and a lifetime counter each for: Motor running time, number of starts, torque switch trippings in end position CLOSED, limit switch trippings in end position CLOSED, torque switch trippings in end position OPEN, limit switch trippings in end position OPEN, torque faults CLOSE, torque faults OPEN, motor protection trippings Time-stamped event report with history for setting, operation and faults: <ul style="list-style-type: none"> Status signals according to NAMUR recommendation NE 107: "Failure", "Function check", "Out of specification", "Maintenance required" Torque characteristics <ul style="list-style-type: none"> 3 torque characteristics (torque-travel characteristic) for opening and closing directions can be saved separately. Torque characteristics stored can be shown on the display.
Motor protection evaluation	Monitoring the motor temperature in combination with thermoswitches within actuator motor
Electrical connection	AUMA plug/socket connector with screw-type connection
Threads for cable entries	Metric threads
Use	Indoor and outdoor use permissible
Mounting position	Any position
Installation altitude	≤ 2,000 m above sea level
Ambient temperature	-25 °C to +60 °C
Humidity	Up to 100 % relative humidity across the entire permissible temperature range Anti-condensation heater in switch compartment, internal supply
Enclosure protection according to EN 60529	IP 68 with AUMA 3-phase AC motor/1-phase AC motor According to AUMA definition, enclosure protection IP 68 meets the following requirements: <ul style="list-style-type: none"> Depth of water: maximum 8 m head of water Duration of continuous immersion in water: Max. 96 hours Up to 10 operations during continuous immersion Modulating duty is not possible during continuous immersion.
Pollution degree	Pollution degree 4 (when closed)
Vibration resistance according to IEC 60068-2-6	1 g, from 10 Hz to 200 Hz Resistant to vibration during start-up or for failures of the plant. However, a fatigue strength may not be derived from this. Not valid in combination with gearboxes.
Corrosion protection	Suitable for installation in industrial units, in water or power plants with a low pollutant concentration as well as for installation in occasionally or permanently aggressive atmosphere with a moderate pollutant concentration (e.g. wastewater treatments plants, chemical industry)
Finish coating	Powder paint and 2-component iron-mica combination
Colour	AUMA silver-grey (similar to RAL 7037)
Weight	Approx. 7 kg (with AUMA plug/socket connector)
Heater in switch compartment	Resistance type heater with 5 W, 24 V AC
Non-intrusive setting	Magnetic limit and torque transmitter MWG for 1 to 500 turns per stroke or 10 to 5,000 turns per stroke
Position and torque feedback signal	Via AUMATIC
Mechanical position indicator	Continuous indication, adjustable indicator disc with symbols OPEN and CLOSED
Running indication	Blinking signal via controls
Indication for manual operation	Indication whether manual operation is active/not active via single switch (1 change-over contact)

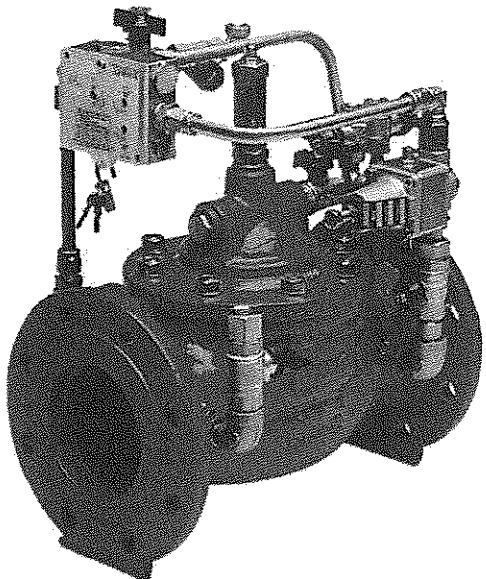
WIRING DIAGRAM: TPC A-0A2-1C2-A000 TPA 00R100-3I1-000



ANTI CAVITATION CYLINDER



PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00



CHOICE OF THE VALVE

The pressure sustaining/relief valve E2116-00 is controlled by a normally closed diaphragm actuated, two ways, spring loaded, adjustable pressure discharging control valve (rep 1), set to maintain a minimum and constant pressure at valve inlet.

When upstream pressure increases to the sustaining/relief set point, the control pilot (rep1) throttles towards open, increasing flow through the pilot circuit; pressure is decreased in the main valve control chamber, inducing the main valve to modulate towards open an appropriate amount, relieving excess upstream pressure through the main valve to its outlet.

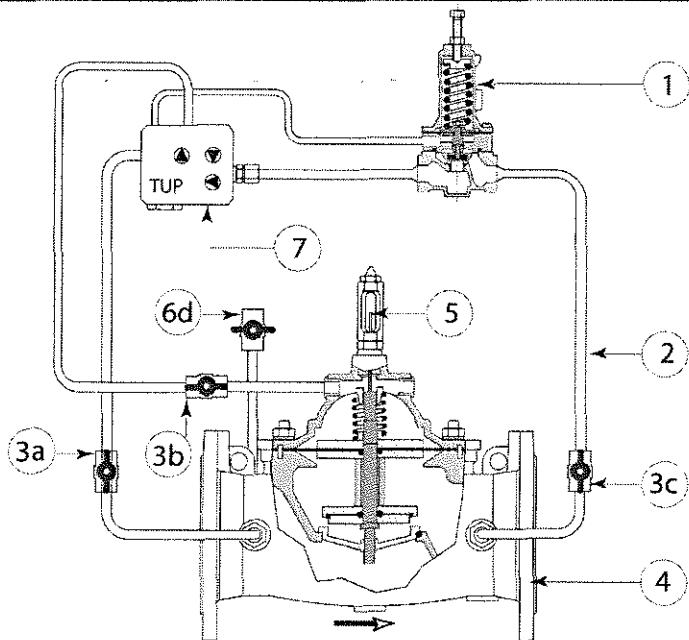
The opening speed can be adjusted by independent flow regulator "OPENING SPEED = OS" located in lockable central control "TUP - 93" rep7]

As the upstream pressure decreases to the sustaining/relief set point, the control pilot (rep1) throttles towards closed, restricting the flow through the pilot circuit. Pressure is increased in the main valve control chamber, inducing the main valve to modulate towards closed an appropriate amount, maintaining the desired upstream pressure.

The closing speed can be adjusted by the independent flow regulator "CLOSING SPEED = CS" located in the lockable central control "TUP-93".

If upstream pressure is dropping below the sustaining/relief set point and is remaining below the set point, the main valve is closing drop-tight.

HYDRAULIC SCHEME

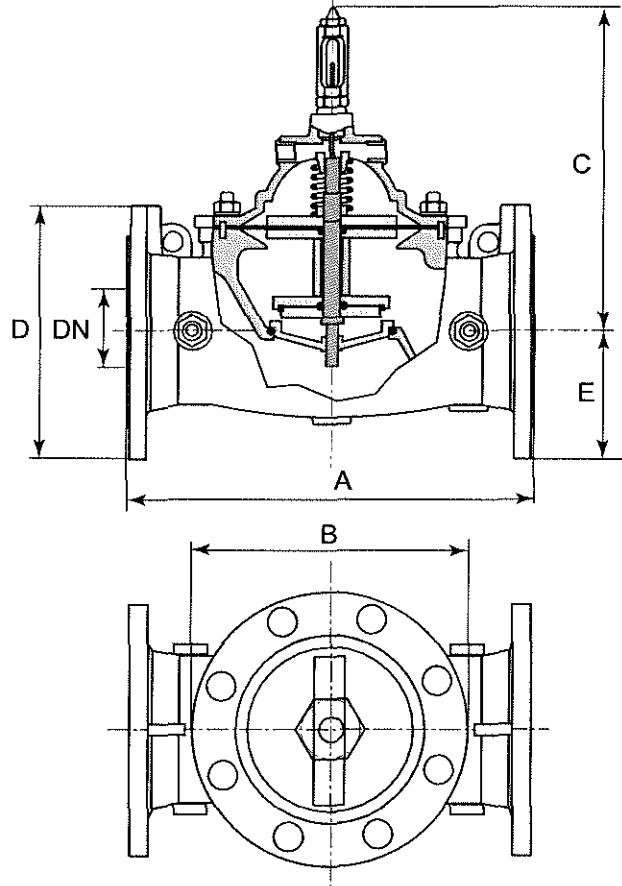


Item	Description	Material
1	Pressure sustaining \ relief pilot	
2	Tube	Stainless steel to EN 10088-3 X2CrNiMo17-12-2 material 1.4404 (AISI316L)
3a 3b 3c	Ball valve	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
4	Main valve	
5	Position indicator with manual venting cock	
6d	Gauge holder ball valve (manometer)	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
7	Centralized control unit	

REFERENCES

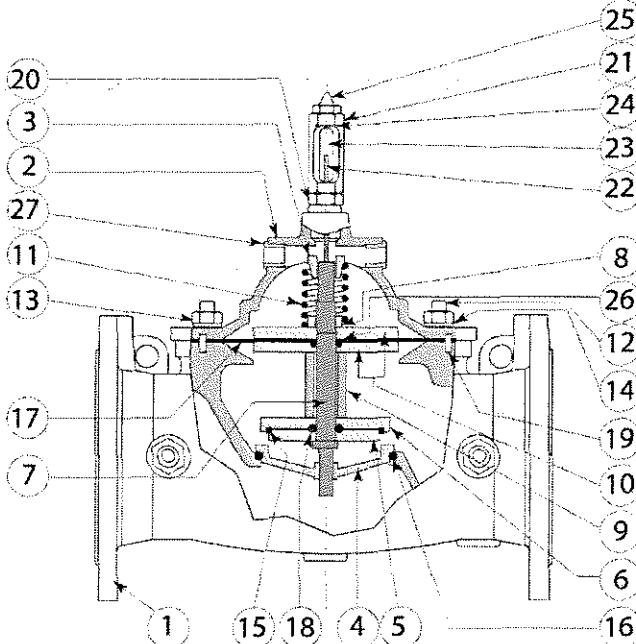
DN	Mass (kg)	PN16 bar
500	935,0	

DIMENSIONS AND MASS



Flanges according to ISO 7005-2.

DN	A	B	C	D	E	Mass
			mm			kg
500	1250	842	840	670	335	820

MATERIAL AND COATING

Item	Qty	Description	Material (type)
01	01	Body	Ductile iron according to ISO 1083 grade GS400-15 or 500-7 / EN 1563 GJS-400-15 or 500-7+ Epoxy minimum thickness 300µ
02	01	Cover	Ductile iron according to ISO 1083 grade GS400-15 or 500-7 / EN 1563 GJS-400-15 or 500-7+ Epoxy minimum thickness 300µ
03	01	Cover bearing	Bronze
04	01	Seat	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
05	01	Quad retainer plate	Stainless steel to EN 10088-3 X2CrNiMo17-12-2 material 1.4404 (AISI316L)
06	01	Quad retainer	Ductile iron according to ISO 1083 grade GS400-15 or 500-7 / EN 1563 GJS-400-15 or 500-7+ Epoxy minimum thickness 300µ
07	01	Stem	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
08	02	Stem nuts	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
09	01	Spacer	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
10	02	Diaphragm washers	Steel S235JR + Epoxy minimum thickness 300µ*
11	01	Spring	Stainless steel to EN 10088-3 X10CrNi18-9 material 1.4319 (AISI302)
12	20	Stud	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
13	20	Nuts	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (A4-80)
14	20	Washer	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
15	01	Quad-ring	NBR (with non toxicity certificate)
16	01	Seat O-ring	Viton
17	01	Diaphragm	NBR (with non toxicity certificate), nylon reinforced
18	01	O-ring	EPDM
19	02	Centring taper pin	Stainless steel to EN 10088-3 X2CrNiMo17-12-2 material 1.4404 (AISI316L)
20	01	Base position indicator	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
21	01	Position indicator housing	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
22	01	Position indicator stem	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)
23	01	Position indicator	Glass
24	02	O-ring	NBR
25	01	Manual venting cock	Brass Ni-plated
26	01	O-ring	Viton
27	07	Reduction	Stainless steel to EN 10088-3 X5CrNiMo17-12-2 material 1.4401 (AISI316)

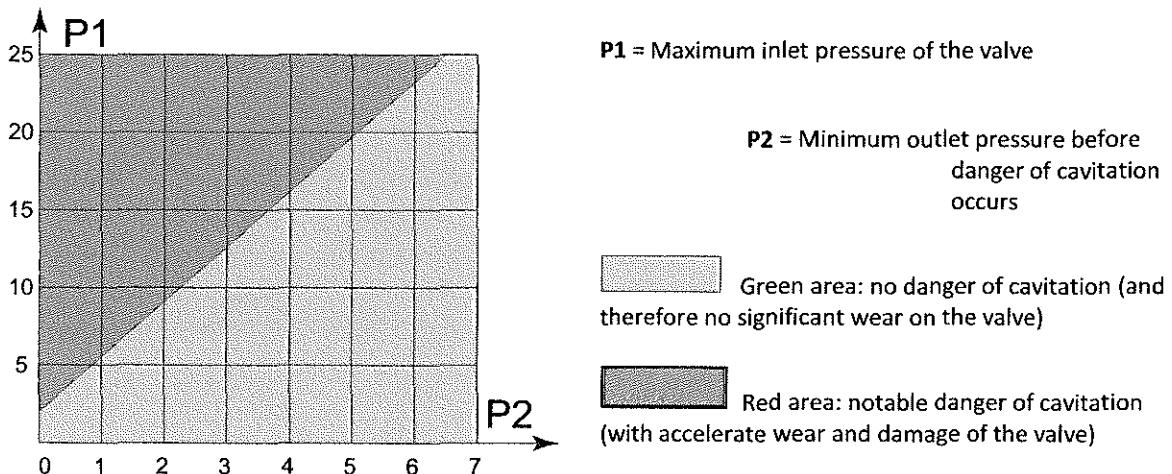
PRESSURE SUSTAINING / RELIEF PILOT RANGE

In order to get the best accuracy from the pressure sustaining valve operation, the preset values for the minimum upstream pressure should be included in the indicated range of the pilot valves. If it is very near to the extreme limits of the range, it would then be advisable to replace the spring by the correct one.

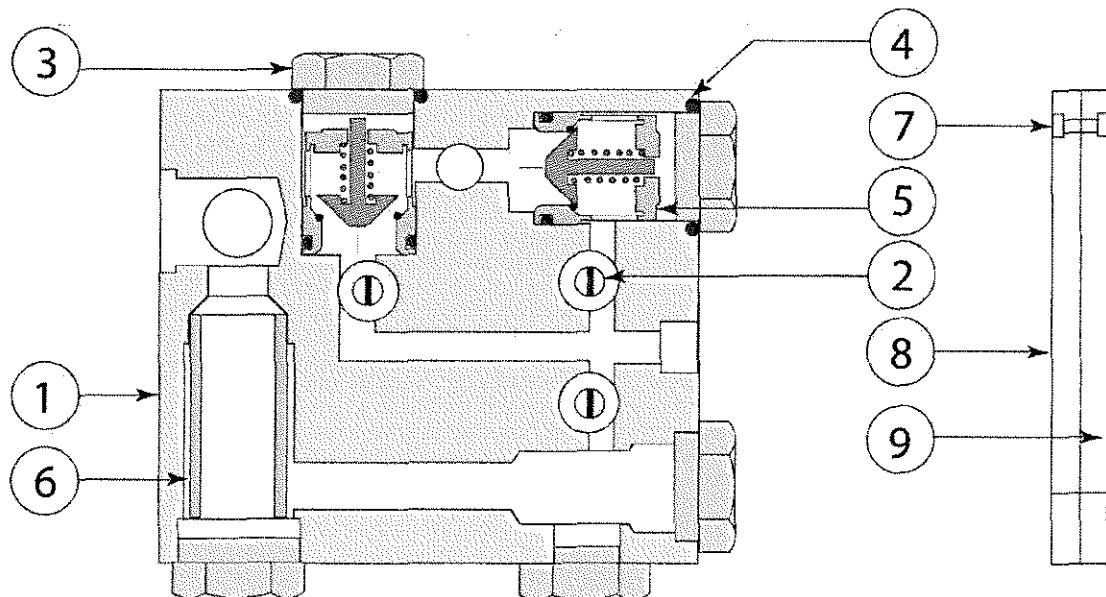
Available range (bar)	Pilot PV ZOC	Approximate correction Bar/turn
1.4-12	Oui	2,0

LIMIT CONDITION

Cavitation diagram: it's the admissible differential pressure normally used in the regulating valve

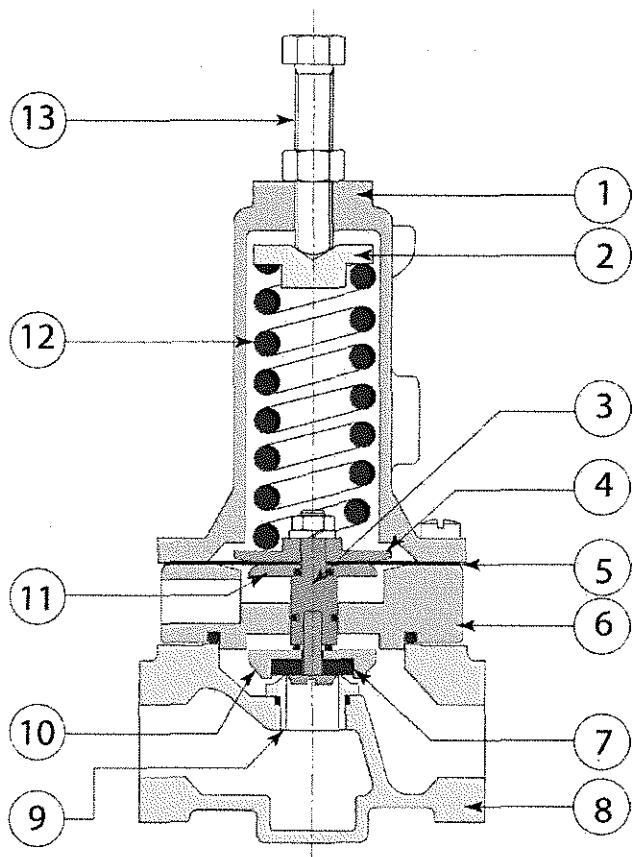


CENTRAL CONTROL UNIT TUP 93



Item	Quantity	Description	Material (type)
01	01	Body	AISI 303
02	03	Cock	AISI 303
03	03	Plug	AISI 303
04	03	O-ring	NBR
05	02	Non return valve (WRC)	
06	01	Screen	AISI 316
07	01	Rivet	Brass
08	01	Bottom label	Polycarbonate makrolon
09	01	Top label	Polycarbonate makrolon

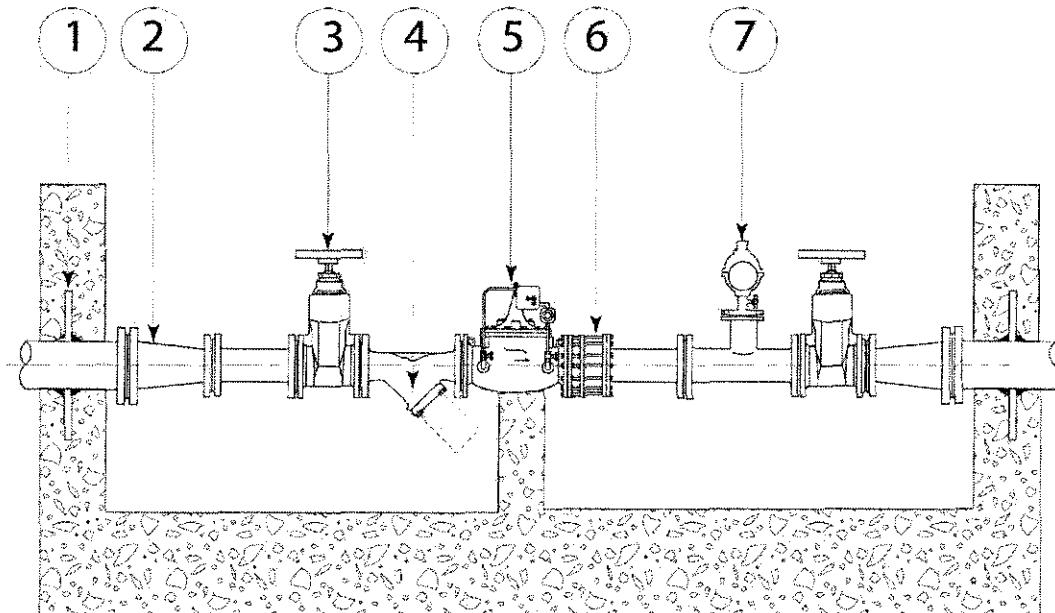
PILOT PV 20 c



Item	Description	Material
1	Pilot cover	Bronze
2	Top spring guide	Bronze
3	Obturator / stem	Brass
4	Top diaphragm washer	Brass Ni-plated
5	Diaphragm	NBR nylon reinforced
6	Spacer	Brass Ni-plated
7	Seat gasket	NBR
8	Body	Bronze
9	Seat	AISI 316
10	Seat retainer	Brass
11	Bottom diaphragm washer	Brass Ni-plated
12	Spring	AISI 302
13	Setting screw	AISI 303

MOUNTING SCHEME (1)

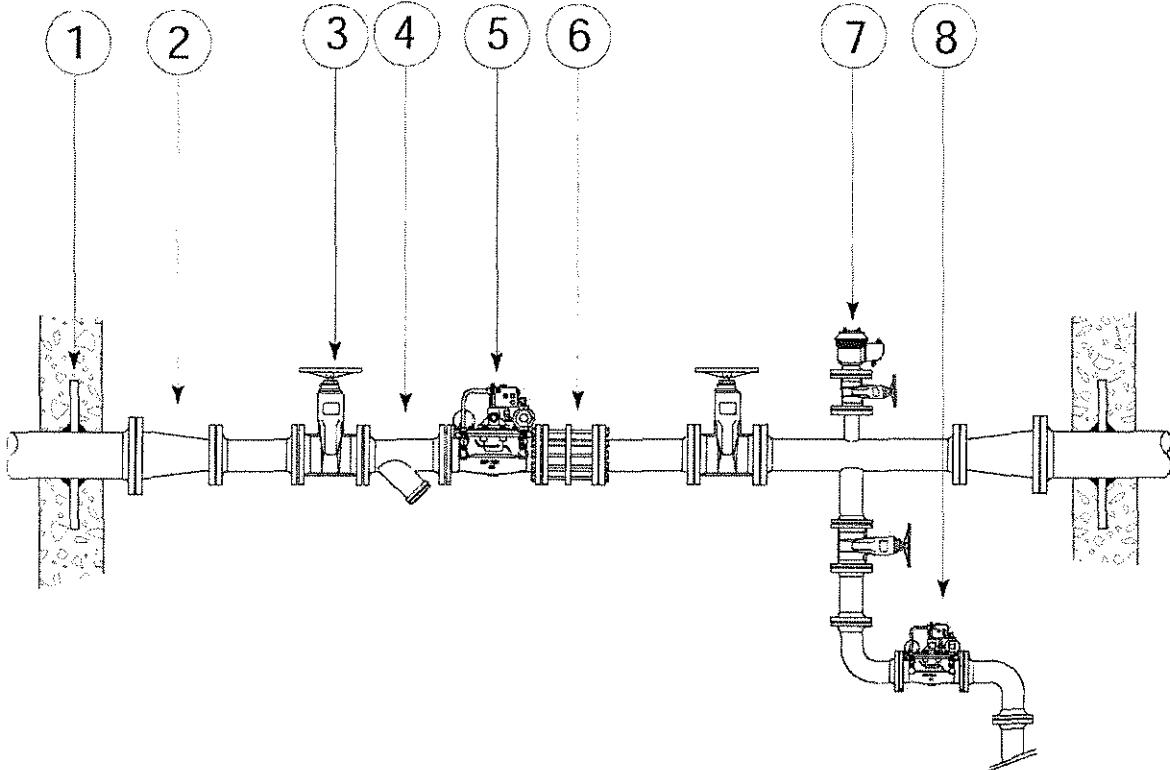
Complementary products



Item	Quantity	Description
01	2	Attachment flange
02	2	Flanged taper
03	3	Isolating valve
04	1	Strainer with drain cock
05	1	Automatic control valve E2001
06	1	Dismantling joint
07	1	Air release / vacuum breaker valve

MOUNTING SCHEME (2)

Complementary products



Item	Quantity	Description
01	2	Attachment flange
02	2	Flanged taper
03	3	Isolating valve
04	1	Strainer with drain cock
05	1	Automatic control valve E2001
06	1	Dismantling joint
07	1	Air release / vacuum breaker valve
08	1	Security valve

PIPELINE PROTECTION	 PAMO SAINT-GOBAIN	Ref : MO 14 QAT 141 R Date : 07/2014 PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00 REINFORCED VERSION DN 500 PN 16
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INSTALLATION

PACKING AND STORAGE

The valves from ND 40 to ND 200 are packed in special cardboard boxes. Outside the carton are clearly pointed out:

- The arrow indicating the position of the valve;
- The name of the customer;
- The code of the valve;
- The number of order confirmation.

The valve is protected by two hardening foam cushions, carefully coated by a thermal plate. This kind of packing if properly stored avoids all the damages originated from transport, unloading, and handling before installation. Avoid storing it under the rain for more than 24 hours!

Open the upper side of the carton and remove the upper cushion. Do not lift the valve by utilizing the pilot, the pilot circuit, or the position indicator. For any kind of handling we recommend to utilize proper eyebolts.

INSTALLATION

The mounting scheme of the valve is shown on the drawing ; if the valve is working as pressure sustaining device in a transport line, it may be recommended to install a by-pass around it, which will allow to put it out of service during some hours for maintenance purpose, without generating problem for the exploitation of the system.

Should installation require the main valve stem to be horizontal (cover pointed sideways), manufacturer should be consulted concerning valves of ND 200 mm and larger.

Note:

All sizes on request are available with an additional venting cover device (venting cock installed at the top of the cover) to permit a simple escaping of air during the first commissioning.

- Before control valve assembly, make sure that pipeline it is free from foreign matters or any other obstacle.
(NOTE: pipeline must be cleaned, possibly, before assembly. For an ideal pipeline cleaning we suggest a 1.5 m/sec speed during several hours!).
- In presence of foreign matters into the fluid it is indispensable to adopt a strainer on valve upstream side.
- Keep free around the valve space enough for operations as maintenance and calibration.
- Set up the valve according to main valve cast arrow indicating flow sense.
- Install the valve so that the FLOW ARROW marked on the valve body matches flow through the line

UPSTREAM  **DOWNSTREAM**

START UP OF AN AUTOMATIC CONTROL VALVE REQUIRES THAT PROPER PROCEDURES BE FOLLOWED. TIME MUST BE ALLOWED FOR THE VALVE TO REACT TO ADJUSTMENTS AND THE SYSTEM TO STABILIZE. THE OBJECTIVE OF THE FOLLOWING PROCEDURE IS TO BRING THE VALVE INTO SERVICE IN A CONTROLLED MANNER.

Pipeline Protection	PAM SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014
PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00 REINFORCED VERSION DN 500 PN 16		

COMMISSIONING: see hydraulic scheme

Close upstream and downstream (if existing) isolation valve see scheme Q5 15 00 10e.

Open all ball cocks (3 a and b) of the pilot circuit. Failure to open these ones will prevent the valve from functioning properly. Ball valve 3 C must be closed.

TUP - 93 (rep 7) pre-setting:

- a) Reaction speed [RS] is already setting = 3
- b) Opening speed [OS] is already setting = 6
- c) Closing speed [CS] is already setting = 2

Calibrate setting screws "OPENING" and "CLOSING" according to the practical service conditions (see below).

If not included in the order, install one pressure gauge by utilising the gauge holder ball valve (6 d).

INITIAL SET UP

1. On pressure sustaining/relief control (rep 1), loose the counter-nut and turn the setting screw clockwise (IN), until the screw is practically compressing the spring at its maximum. This is simulating the highest setting value of the spring range, from which the commissioner will have to gradually decrease the pressure, up to the prescribed one.

2. Check the setting of the TUP - 93, as indicated above.

3. Open upstream isolation valve SLOWLY of one / two turns maximum, in order to allow a controlled filling of the regulating valve, which is going to close [in any case, if the maximum set value of control (1) is higher than the upstream pressure of the system].

4. Vent air of main valve cover through the safety venting cock mounted on the valve position indicator (5).

5. Check the upstream pressure gauge, which should show a pressure value corresponding to the system pressure. To open partially the inlet and outlet isolating valve, and completely the ball valve 3c.

Then to turn progressively by $\frac{1}{2}$ turn the regulating screw of control (1) anti-clockwise (OUT), to decrease the set maximum pressure. Wait some seconds (5 - 10 s) after each (1/2 turn) correction, allowing to the pilot circuit to react.

SUSTAINING VALVE

As soon as the flow starts in the pilot circuit (WHISTLE of water), observe the upstream gauge and unscrew further and very slowly the regulating screw of control (1). The main valve (rep 4) opens, releasing the inlet pressure to its outlet; wait until the main valve is stable and read the set pressure.

Unscrew further the regulating screw of control (rep 1), until the inlet pressure is reaching the prescribed value.

SUSTAINING VALVE Fine tune the pressure sustaining pilot (1) to the set point:

SCREW CLOCKWISE (IN) ----->	increase inlet pressure
SCREW ANTI-CLOCK (OUT) --->	decrease inlet pressure

RELIEF VALVE

As soon as the flow starts in the pilot circuit (WHISTLE of water), screw clockwise (IN) the regulating screw of the control (rep 1), in order to set the pressure relief value at higher value than the one of the system [system pressure + prescribed overpressure, which can be computed by using the data given here above].

Example:

Pressure relief valve mounted on a pumping transport line (pump in service) / control (1) has a standard range of 1.4 - 14 bars:

- a) Dynamic pressure P1 of the system starts to open the pilot (1)
- b) overpressure chosen = 1 bar, requesting to screw clockwise the regulating screw of pilot (1) of half-turn -----> relief pressure value is now set to [P1 + 1 bar]

PIPELINE PROTECTION	 PAMO SAINT-GOBAIN	Réf : MO 14 QAT 141 R Date : 07/2014 PRESSURE SUSTAINING RELIEF VALVE TYPE E2116-00 REINFORCED VERSION DN 500 PN 16
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6. When the desired setting is reached, open completely, but slowly, the upstream isolation valve.
7. Then lock the counter-nut of pilot (1) and the plastic cap.
8. **"TUP - 93" adjusting closing speed:**
The closing speed adjustment reduces the flow entering in the main valve (4) control chamber.
Do not reduce this value below 1 to assure a correct closing of the valve.
- "TUP - 93" adjusting opening speed:**
The opening speed adjustment reduces the flow in exit from the main valve (4) control chamber. If the opening speed of the valve is too fast [pre-setting of the flow regulator (OS) at value = 6] decrease the adjustment of the regulator progressively towards 3. In the opposite case to increase the value but without going below value 1 to assure a correct opening of the valve.

MAINTENANCE

Recommended spare parts

Full set of gaskets for E2001

Full set of gaskets for PV20 C

The quality of the material used in the manufacture of our valves should produce no wear of the internal components.
However we are recommending:

AFTER 6 MONTHS OF SERVICE

Control and clean eventually the TUP - 93 screen

Note: an obstructed screen due progressively the valve out of order.

AFTER 12/18 MONTHS OF SERVICE

- Control and clean the TUP - 93screen.
- Take the main valve apart, by removing first the complete pilot circuit.
- Unscrew the stud nuts and remove the cover and internal diaphragm assembly.
- Check for any eventual damage of the QUAD-RING and the diaphragm.
- Clean thoroughly the internal part of the valve, grease slightly the stem at both guided locations (water grease, non-toxic!!).
- Assemble the main valve and the pilot circuit.
- Put the valve back into service.

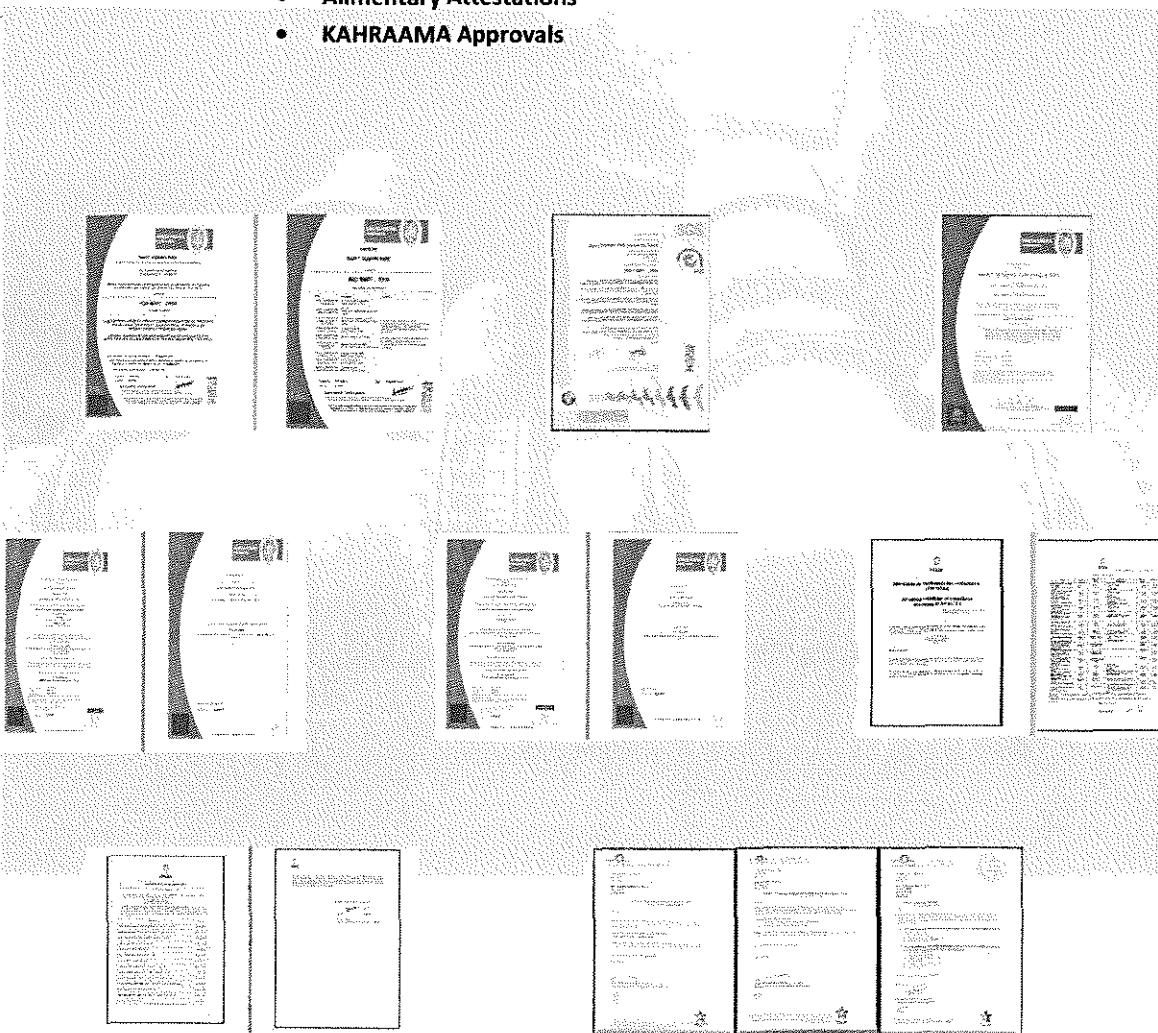
This control should then allow determining the cycle of the requested maintenance, since it is taking into consideration the true service conditions of the valve.

For any further information contact our Customer Service, indicating all data as per plastic label on main valve body. Give full detailed information's about working conditions, the type of problem, and report the adjusting values (OS-CS-RS).

QATAR	MO 14 QAT 141 R 07/2014
GTC / 626A / 2014 <i>Construction of Mega Reservoir PRPS at Umm Birka Package A</i>	CERTIFICATES

4. CERTIFICATES :

- Management Quality System Certificates ISO 9001-2008
- Environment Certificates ISO 14001-2004
- Conformity Certificates EN 1074-2000
- Alimentary Attestations
- KAHRAAMA Approvals



CERTIFICATES



Réf : MO 14 QAT 141 R
Date : 07/2014

MANAGEMENT QUALITY
SYSTEM CERTIFICATES
ISO 9001-2008

MANAGEMENT QUALITY SYSTEM CERTIFICATES ISO 9001-2008



SAINT GOBAIN PAM

Il s'agit d'un certificat multi-sites. Le détail des sites est énuméré dans l'annexe de ce certificat.

91 Avenue de la Libération
54000 NANCY - FRANCE

Bureau Veritas Certification certifie que le système de management de l'organisme susmentionné a été audité et jugé conforme aux exigences de la norme :

Standard

ISO 9001 : 2008

Domaine d'activité

CONCEPTION, PRODUCTION ET COMMERCIALISATION DE PRODUITS
POUR CANALISATIONS ET ACCESSOIRES, APPAREILS DE
ROBINETTERIE ET PIÈCES DE VOIRIE.

DESIGN, MANUFACTURE AND MARKETING OF PRODUCTS FOR
PIPELINES AND ACCESSORIES, VALVES AND MUNICIPAL CASTINGS.

Date de début du cycle de certification : 28 janvier 2014

Sous réserve du fonctionnement continu et satisfaisant du système de management de l'organisme, ce certificat est valable jusqu'au : 27 janvier 2017

Date originale de certification : 11 février 1993

Certificat n° : FR013520.1

Date : 28 janvier 2014

Attaire n° : 8079851

Jacques Matillon - Directeur général

Adresse de l'organisme certificateur : Bureau Veritas Certification Paris
80, avenue du Général de Gaulle - Immeuble La Guillotière - 92046 Paris La Défense

Des informations supplémentaires concernant le périmètre de ce certificat ainsi que l'applicabilité des exigences du système de management peuvent être obtenues en consultant l'organisme. Pour vérifier la validité de ce certificat, vous pouvez téléphoner au : +33 (0)1 41 97 00 60.



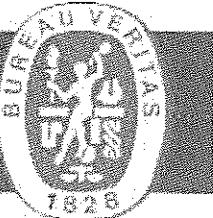
CERTIFICAT
DE SYSTÈME
DE GESTION
ADMINISTRATIF,
ACCORDE PAR
COFRAC

CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**MANAGEMENT QUALITY
SYSTEM CERTIFICATES
ISO 9001-2008**

BUREAU VERITAS
Certification

**ANNEXE****SAINT GOBAIN PAM***Standard***ISO 9001 : 2008***Périmètre de Certification*

Site	Adresse	Périmètre
SAINT GOBAIN PAM Siège Social	91 Avenue de la Libération, 54000 NANCY, France	
SAINT GOBAIN PAM Siège Opérationnel	BP 109, 54704 PONT A MOUSSON CEDEX, France	
SAINT GOBAIN PAM USINE DE PONT A MOUSSON	Av Camille Cavallier - BP 129, 54704 PONT A MOUSSON CEDEX, France	CONCEPTION, PRODUCTION ET COMMERCIALISATION DE PRODUITS POUR CANALISATIONS ET ACCESSOIRES, APPAREILS DE ROBINETTERIE ET PIÈCES DE VOIRIE.
SAINT GOBAIN PAM USINE DE FOUG	Av des Fonderies, 54570 FOUG, France	
SAINT GOBAIN PAM USINE D'EBAYARD	52170 CHEVILLON, France	
SAINT GOBAIN PAM FONDERIE DE BLENOO	Avenue Camille Cavallier, 54700 PONT A MOUSSON, France	DESIGN, MANUFACTURE AND MARKETING OF PRODUCTS FOR PIPELINES AND ACCESSORIES, VALVES AND MUNICIPAL CASTINGS.
SAINT GOBAIN PAM USINE DE TOUL	21 de la Croix de Metz, 54200 TOUL, France	
SAINT GOBAIN PAM Siège Social Italie	Via E Romagnoli 6, 20148 MILANO, Italie	
SAINT GOBAIN PAM USINE DE LAVIS Italie	Via Galvani N°6, 38015 LAVIS TN, Italie	

Certificat n° : FR013520-1

Date : 26 janvier 2014

Affaire n° : 6079851

Jacques Maillion - Directeur général

Adresse de l'organisme certifié : Bureau Veritas Certification France
50, avenue du Général de Gaulle - Immeuble Le Guitaut - 92046 Paris La Défense

Des informations supplémentaires concernant le périmètre de ce certificat ainsi que l'applicabilité
des exigences du système de management peuvent être obtenues en consultant l'organisme.
Pour vérifier la validité de ce certificat, vous pouvez téléphoner au : +33 (0)1 41 97 00 60.

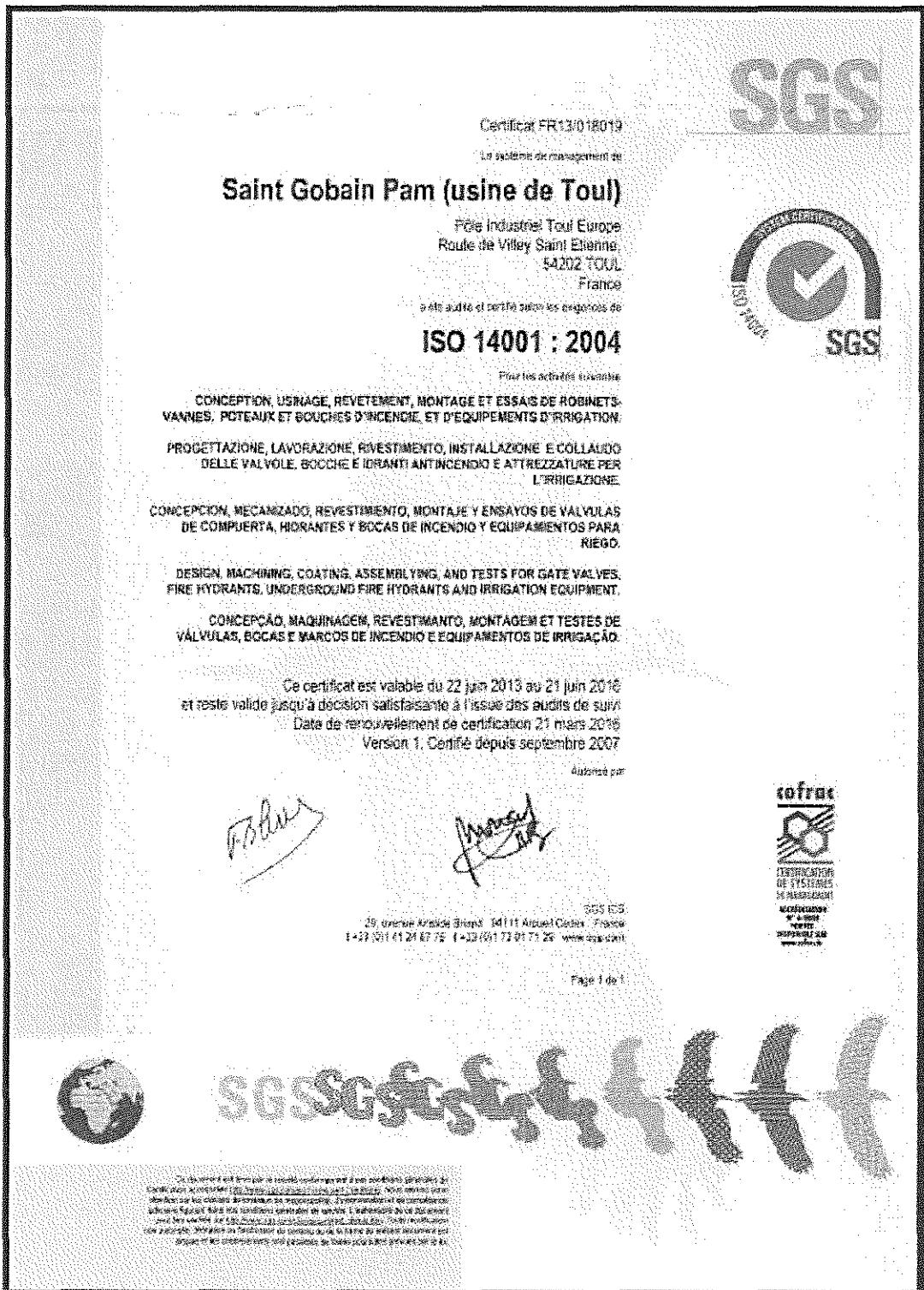


CERTIFICATESRéf : MO 14 QAT 141 R
Date : 07/2014**ENVIRONMENT CERTIFICATES
ISO 14001-2004****ENVIRONMENT CERTIFICATES ISO 14001-2004**

CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**ENVIRONMENT CERTIFICATES
ISO 14001-2004**



CERTIFICATESRef.: MO 14 QAT 141 R
Date: 07/2014**CONFORMITY CERTIFICATES
EN 1074-2000****CONFORMITY CERTIFICATES EN 1074-2000****Certificate of Conformity**

Addressed to

SAINT GOBAIN PAM ITALIA SPA

Factory: LAVIS

Via Calvari, 6 - 38015 LAVIS (TN) - ITALY

Bureau Veritas Italia S.p.A. certify that the following products

Valves for water pipelines or sewerage pipelines

Commercial brand:

Euro Stop
from Ø 150 to Ø 2000 PN 10/16/25Euro Stop NGL
from Ø 150 to Ø 800 PN 10/16/25

designed and produced by Saint Gobain Canalisation
have been evaluated and found in conformity against the requirements of
the following standard:

EN 1074 – 1 & 2 : 2000

Valves for water supply, fitness for purpose requirements and appropriate verification tests.

Part 1: general requirements

Part 2: isolating valves

These products belong to family

Ductile iron piping systems including pipes, fittings and valves to convey water
(water intended for human consumption, irrigation, fire protection, sewerage)

Certification according requirements stated in:

RT ACCREDIA 06
GP01P Bureau Veritas Italia S.p.A. rev.7 07.2012

Original Receipt Date: 21/12/2008
Last Revision Date: 29/01/2013
Expiration Date: 28/01/2016
Subject to the continued satisfactory operation, to check the certificate validity please refer to website: www.bvitalia.it
Further information regarding the scope of the certificate and the applicability of standards' requirements may be obtained by consulting the agreement.

Date: 29/01/2013

Certificate n°: 220/007

ACREDIA

EN ISO 9001
EN ISO 14001
ISO 18001
IEC 60068-2-27
ISO 9001:2008
ISO 14001:2004
IEC 60068-2-27
ISO 18001:2007
AS/NZS ISO 9001
AS/NZS ISO 14001
AS/NZS IEC 60068-2-27
AS/NZS ISO 18001

Bureau Veritas Italia S.p.A. - Via Filzimare, 35 - 38125 MILANO

CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**CONFORMITY CERTIFICATES
EN 1074-2000****Appendix 01**

Awarded to:

SAINT GOBAIN PAM ITALIA SPA

Factory: LAVIS

Via Galvani, 6 - 38015 LAVIS (TN) - ITALY

Epoxy Coating for fittings from commercial brand EUROSTOP.

EN 14901:2006

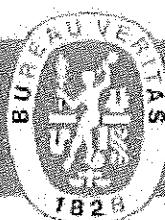
Ductile iron pipes, fittings, accessories- Epoxy coating (heavy duty) of ductile iron fittings and accessories

Last emission date: 29/01/2013

Certificato N°: **220/007**



Bureau Veritas Italia S.p.A - Via Mazzini, 19 - 20126 MILANO

CERTIFICATESRéf : MO 14 QAT 141 R
Date : 07/2014**CONFORMITY CERTIFICATES
EN 1074-2000****SUREAU VERITAS
Certification****Certificate of Conformity**Awarded in
SAINT GOBAIN TOULFactory: **TOUL**

21 croix de Metz 54200 TOUL - FRANCE

Bureau Veritas Italia S.p.A. certify that the following products:

Valves for water pipelines or sewerage pipelines

from Ø 60 to Ø 400

Commercial brand:
Euro 29

designed and produced by Saint Gobain Canalisation
have been evaluated and found in conformity against the requirements of
the following standard:

EN 1074-1&2:2000

Valves for water supply, fittings for purpose requirements and appropriate verification tests
Part 1: general requirements
Part 2: isolating valves

These products belong to family

Ductile iron piping systems including pipes, fittings and valves to convey water
(water intended for human consumption, irrigation, fire protection, sewerage).

Certification according requirements stated in:

**RT ACCREDIA 06
GP01P Bureau Veritas Italia S.p.A. rev.7 07.2012**

Original Certificate Date: 21/12/2006
Last Revision Date: 29/01/2013
Signature Date: 28/01/2016
Subject of the mentioned certificate operation, to check the certificate validity please refer to website www.bureauveritas.it
Further clarifications regarding the scope of this certificate and the applicability of standards requirements may be obtained by consulting the organization.

Date 29/01/2013

Certificate N° 220/007

ACREDIAS02-NP-3954
S02-NP-3955
S02-NP-3956
S02-NP-3957
S02-NP-3958
S02-NP-3959

Bureau Veritas Italia S.p.A. - Via Minerva, 15 - 20129 MILANO

CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**CONFORMITY CERTIFICATES
EN 1074-2000**

BUREAU VERITAS
Certification

**Appendix 01**

Awarded to:

SAINT GOBAIN PAM

Factory: TOUL
ZI croix de Metz 54200 TOUL - FRANCE

Applied Coating:

EN 14991:2006

Ductile iron pipes, fittings, accessories- Epoxy coating (heavy duty) of ductile iron fittings and accessories.

Date: 29/01/2013

Certificate N°: **220/007**

Bureau Veritas Italia S.p.A - Via Mazzini, 18 - 20138 MILANO



CERTIFICATES



Réf : MO 14 QAT 141 R
Date : 07/2014

CONFORMITY CERTIFICATES
EN 1074-2000



Attestation de conformité des ventouses à l'EN 1074-4

Air valves certificate of compliance according to EN 1074-4

Centre Emetteur/Performing Center : METZ
CB188/13/2566547.C.TG n°1

Le soussigné T. GARCIA, Expert, agissant dans le cadre des conditions générales d'intervention de la Division France du BUREAU VERITAS, et à la demande de la Société :
The undersigned, T.GARCIA, Surveyor acting within the scope of the general conditions of Division France of BUREAU VERITAS and at the request of :

Saint-GOBAIN PAM
91, Avenue de la Libération
54076 Nancy cedex
France

Atteste que/attests that :

Les essais de performance concernant les ventouses trois fonctions de la gamme VENTEX DN 50,60, 65, 80, 100, 150 et 200 PN 10/16/25 ont été effectués selon la norme EN 1074-4 2000. Les résultats sont conformes aux critères d'acceptation.

The performance tests on the three functions air valves of the range VENTEX DN 50, 60, 65, 80, 100, 150 and 200 PN 10/16/25 have been carried out according to EN 1074-4 2000 standard. The results conform to the requirements.

CERTIFICATES



Réf : MO 14 QAT 141 R
Date : 07/2014

CONFORMITY CERTIFICATES
EN 1074-2000

CB188/13/2566547.C.TG n°1 page 4/4

VENTEX DN200 PN25

États Tests	Nom(s) Standard	N° Indice Indice	Exigences Requirements	Résultats Results	Référence Reference
Résistance à la pression intérieure de l'enveloppe Resistance to internal pressure of the shell	EN 107-4- §5.1.1	EN 107-1 § 5.1.1	- Pas de fuite - Pas de dommage - No leak - No damage	Conforme Conforme	RO 2110-15- 12/2010
Résistance de l'obturateur à la pression intérieure Resistance of the obturator to internal pressure	EN 107-4- §5.1.2	EN 107-1 § 5.1.1	- Pas de fuite - Pas de dommage - No leak - No damage	Conforme Conforme	RO 2110-15- 12/2010
Résistance aux efforts de manœuvre Resistance to operating loads	EN 107-4- §5.1.4	EN 107-1 § 5.1.4	- Pas de dommage - Manoeuvrable à MOT-DN - No damage - Manoeuvrable at MOT-DN	Conforme Conforme	RO 2110-15- 12/2010
Banchette de l'enveloppe à pression intérieure Leaf/gasket of the shell to internal pressure	EN 107-4- §5.2.1.1	EN 107-1 § 5.1.1	- Pas de fuite - Pas de dommage - No leak - No damage	Conforme Conforme	RO 2110-15- 12/2010
Banchette de l'enveloppe à pression intérieure Leaf/gasket of the shell to external pressure	EN 107-4- §5.2.1.2	EN 107-1 § 5.2.1.2 Annexe B	- Variation de pression : 0,02 bar Pressure variation : 0,02 bar	Conforme Conforme	RO 2110-15- 12/2010
Banchette du siège haute pression Seat/gasket at high pressure	EN 107-4- §5.2.2.1	EN 107-1 §5.2.2.1	- Pas de fuite sur les 2 siègeurs - No leak on the two seats	Conforme Conforme	RO 2110-15- 12/2010
Banchette du siège basse pression Seat/gasket at low pressure	EN 107-4- §5.2.2.2	EN 107-1 §5.2.2.2	- Pas de fuite sur les 2 siègeurs - No leak on the two seats	Conforme Conforme	RO 2110-15- 12/2010
Couple maximal de manœuvre MOT Minimum operating torque MOT	EN 107-4- §5.2.3	EN 107-1 §5.2.3 EN 107-4-§5.2.3	- Couple de manœuvre à MOT - No leak - Operating torque at MOT	Conforme Conforme	RO 2110-15- 12/2010
Caractéristiques de débit d'air pour la fonction dégazage Airflow characteristics for air venting function	EN 107-4- §5.3.1	Données calculées Calculated data		Conforme Conforme	RO 2110-15- 12/2010
Caractéristiques de débit d'air pour la fonction dégazage Airflow characteristics for air venting function	EN 107-4- §5.3.2	Données calculées Calculated data		Conforme Conforme	RO 2110-15- 12/2010
Caractéristiques de débit d'air pour la fonction dégazage Airflow characteristics for air venting function	EN 107-4- §5.3.3	Calcul à débit constant Calculating sonic flow		Conforme Conforme	RO 2110-15- 12/2010
Résistance aux produits de protection Resistance to protection products	EN 107-4- §5.4	EN 107-1 §5.4	- Pas de fuite - Pas de dommage - No leak - No damage	Conforme Conforme	RO 2110-15- 12/2010
Résistance pour les fonctions dégazage/ventilation Resistance for air venting/venting function	EN 107-4- §5.5.1	EN 107-4- Annexe C	- Échanche selon 107-4-§ 5.2.1 & 5.2.2 - Tight according to 107-4-§ 5.2.1 & 5.2.2	Conforme Conforme	RO 2110-15- 12/2010
Résistance de la fonction dégazage Resistance for air venting function	EN 107-4- §5.5.2	EN 107-4- Annexe C	- Échanche selon 107-4-§ 5.2.1 & 5.2.2 - Tight according to 107-4-§ 5.2.1 & 5.2.2	Conforme Conforme	RO 2110-15- 12/2010
Résistance à la pression après température prolongée Long term pressure/long test	EN 107-4- §5.5.3	EN 107-4-§5.5.3	- Ouverture suréchappement de pression - Échanche selon 107-4-§ 5.2.1 & 5.2.2 - Opening when pressure released - Tight according to 107-4-§ 5.2.1 & 5.2.2	Conforme Conforme	RO 2110-15- 12/2010

Observation: l'essai de performance réalisé sur la VENTEX DN200 PN25 est représentatif des DN 150 et 200 PN10/16/25.

Observation: the performance test performed on the VENTEX DN200 PN25 is representative of the DN 150 and 200 PN10/16/25.

Metz, le 26/02/2013

Thierry GARCIA



CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**ALIMENTARY
ATTESTATIONS****ALIMENTARY ATTESTATIONS****CERTIFICATE OF CONFORMITY**

N° CB188/08/1853598.C.TG N° 1

The undersigned, Thierry GARCIA, Surveyor acting within the scope of the general conditions of Division France of BUREAU VERITAS and at the request of:

SAINT-GOBAIN PAM
91, Avenue de la Libération
54076 Nancy Cedex - FRANCE

Certifies having examined the SAINT-GOBAIN PAM technical documentation related to the following list of product ranges for drinking water networks and the Reports by bodies authorized by the General Direction of Health in the frame of the "Arrêté du 29 mai 1997" (French regulation) related to materials and items used in fixed facilities of production treatment and distribution of potable water for human consumption.

PRODUCTS	ACS N°
Rubber seal gate valves EURO20 NG DN 85 to 150 - type 21 23 24 25 27	07ACCNY519
Rubber seal gate valves EURO20 NG DN 200 to 350 - type 21 23 24 25 27	08ACCNY126
Rubber seal gate valves EURO 20 DN 40 to 400 type 21 23 24 25 27	06ACCNY044
Single Air valve PURGEX DN 40 and 100	03ACCNY009
Double air valve VEMEX DN 50 to 200	03ACCNY105
Ranged Butterfly valves BB/PA DN 150 to 1200	07ACCNY520
Coupling LINK GS DN 40 to 600 (GGS)	03ACCNY108
Coupling and flange adaptor LINK PS et QUICK PV 40 to 2000	05ACCNY088
Coupling and flange adaptor QUICK et LINK GS DN 350 to 1000 US	07ACCLY645
Dedicated flange adaptor QUICK GS DN 60 to 300 for ductile iron pipes	03ACCNY073
Coupling and flange adaptor wide range ULTRA LINK et ULTRA QUICK type A to L	03ACCNY100
Dismantling joints DN 40 to 2000 type PA PO PF	05ACCNY087
Pillar hydrant Atlas Plus, Hermes Plus, Ajax Plus, C9 Plus, DN 80 100 150	07ACCNY522
Fire hydrant DN80 and DN100	07ACCNY521

1 / 2

CERTIFICATES

Réf : MO 14 QAT 141 R
Date : 07/2014

**ALIMENTARY
ATTESTATIONS**

From the examination of these documents, it is concluded that the products listed after and used by SAINT-GOBAIN PAM for manufacturing its products all have an "Attestation de Conformité Sanitaire" ("ACS", French Regulation). They conform to the applicable requirements of the articles 2 and 5 of the "Arrêté du 29 mai 1997" and of "Décret N°2007-49 du 11 janvier 2007, article R. 1321-48", and can be fully used for the distribution of drinking water.

At Saint Julien Les Metz, on 09/04/2008

A handwritten signature in black ink, appearing to read "Thierry Garcia".
A circular official stamp with the text "MINISTERE DE LA SANTE" around the perimeter and "M. GARCIA" in the center.

Thierry Garcia
Surveyor, Industry Department, Metz, FRANCE

2/2

CERTIFICATES



Réf : MO 14 QAT 141 R
Date : 07/2014

KAHRAAMA APPROVALS

KAHRAAMA APPROVALS



MSSWP (464) ٤٩ | 2013
19/05/2013
09/07/1434

M/s. Maxine Trading Co. W.L.L.
Tel # 44558888
Fax # 44556455
P.O. Box 76
Doha, Qatar

Subject: Gate Valve Markings
(M/s St. Gobain, France)
Dear Sir,

With reference to your letter dated 29 April 2013 and the letter of your principal M/s. St. Gobain PAM, France Ref# SAFA/006/13 dated 28 April 2013 regarding the above subject which is self-explanatory. Please be informed that the information to be implemented regarding markings of Gate Valves are as follows:

A) All Valves shall have clearly marked in the casting of the body the following information;

1. Size of Valve in mm
2. Pressure Rating in bars
3. Manufacturer's Name and/or Logo
4. Material Type (GGG40/36/SG)

B) All Valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip the following information;

1. Name of the manufacturer
2. Individual Serial Number
3. Tender Number & Project Title
4. Model Number
5. Manufacturing Standards Number
6. Year of Manufacture

This is for your information and consideration.

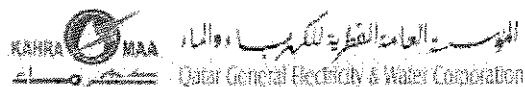
Best regards,

Eng. Mohd Thani E.J. Al Maadeed
A/Manager, Water Planning Department

cc: mohamed
Tawfiq

Water Network Planning Department, P.O. Box: 41 Doha-Qatar
Tel: (00974) 44845988 - 44845929, Fax: (00974) 44845921



CERTIFICATESRéf : MO 14 QAT 141 R
Date : 07/2014**KAHRAAMA
APPROVALS**WTS-MP-399/ 42 /2011
08/11/1432
06/10/2011M/s. Majnai Trading Co.
P.O. Box 76
Doha, Qatar**Subject: Renewal of Approval for Butterfly Valves and Air Valves**
(M/s. St. Gobain PAM, Italy)

Dear Sir

With reference to the above subject and after going through the documents submitted which complies with Kahramaa specifications and requirements, please be advised that Butterfly and Air Valves by M/s. St. Gobain PAM, Italy is approved in the State of Qatar.

The approved types & sizes are:

1. Eurostop Butterfly Valve- 150mmØ to 2000mmØ
2. Ventex Air Valve - 50mmØ to 200mmØ

Note: In case of any changes in the design or material (however minor) of the above Valves, Water Planning Department must be notified for further evaluation.

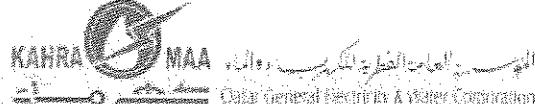
This approval is valid up to 05-10-2014.

Best Regards,

ENG. IBRAHIM MOHAMMED A. AL SADA
MANAGER, WATER PLANNING DEPARTMENTS.D. HWTS
MO/WPMI
H-399

هذا البريد الإلكتروني محمي بحقوق الملكية الفكرية لـ دولة قطر للمياه والبيئة (DQW) وله حماية قانونية.
Water Networks Planning Department P.O. Box 41 Doha-Qatar Tel (00974) 44845088 Fax (00974) 44845021



CERTIFICATESRéf : MO 14 QAT 141 R
Date : 07/2014**KAHRAAMA
APPROVALS**MSS-MP-463/2.0 -2012
01/08/2012
13/09/2013M/s. Mawani Trading Co. W.L.L.
P.O. Box 76
Doha, Qatar**Subject: Renewal of Approval of Gate Valves**
(M/s. St. Gobain, France)

Dear Sir,

With reference to the above subject and after going through the documents submitted, please be advised that the Gate Valves manufactured by M/s. St. Gobain, France is approved to be used in the State of Qatar.

The approved size and model are the following:
Model Euro 20 up to 490mm diameter.

Note: In case of any changes in the design or material (however minor) of the above Gate Valves, Water Planning Department- WNA must be notified for further evaluation.

This Approval is valid up to 31/07/2015

Best regards,

ENG. IBRAHIM MOHAMMED A. AL SADA
MANAGER, WATER PLANNING DEPARTMENT

CC: SEMSC
HOMD
HWP
HWTS

P.M.D.S.

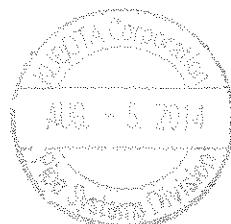
M/s. Mawani Trading, Tel: +974-44815000, Fax: +974-44813080

Water Networks Planning Department, P.O. Box 41 Doha- Qatar
Tel: +(00974) 44815000 - 44813080, Fax: +(00974) 44813021



Kubota

TECHNICAL SPECIFICATION
ON
DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES



△							KUBOTA Corporation	
△							CLIENT QATAR GENERAL ELECTRICITY & WATER CORPORATION	
△							PROJECT CONSTRUCTION OF MEGA RESERVOIR PRPSs (GTC 626/2014)	
△	ISSUE FOR APPROVAL	-	-	-	-			
REV.	DESCRIPTION	DATE	PRP'D	CHE'D	APP'D			
DESIGNED BY		CHECKED BY	APPROVED BY			DATE	SPEC. No. TTE-S-1486	REV. No.
						5 AUG 2014	REPORT No. -	0

Kubota

1. SCOPE OF APPLICATION

This specification applies to centrifugally cast ductile iron pipes (hereinafter called "pipes"), non-centrifugally cast ductile iron fittings (hereinafter called "fittings") and accessories for CONSTRUCTION OF MEGA RESERVOIR PRPSs (GTC 626/2014).

Note: Non-centrifugally cast ductile iron flanged pipes are classified to "fittings".

2. APPLICABLE STANDARD

Pipes and fittings for DN1600 and smaller will conform to BS EN 545-2006 and that for DN1800 and larger will conform to ISO2531-1998.

3. WALL THICKNESS

3.1 Pipes

The wall thickness of pipes will conform to Class K-9.

3.2 Fittings

The wall thickness of all fittings including tees will conform to the applicable standard.

The allowable operating pressure (PFA) of DN900 and larger socketed tees will be 16 bar.

4. LAYING LENGTH OF PIPES

The nominal laying length of pipes will be as shown in Table 1.

Table 1

Nominal diameter DN	Nominal laying length L (m)
150 to 250	5
300 to 500	6
600 to 1400	6, 9
1600	9
1800	6
2000	5
2200 to 2400	4

5. JOINTS

5.1 Flexible joints

Pipes and fittings for DN2000 and smaller except for collars will be supplied with push-on (T-type) joint.

The allowable deflection angle of T-type joint for DN250 to DN300 is 4.0 degrees, that for DN500 to DN600 is 3.0 degrees and that for DN800 to DN900 is 2.5 degrees.

Pipes and fittings for DN2200 and larger and collars will be supplied with mechanical (K-type) joint.

5.2 Flanges

Flanges will be of integral raised face (RF) type and drilled conforming to PN16.

6. MARKING

The following cast-on, cold-stamped or painted marks will appear on each pipe.

The size of markings will conform to manufacturer's standard.

- (1) The indication that the pipe is of ductile iron: "D"
- (2) The year of manufacture (the last two digits)
- (3) The manufacturer's identification mark: "  "
- (4) The nominal diameter
- (5) The class designation: "K-9"
- (6) The number of standard: "BS EN 545" or "ISO 2531"
- (7) GTC contract number: "GTC626 A B C D & E", as shown in Fig. 1, 2.

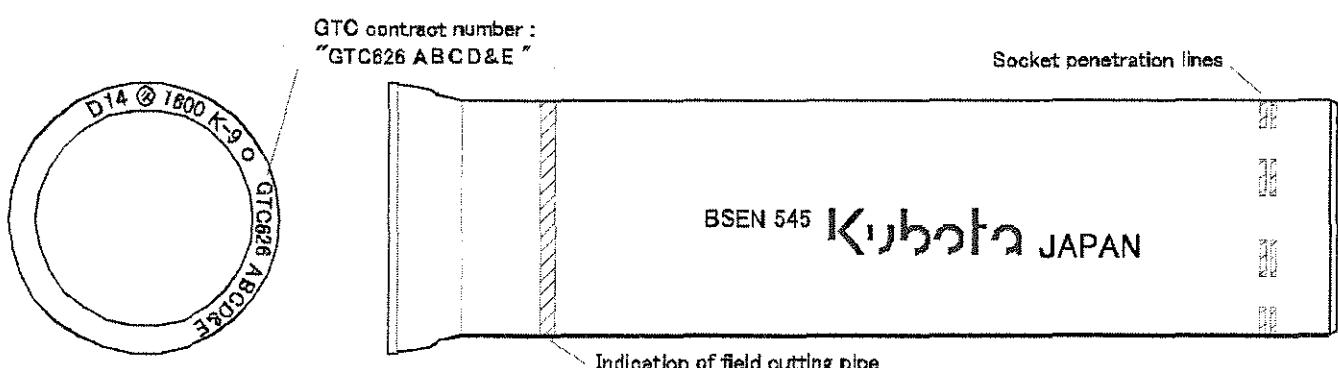


Fig.1 Marking for Pipes

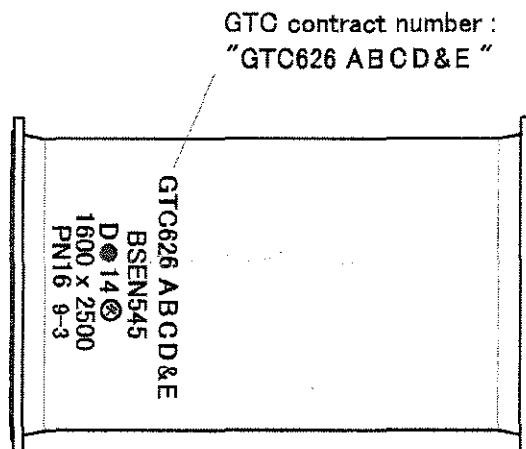


Fig. 2 Marking for Fittings

In case of fittings, these marks except for item (5) will appear on the body of each fitting together with its main characteristics (i.e., angle of bend, pressure rating of flange, etc.).

For pipes, "Kubota JAPAN" may also be painted on the body.

In case of pipes and fittings with spigot ends for push-on joint, socket penetration lines (two white painted lines) will appear on the spigot end.

The manufacturer may add other marks provided these do not conflict with those mentioned above.

7. MECHANICAL PROPERTIES

The mechanical properties of pipes and fittings will be as shown in Table 2.

Table 2

Type of casting	Nominal diameter DN	Tensile strength Min. (N/mm ²)	Elongation Min. (%)
Pipes	150 to 1000	420	10
	1200 to 2400	420	7
Fittings	80 to 2400	420	5

8. TOLERANCES ON DIMENSIONS

The tolerances on wall thickness and length of pipes and fittings will conform to the applicable standard.

Tolerance on the external diameter of pipes suitable for cutting on site will be applied for over two thirds of the nominal length from the spigot end.

9. HYDROSTATIC TEST PRESSURE AT WORKS

The hydrostatic works test pressure for pipes and fittings will be as shown in Table 3.

Table 3

Nominal diameter DN	Works hydrostatic test pressure (bar)		Duration (sec)
	Pipes	Fittings	
80 to 300	50	25	10
350 to 600	40	16	10
700 to 1000	32	10	10
1200 to 2000	25	10	10
2200 to 2400	18	10	10

10. EXTERNAL COATING

Pipes and fittings will be coated externally with zinc primer followed by a finish coating of bitumen.

The zinc primer for pipes for DN1600 and smaller will be metallic zinc of 200 g/m² and that for pipes for DN1800 and larger and fittings will be zinc rich paint of 220 g/m².

The minimum mean dry film thickness of the finish coating will be 100 microns.

Pipes and fittings above ground or inside chamber including flange adaptor will be coated in the same way (black colour).

11. INTERNAL LINING OF PIPES AND COATING OF FITTINGS

11.1 Pipes

Pipes will be lined internally with cement mortar in accordance with ISO 4179-2005.

The cement will be sulphate-resisting Portland cement conforming to BS 4027-1991.

The lining thickness will be as shown in Table 4.

Table 4

Nominal diameter DN	Lining thickness (mm)	
	Nominal value	Minimum value at one point
150 to 300	3.5	2.0
350 to 600	5.0	3.0
800 to 1200	6.0	3.5
1400 to 2000	9.0	6.0
2200 to 2400	12.0	8.0

The inside surface of the socket will be free of mortar and coated with zinc rich paint of 150 g/m² followed by a finish coating of bitumen.

The minimum mean total dry film thickness of the coating will be 150 microns.

11.2 Fittings

The internal surface of fittings will be coated with fusion-bonded epoxy and/or solvent-free type epoxy paint to minimum dry film thickness of 300 microns.

Holiday detection of the coating will be carried out with a test voltage of 3 kV.

The inside surface of the socket will be coated with zinc rich paint of 150 g/m² followed by a finish coating of bitumen.

The minimum mean total dry film thickness of the coating will be 150 microns.

12. ACCESSORIES

12.1 Accessories for push-on (T-type) joint

Rubber gaskets will be of synthetic rubber (EPDM).

12.2 Accessories for mechanical (K-type) joint

Rubber gaskets will be of synthetic rubber (EPDM).

Glands will be of ductile iron conforming to the specification for fittings.

Tee-head bolts and hexagon nuts will be of ductile iron and their surfaces will be coated with synthetic resin (epoxy) paint.

12.3 Accessories for flange joint

Rubber gaskets will be of inside-bolt-circle type made of fiber reinforced synthetic rubber (EPDM) with a thickness of 3 mm for DN1200 and smaller and 6 mm for DN1400 to DN1600, and of metal reinforced synthetic rubber (EPDM) with a thickness of 10 mm for DN1800 and larger.

Hexagon head bolts and nuts will be of hot dip galvanized mild steel.

The minimum thickness of galvanizing for bolts will be 70 microns.

13. INSPECTION

Fundamentally, manufacturer's inspection will be final.

The inspection stipulated in mutually agreed standard would be carried out by our own inspectors according to our manufacturing schedule.

In case the purchaser himself wishes to inspect, or the purchaser wishes to make his representative inspect, he should notify us prior to the contract.

The manufacturer will co-operate to carry out such inspection and provide the equipment and labour necessary for the carrying out of the inspection.

However, the inspection will be undertaken at the work(s) of the manufacturer following its own production schedule and in any case it should not hinder the normal production.

The inspector appointed by the purchaser and accredited to the manufacturer should be advised in advance of the time at which the operations of inspection will normally take place.

Should the purchaser or his representative not be present when these operations are carried out at the time agreed upon, the manufacturer will be entitled to proceed with the inspection without the purchaser or his representative being present.

Deloitte.

SEAH STEEL CORPORATION AND SUBSIDIARIES

**CONSOLIDATED FINANCIAL STATEMENTS
AS OF AND FOR THE YEARS ENDED
DECEMBER 31, 2013 AND 2012,
AND INDEPENDENT AUDITORS' REPORT**

Independent Auditors' Report

English Translation of a Report Originally Issued in Korean

To the Shareholders and the Board of Directors of
SeAH Steel Corporation:

We have audited the accompanying consolidated financial statements of SeAH Steel Corporation and subsidiaries (the "Group"). The financial statements consist of the consolidated statements of financial position as of December 31, 2013 and 2012, and the related consolidated statements of comprehensive income, consolidated statements of changes in shareholders' equity and consolidated statements of cash flows, all expressed in Korean won, for the years ended December 31, 2013 and 2012. The Group's management is responsible for the preparation and fair presentation of the consolidated financial statements, and our responsibility is to express an opinion on these consolidated financial statements based on our audits. We did not audit the financial statements of SeAH Steel America, Inc. and others, whose financial statements reflect 24.0% and 23.3% of total assets and 36.7% and 35.7% of total revenues of consolidated financial statements as of and for the years ended December 31, 2013 and 2012, respectively. Those financial statements were audited by other auditors whose reports have been furnished to us, and our opinion, insofar as it relates to the amounts included for those entities, is based solely on the reports of the other auditors.

We conducted our audits in accordance with auditing standards generally accepted in the Republic of Korea. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, based on our audits and the reports of other auditors, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the Group as of December 31, 2013 and 2012, and the results of its operations and its cash flows for the years ended December 31, 2013 and 2012, in conformity with Korean International Financial Reporting Standards ("K-IFRS").

March 13, 2013

Notice to Readers

This report is effective as of March 13, 2014, the auditors' report date. Certain subsequent events or circumstances may have occurred between the auditors' report date and the time the auditors' report is read. Such events or circumstances could significantly affect the accompanying consolidated financial statements and may result in modifications to the auditors' report.

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF FINANCIAL POSITION
AS OF DECEMBER 31, 2013 AND 2012

ASSETS	Notes	December 31, 2013		December 31, 2012	
			(Korean won)		(Korean won)
CURRENT ASSETS:					
Cash and cash equivalents	34	₩ 129,144,289,969	₩	151,952,861,423	
Trade and other accounts receivable	4,14 and 29	371,108,343,087		398,437,652,594	
Other financial assets	5,14 and 35	28,706,799,982		62,821,371,325	
Other current assets	6	17,929,534,769		21,889,624,717	
Current tax assets		679,487,112		1,925,289,676	
Inventories	7 and 14	442,025,610,564		446,705,413,315	
		<u>989,594,065,483</u>		<u>1,083,732,213,050</u>	
NON-CURRENT ASSETS:					
Property, plant and equipment	8,14 and 29	858,512,022,146		800,125,093,062	
Investment property	9	12,440,581,211		8,655,709,075	
Intangible assets	10	9,321,102,696		10,149,853,571	
Investments in associates	11				
Investments in joint ventures	12	8,006,655,381		8,441,178,220	
Trade and other accounts receivable	4	8,966,395,081		9,137,883,401	
Deferred tax assets	27	1,788,773,601		1,639,807,780	
Other non-current financial assets	5 and 35	105,367,747,614		106,326,715,716	
Other non-current assets	6	1,563,199,071		2,141,860,524	
		<u>1,005,966,476,801</u>		<u>946,618,101,349</u>	
TOTAL ASSETS		₩ 1,995,560,542,284		₩ 2,030,350,314,399	

(Continued)

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF FINANCIAL POSITION (CONTINUED)
AS OF DECEMBER 31, 2013 AND 2012

LIABILITIES	Notes	December 31, 2013		December 31, 2012	
			(Korean won)		(Korean won)
CURRENT LIABILITIES:					
Trade and other payables	13 and 29	₩ 225,438,576,469	₩	281,763,774,089	
Short-term borrowings	14 and 15	400,630,457,582		431,211,992,126	
Income tax payable		5,141,617,166		16,330,786,783	
Other financial liabilities	17	112,167,611		233,797,341	
Other current liabilities	18	3,970,574,526		9,060,871,300	
		<u>635,293,393,354</u>		<u>738,601,221,639</u>	
NON-CURRENT LIABILITIES:					
Trade and other payables	13	1,818,498,009		1,463,262,154	
Long-term borrowings	14 and 15	157,052,115,497		185,105,686,962	
Retirement benefit obligation	16	2,792,365,785		2,156,254,594	
Deferred tax liabilities	27	98,808,142,167		98,736,249,670	
Other non-current financial liabilities	17	-		84,998,567	
Other non-current liabilities	18	351,265,791		262,898,148	
		<u>260,822,387,249</u>		<u>287,809,350,095</u>	
TOTAL LIABILITIES		<u>896,115,780,603</u>		<u>1,026,410,571,734</u>	
SHAREHOLDERS' EQUITY:					
Equity attributable to owners of the Group:					
Capital stock	19	30,000,000,000		30,000,000,000	
Other paid-in capital	20	27,422,619,678		27,469,083,678	
Retained earnings	21	986,982,104,081		885,668,325,591	
Other capital components	22	31,549,044,431		40,815,525,819	
		<u>1,075,953,768,190</u>		<u>983,952,935,088</u>	
Non-controlling interests		23,490,993,491		19,986,807,577	
TOTAL SHAREHOLDERS' EQUITY		<u>1,099,444,761,681</u>		<u>1,003,939,742,665</u>	
TOTAL LIABILITIES AND SHAREHOLDERS' EQUITY		<u>₩ 1,995,560,542,284</u>	₩	<u>2,030,350,314,399</u>	

(Concluded)

See accompanying notes to consolidated financial statements.

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME
FOR THE YEARS ENDED DECEMBER 31, 2013 AND 2012

	Notes	2013 (Korean won)	2012 (Korean won)
SALES	23 and 29	₩ 2,219,155,488,120	₩ 2,470,414,332,405
COST OF SALES	29	1,914,463,705,259	2,138,361,744,888
GROSS PROFIT		<u>304,691,782,861</u>	<u>332,052,587,517</u>
Selling and administrative expenses	24,29	150,084,485,646	158,602,687,100
OPERATING INCOME		<u>154,607,297,215</u>	<u>173,449,900,417</u>
Financial income	25	35,684,473,633	45,201,321,297
Financial cost	25	43,200,288,058	45,753,366,976
Gain from investments in associates and joint ventures	12	472,967,200	360,632,827
Loss from investments in associates and joint ventures	12	569,953,373	582,613,769
Other non-operating income	26 and 29	5,118,412,660	40,773,601,013
Other non-operating expense	26	<u>1,801,033,736</u>	<u>58,997,204,847</u>
NET INCOME BEFORE INCOME TAX		<u>150,311,875,541</u>	<u>154,452,269,962</u>
INCOME TAX EXPENSE	27	33,662,173,460	54,812,679,485
NET INCOME		<u>116,649,702,081</u>	<u>99,639,590,477</u>
OTHER COMPREHENSIVE INCOME (LOSS):			
Items that will be reclassified subsequently to income (loss):			
Gain (loss) on valuation of AFS financial assets		(8,971,790,647)	(48,376,294,329)
Changes in capital variation of equity method		(4,892,580,922)	(39,551,074,048)
Foreign currency translation differences of foreign operations		(7,098,819)	(540,460,515)
Tax effects		(7,029,906,366)	(23,152,270,868)
		2,957,795,460	14,867,511,102
Items that will not be reclassified subsequently to income (loss):			
Remeasurement factor on defined benefit plans		(3,405,446,418)	5,373,183,263
Tax effects		(4,492,673,375)	7,088,632,274
		<u>1,087,226,957</u>	<u>(1,715,449,011)</u>
TOTAL COMPREHENSIVE INCOME		<u>(12,377,237,065)</u>	<u>(43,003,111,066)</u>
		<u>104,272,465,016</u>	<u>56,636,479,411</u>

(Continued)

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME (CONTINUED)
FOR THE YEARS ENDED DECEMBER 31, 2013 AND 2012

	Notes	2013	2012
		(Korean won)	
Net income attributable to:			
Owners of the Group		₩ 113,440,206,908	₩ 96,504,645,117
Non-controlling interests		3,209,495,173	3,134,945,360
Comprehensive income attributable to:			
Owners of the Group		100,768,279,102	54,549,601,002
Non-controlling interests		3,504,185,914	2,086,878,409
EARNINGS PER SHARE:	28		
Basic and diluted earnings per share from continuing operations		₩ 19,512	₩ 16,610

(Concluded)

See accompanying notes to consolidated financial statements.

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF CHANGES IN SHAREHOLDERS' EQUITY
FOR THE YEARS ENDED DECEMBER 31, 2013 AND 2012

	(Korean won)					
	Capital stock	Other paid-in capital	Retained earnings	Other capital components	Non-controlling interests	Total shareholders' equity
Balance as of January 1, 2012	₩ 30,000,000,000	₩ 26,427,587,016	₩ 792,490,483,711	₩ 88,143,753,197	₩ 18,121,845,562	₩ 955,183,669,486
Dividends	-	-	(8,699,986,500)	-	-	(8,699,986,500)
Disposal of treasury stock	-	1,187,032,662	-	-	-	1,187,032,662
Acquisition of subsidiary	-	(145,536,000)	-	-	-	(145,536,000)
Total comprehensive income for the period	-	-	101,877,828,380	(47,328,227,378)	2,086,878,409	56,636,479,411
Net income	-	-	96,504,645,117	-	3,134,945,360	99,639,590,477
Remeasurement factor on defined benefit plans	-	-	5,373,183,263	-	-	5,373,183,263
Gain on valuation of AFS financial assets	-	-	-	(29,979,714,128)	-	(29,979,714,128)
Changes in capital variation of equity method	-	-	-	(409,669,070)	-	(409,669,070)
Gain (loss) on overseas operations translation	-	-	-	(16,938,844,180)	(1,048,066,951)	(17,986,911,131)
Dividends from subsidiaries	-	-	-	-	(221,916,394)	(221,916,394)
Balance as of December 31, 2012	₩ 30,000,000,000	₩ 27,469,083,678	₩ 885,668,325,591	₩ 40,815,525,819	₩ 19,986,807,577	₩ 1,003,939,742,665
Balance as of January 1, 2013	₩ 30,000,000,000	₩ 27,469,083,678	₩ 885,668,325,591	₩ 40,815,525,819	₩ 19,986,807,577	₩ 1,003,939,742,665
Dividends	-	-	(8,720,982,000)	-	-	(8,720,982,000)
The extinction of deferred corporate tax due to merge	-	(46,464,000)	-	-	-	(46,464,000)
Total comprehensive income for the period	-	-	110,034,760,490	(9,266,481,388)	3,504,185,914	104,272,465,016
Net income	-	-	113,440,206,908	-	3,209,495,173	116,649,702,081
Remeasurement factor on defined benefit plans	-	-	(3,405,446,418)	-	-	(3,405,446,418)
Gain on valuation of AFS financial assets	-	-	-	(3,708,576,340)	-	(3,708,576,340)
Changes in capital variation of equity method	-	-	-	(5,380,906)	-	(5,380,906)
Gain (loss) on overseas operations translation	-	-	-	(5,552,524,142)	294,690,741	(5,257,833,401)
Balance as of December 31, 2013	₩ 30,000,000,000	₩ 27,422,619,678	₩ 986,982,104,081	₩ 31,549,044,431	₩ 23,490,993,491	₩ 1,099,444,761,681

See accompanying notes to consolidated financial statements.

SEAH STEEL CORPORATION AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF CASH FLOWS
FOR THE YEARS ENDED DECEMBER 31, 2013 AND 2012

	(Korean won)	
	2013	2012
CASH FLOWS FROM OPERATING ACTIVITIES:		
Cash generated from operating activities:		
Net income	₩ 116,649,702,081	₩ 99,639,590,477
Adjustments to reconcile net income to net cash provided by (used in) operating activities:	81,598,149,525	101,790,054,481
Changes in working capital	(14,439,274,705)	(17,810,784,295)
Receipt of interest	2,682,976,237	6,543,153,502
Payment of interest	(8,816,437,927)	(14,239,242,824)
Receipt of dividends	3,169,532,357	2,843,013,944
Income taxes paid:	(39,020,154,310)	(54,288,102,383)
Net cash provided by operating activities	<u>141,824,493,258</u>	<u>124,477,682,902</u>
CASH FLOWS FROM INVESTING ACTIVITIES:		
Collection of short-term loan	242,300,000	173,000,000
Increase in short-term loan	-	(200,000,000)
Collection of short-term financial instruments	90,619,779,556	110,202,733,437
Increase in short-term financial instruments	(48,624,773,393)	(116,048,643,342)
Disposal of property, plant and equipment	2,300,841,957	3,008,555,759
Acquisition of property, plant and equipment	(133,168,702,462)	(118,157,206,737)
Disposal of intangible assets	72,727,273	66,363,637
Acquisition of intangible assets	(95,510,554)	(888,676,000)
Decrease in long-term loan	20,749,848	104,320,870
Increase in long-term loan	(602,831,700)	(233,000,000)
Collection of long-term financial instruments	3,000,000	-
Increase in long-term financial instruments	(233,678,829)	(152,901,748)
Disposal of financial assets designated as at fair value through profit or loss ("FVTPL")	16,559,986,302	15,896,426,329
Acquisition of financial assets designated as at FVTPL	(24,000,000,000)	(19,624,700,000)
Disposal of AFS financial assets	1,062,028,706	1,567,746,210
Acquisition of AFS financial instruments	(2,474,874,733)	(25,790,343,655)
Acquisition of subsidiary	-	(5,569,566,962)
Net cash used in investing activities	<u>(98,318,958,029)</u>	<u>(155,645,892,202)</u>
CASH FLOWS FROM FINANCING ACTIVITIES:		
Repayment and proceeds of short-term borrowings	(58,613,190,319)	(56,482,888,067)
Repayment of current portion of long-term borrowings	(29,479,177,219)	(7,216,926,741)
Repayment of current portion of debentures	(50,000,000,000)	(529,927,500)
Proceeds from long-term borrowings	2,808,525,000	20,000,000,000
Repayment of long-term borrowings	-	(11,302,840,000)
Proceeds from issue of debentures	79,759,800,000	49,761,800,000
Increase in financial lease liabilities	-	175,989,357
Decrease in financial lease liabilities	(61,344,140)	(76,716,864)
Repayment of exchangeable bonds	-	(88,250)
Payment of dividends	(8,720,726,930)	(8,921,256,963)
Disposal of treasury stock	-	1,509,276,998
Net cash used in financing activities	<u>(64,306,113,608)</u>	<u>(13,083,578,030)</u>
NET DECREASE IN CASH AND CASH EQUIVALENTS	(20,800,578,379)	(44,251,787,330)
CASH AND CASH EQUIVALENTS, BEGINNING OF YEAR	151,952,861,423	200,284,799,804
EXCHANGE RATE FLUCTUATION EFFECT OF CASH AND CASH EQUIVALENTS	(2,007,993,075)	(4,080,151,051)
CASH AND CASH EQUIVALENTS, END OF YEAR	<u>₩ 129,144,289,969</u>	<u>₩ 151,952,861,423</u>

See accompanying notes to consolidated financial statements.

SEAH STEEL CORPORATION AND SUBSIDIARIES
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
AS OF AND FOR THE YEARS ENDED DECEMBER 31, 2013 AND 2012

1. GENERAL INFORMATION:

(1) Controlling Company

SeAH Steel Corporation (the “Company”), which is a parent company in accordance with K-IFRS 1027, *Consolidated and Separate Financial Statements*, was founded as Pusan Steel Pipe on September 19, 1960, and was listed on the stock market governed by Korea Exchange (formerly, Korea Stock Exchange) on March 13, 1969. The name of the Company was changed to Pusan Pipe in February 1975 and with the launch of the SeAH Group, changed the Company name to SeAH Steel on January 1, 1996. The Company’s primary operations consist of Structural pipe, Ordinary Pipe, Line Pipe for Oil and Gas, Steel Tubes for Boiler & Heat Exchanger, Rigid Steel Conduits, Carbon Steel Tubes for Machine Structural Purposes, Stainless Steel pipe, Galvanized Iron and Pre-Painted Galvanized Iron, and has established the headquarter in Seoul, Korea, and plants in Pohang, Changwon, Gunsan and Ansan in Korea.

The Company carried out a spin-off on July 1, 2001, in accordance with the Commercial Code of Korea, founding the subsidiary, SeAH Holdings, for the specialization in sales, investing and market concentration. As of December 31, 2012, the Company has ₩30,000 million in capital stock.

As of December 31, 2013, major shareholders are as follows:

Shareholders	Number of shares	Ratio of shareholding (%)
Lee, Tae Sung	1,147,366	19.12
Lee, Soon Hyung	680,556	11.34
Lee, Ju Sung	650,895	10.85
Treasury stocks	186,012	3.10
Others	3,335,171	55.59
Total	6,000,000	100.00

(2) Investments in subsidiaries

- 1) In accordance with the Korean International Financial Reporting Standards (“K-IFRS”) 1027, *Consolidated and Separate Financial Statements*, details of the Group’s investments in subsidiaries as of December 31, 2013 and 2012, are as follows:

Company name	Period-end	Type of business	Ownership percentage (%) (*1)		
			December 31, 2013	December 31, 2012	Location
SeAH Steel America	December 31	Distributing steel pipe and steel sheets	88.57	88.57	USA
State Pipe & Supply	December 31	Distributing steel pipe and steel sheets	93.14	93.14	USA
SeAH Steel California	December 31	Investments	100	100	USA
SeAH Steel Vina	December 31	Manufacturing and distributing steel pipe	100	100	Vietnam
SeAH Japan	December 31	Distributing steel pipe and steel sheets	100	100	Japan
SeAH Steel UAE	December 31	Manufacturing and distributing steel pipe	100	100	UAE
SeAH Steel Pipe (*2)	December 31	Manufacturing and distributing steel pipe	-	100	Domestic

(*1) Ownership interest held by controlling interests, is that it means the shares that are attributable directly or indirectly to the owner of the controlled entities. Therefore, it may be differences shareholding ratio calculated by subtracting the subsidiaries within the Group with respect to its own shares held by the simple sum of ownership from 100% of the shares in each subsidiary.

(*2) SeAH Steel Pipe has been merged by controlling company.

2) Newly included or excluded in subsidiaries as of December 31, 2013, is as follows :

Description Excluded	Company SeAH Steel Pipe	2013		Description Merged

3) The summary of the subsidiaries' financial statements is as follows (Unit: Korean won in millions):

	December 31, 2013							
	Current assets	Non-current assets	Total assets	Current liabilities	Non-current liabilities	Total liabilities	Controlling interests	Non-controlling interests
SeAH Steel America	₩ 270,709	₩ 25,737	₩ 296,446	₩ 94,196	₩ -	₩ 94,196	₩ 202,250	₩ -
State Pipe & Supply	55,208	8,668	63,876	41,166	76	41,242	22,634	-
SeAH Steel California	423	-	423	11	-	11	412	-
SeAH Steel Vina	32,689	32,829	65,518	31,731	128	31,859	33,659	-
SeAH Japan	63,034	1,539	64,573	54,688	2,512	57,200	7,373	-
SeAH Steel UAE	9,907	62,110	72,017	21,612	106	21,718	50,299	-

	December 31, 2012							
	Current assets	Non-current assets	Total assets	Current liabilities	Non-current liabilities	Total liabilities	Controlling interests	Non-controlling interests
SeAH Steel America	₩ 279,961	₩ 25,577	₩ 305,538	₩ 127,449	₩ -	₩ 127,449	₩ 178,089	₩ -
State Pipe & Supply	42,271	9,573	51,844	29,443	130	29,573	22,271	-
SeAH Steel California	430	176	606	-	-	-	606	-
SeAH Steel Vina	39,715	24,315	64,030	33,523	360	33,883	30,147	-
SeAH Japan	61,326	1,608	62,934	52,878	1,076	53,954	8,980	-
SeAH Steel UAE	14,900	59,618	74,518	22,568	124	22,692	51,826	-
SeAH Steel Pipe	25,336	131,772	157,108	78,912	30	78,942	78,166	-

The amount above includes the fair value adjustment occurred on the date of acquisition. The transaction within the Group has not been deducted from the amount above.

4) The summary of the subsidiaries' operation performances is as follows (Unit: Korean won in millions):

	2013				
	Sales		Operating income	Net income	Other comprehensive income
	₩	₩	₩	₩	₩
SeAH Steel America	728,976	₩ 44,716	₩ 27,799	₩ (3,636)	₩ 24,163
State Pipe & Supply	80,863	1,101	717	(355)	362
SeAH Steel California	349	(190)	(192)	(2)	(194)
SeAH Steel Vina	115,606	5,198	4,105	(594)	3,511
SeAH Japan	326,911	4,203	158	(1,765)	(1,607)
SeAH Steel UAE	22,485	(440)	(792)	(735)	(1,527)

	2012				
	Sales		Operating income	Net income	Other comprehensive income
	₩	₩	₩	₩	₩
SeAH Steel America	792,509	₩ 44,608	₩ 26,877	₩ (13,123)	₩ 13,754
State Pipe & Supply	63,620	(247)	236	(1,704)	(1,468)
SeAH Steel California	774	183	(30,423)	(760)	(31,183)
SeAH Steel Vina	119,983	5,018	3,950	(2,221)	1,729
SeAH Japan	383,567	4,986	742	(1,715)	(973)
SeAH Steel UAE	16,213	(2,875)	(3,417)	429	(2,988)
SeAH Steel Pipe	42,413	284	(2,979)	-	(2,979)

The amount above includes the fair value adjustment occurred on the date of acquisition. The transaction within the Group has not been deducted from the amount above.

5) The summarized cash flows of subsidiaries for the years ended on December 31, 2013 and 2012, are as follows:

	December 31, 2013								
	Cash flows from operating activities	Cash flows from investing activities	Cash flows from financing activities	Cash and cash equivalents, beginning of year	Exchange rate fluctuation effect of cash and cash equivalents	Cash and cash equivalents, end of year			
SeAH Steel America	W 29,491	W (2,344)	W (32,585)	W 12,915	W 7	W 7,484			
State Pipe & Supply	(12,067)	(87)	13,189	1,900	(274)	2,661			
SeAH Steel California	42	-	-	372	(7)	407			
SeAH Steel Vina	(1,180)	(13,241)	8,375	9,984	72	4,010			
SeAH Japan	(3,029)	(236)	5,424	8,521	(1,815)	8,865			
SeAH Steel UAE	3,166	(4,800)	-	3,382	9	1,757			

	December 31, 2012								
	Cash flows from operating activities	Cash flows from investing activities	Cash flows from financing activities	Cash and cash equivalents, beginning of year	Exchange rate fluctuation effect of cash and cash equivalents	Cash and cash equivalents, end of year			
SeAH Steel America	W 15,396	W (66)	W (16,381)	W 15,022	W (1,056)	W 12,915			
State Pipe & Supply	(1,971)	(333)	2,015	2,354	(165)	1,900			
SeAH Steel California	375	-	(113)	132	(22)	372			
SeAH Steel Vina	3,404	(2,900)	201	10,026	(748)	9,983			
SeAH Japan	13,877	(156)	(14,539)	11,010	(1,671)	8,521			
SeAH Steel UAE	(270)	(6,503)	-	10,574	(418)	3,383			
SeAH Steel Pipe	(29,528)	(8,534)	41,439	464	-	3,841			

The amount above includes the fair value adjustment occurred on the date of acquisition. The transaction within the Group has not been deducted from the amount above.

6) The details of the non-controlling interests percentages and financial status, operation performances and dividends attributable to non-controlling interests for the years ended on December 31, 2013 and 2012, are as follows:

	December 31, 2013							
	Non-controlling interests (%)	Accumulated non-controlling interests	Net income attributable to non-controlling interests	Total comprehensive income attributable to non-controlling interests	Dividends paid to non-controlling interests			
SeAH Steel America	11.43%	W 21,938	W 3,177	W 3,485	W -			
State Pipe & Supply	6.86%	1,553	32	19	-			
		W 23,491	W 3,209	W 3,504	W -			

	December 31, 2012							
	Non-controlling interests (%)	Accumulated non-controlling interests	Net income attributable to non-controlling interests	Total comprehensive income attributable to non-controlling interests	Dividends paid to non-controlling interests			
SeAH Steel America	11.43%	W 15,623	W 3,123	W 2,163	W (222)			
State Pipe & Supply	6.86%	4,364	12	(76)	-			
		W 19,987	W 3,135	W 2,087	W (222)			

(*1) Ownership interest held by non-controlling interests, is that it means the shares that are not attributable directly or indirectly to the owner of the controlled entities. Therefore, it may be differences shareholding ratio calculated by subtracting the subsidiaries within the Group with respect to its own shares held by the simple sum of ownership from 100% of the shares in each subsidiary

2. STANDARDS AFFECTING PRESENTATION AND DISCLOSURE AND SIGNIFICANT ACCOUNTING POLICIES:

(1) Basis of preparing consolidated financial statements

The Controlling Company and its subsidiaries (the “Group”) have prepared the consolidated financial statements in accordance with the K-IFRS for the annual period beginning on January 1, 2011.

Major accounting policies used for the preparation of the consolidated financial statements are stated below. Unless stated otherwise, these accounting policies have been applied consistently to the consolidated financial statements for the current period and the comparative period.

The consolidated financial statements have been prepared on the historical cost basis, except for certain non-current assets and financial instruments that are measured at revalued amounts or fair values, as explained in the accounting policies below. Historical cost is generally based on the fair value of the consideration given.

Meanwhile, the Group's consolidated financial statements for annual shareholders' meeting have been confirmed by the board of directors on February 29, 2014.

1) Amendments to K-IFRS affecting amounts reported in the consolidated financial statements

The following amendments to K-IFRS have been applied in the current year and have affected the amounts reported in the consolidated financial statements.

Amendments to K-IFRS 1001 – Presentation of Financial Statements

The amendments to K-IFRS 1001 require items of other comprehensive income to be grouped into two categories in the other comprehensive income section: (a) items that will not be reclassified subsequently to profit or loss and (b) items that may be reclassified subsequently to profit or loss when specific conditions are met. Other than this presentation change, the application of the amendments to K-IFRS 1001 does not result in any impact on the Group's financial position and financial performance.

The amendments have been applied retrospectively for the comparative period, and hence the presentation of items of other comprehensive income has been modified to reflect the changes.

Amendments to K-IFRS 1019 – Employee Benefits

The amendments to K-IFRS 1019 require the recognition of changes in defined benefit obligations and in fair value of plan assets when they occur, and hence eliminate the ‘corridor approach’ permitted under the previous version of K-IFRS 1019 and accelerate the recognition of past service costs. All actuarial gains and losses are recognized immediately through other comprehensive income (the option to recognize actuarial gains and losses in profit or loss has also been removed). Furthermore, the interest cost and expected return on plan assets used in the previous version of K-IFRS 1019 are replaced with a ‘net interest’ amount under K-IFRS 1019 (as revised in 2011), which is calculated by applying the discount rate to the net defined benefit liability or asset. The amendments to K-IFRS 1019 also require the recognition of past service cost as an expense at the earlier date of (a) when the plan amendment or curtailment occurs and (b) when the Group recognizes related restructuring costs or termination benefits. The amendments have had no material impact on the consolidated financial statements.

Amendments to K-IFRS 1107 – Financial Instruments: Disclosures

The amendments to K-IFRS 1107 are mainly focusing on presentation of the offset between financial assets and financial liabilities and require entities to disclose information about rights of offset and related arrangements (such as collateral agreements) for financial instruments under an enforceable master netting agreement or similar arrangement, irrespective of whether they would meet the offsetting criteria under K-IFRS 1032. As the Group has neither any offsetting financial instruments under K-IFRS 1032 nor any rights of offset or related arrangements in place, the application of the amendments has had no material impact on the disclosures or on the amounts recognized in the consolidated financial statements.

K-IFRS 1110 – Consolidated Financial Statements

K-IFRS 1110 replaces the parts of K-IFRS 1027, *Consolidated and Separate Financial Statements*, that deal with consolidated financial statements and K-IFRS 2012, *Consolidation – Special Purpose Entities*, and establishes a single basis for consolidation for all entities, including structured entities (the term from K-IFRS 2012, ‘special purpose entities’, is no longer used). Under K-IFRS 1110, an investor controls an investee when the investor is exposed, or has rights, to variable returns from its involvement with the investee and has the ability to affect those returns through its power over the investee. The amendments has had no material impact on the disclosures or on the amounts recognized in the consolidated financial statements.

K-IFRS 1111 – *Joint Arrangement*

K-IFRS 1111 deals with how a joint arrangement of which two or more parties have joint control should be classified either as a joint operation or a joint venture. The classification of joint arrangements under K-IFRS 1111 is determined based on the rights and obligations of parties to the joint arrangements by considering the structure, the legal form of the arrangements, the contractual terms agreed by the parties to the arrangement and, when relevant, other facts and circumstances. A joint operation is a joint arrangement whereby the parties that have joint control of the arrangement (i.e., joint operators) have rights to the assets, and obligations for the liabilities, relating to the arrangement. A joint venture is a joint arrangement whereby the parties that have joint control of the arrangement (i.e., joint venturers) have rights to the net assets of the arrangement. If the Group is a joint operator, the Group is to recognize assets, liabilities, revenues and expenses in relation to its interest in a joint operation and if the Group is a joint venture, the Group is to account for that investment using the equity method. The application of K-IFRS 1111 has not had any material impact on the Group's consolidated financial statements.

K-IFRS 1112 – *Disclosure of Interest in Other Entities*

K-IFRS 1112 is a disclosure standard and is applicable to entities that have interests in subsidiaries, joint arrangements, associates or unconsolidated structured entities. This standard requires an entity to disclose the nature of, and risks associated with, its interests in other entities and the effects of those interests on its financial position, financial performance and cash flows.

K-IFRS 1113 – *Fair Value Measurement*

K-IFRS 1113 establishes a single source of guidance for fair value measurements and disclosure about fair value measurements. The standard defines fair value, establishes a framework for measuring fair value and requires disclosures about fair value measurements. K-IFRS 1113 defines fair value as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. Fair value is measured by taking into account the characteristics of the asset or liability that market participants would take when pricing the asset or liability at the measurement date. A fair value measurement under K-IFRS 1113 requires an entity to determine the particular asset or liability that is subject of the measurement, the principal (or most advantageous) market for the asset or liability, and the valuation technique(s) appropriate for the measurement. In addition, K-IFRS 1113 requires extensive disclosures about fair value measurements. The amendments has had no material impact on the disclosures or on the amounts recognized in the consolidated financial statements.

There are some other amendments made to K-IFRSs, such as the tax effect of distribution to holders of equity instruments (the amendments to K-IFRS 1032), which have not resulted in material effects on the Group's consolidated financial statements.

2) New and revised K-IFRS in issue, but not yet effective

The Group has not applied the following new and revised K-IFRS that have been issued, but are not yet effective.

Amendments to K-IFRS 1032 – Financial Instruments: Presentation

The amendments to K-IFRS 1032 clarify existing application issue relating to the offset of financial assets and financial liabilities requirements. Specifically, the amendments clarify the meaning of 'currently has a legally enforceable right of set-off' and 'simultaneous realization and settlement.'

Group's right to offset must not be conditional on the occurrence of future events but enforceable anytime during the contract periods, during the ordinary course of business with counterparty, a default of counterparty and master netting agreement or in some forms of non-recourse debt. The amendments to K-IFRS 1032 are effective for annual periods beginning on or after January 1, 2014.

Amendments to K-IFRS 1039 – Financial Instruments: Recognition and Measurement

The amendments to K-IFRS 1039 allows the continuation of hedge accounting when a derivative is novated to a clearing counterparty or entity acting in a similar capacity and certain conditions are met. The amendment to K-IFRS 1039 is effective for annual periods beginning on or after January 1, 2014.

Amendments to K-IFRS 1110, K-IFRS 1112 and K-IFRS 1027, Investment Entities

The amendments introduce an exception to the principle under K-IFRS 1110 that all subsidiaries shall be consolidated and require a reporting entity that meets the definition of an investment entity not to consolidate its subsidiaries but instead to measure its subsidiaries at FVTPL in its consolidated and separate financial statements. In addition, consequential amendments have been made to K-IFRS 1112 and K-IFRS 1027 to introduce new disclosure requirements for investment entities. The investment entities amendments are effective for annual periods beginning on or after January 1, 2014.

K-IFRS 2121 – *Levies*

K-IFRS 2121 defines a levy as a payment to a government for which an entity receives no specific goods or services. The interpretation requires that a liability is recognized when the obligating event occurs. The obligating event is the activity that triggers payment of the levy and is typically specified in the legislation that imposes the levy. The interpretation is effective for annual periods beginning on or after January 1, 2014.

The list above does not include some other amendments, such as the Amendments to K-IFRS 1036 relating to recoverable amount disclosures for non-financial assets that are effective from January 1, 2014, with earlier application permitted. The Group is in the process of evaluating the impact on the consolidated financial statements upon the application of new and revised K-IFRSs that have been issued but are not yet effective.

(2) Basis of consolidation

The consolidated financial statements incorporate the financial statements of the Company and entities (including structured entities) controlled by the Company (and its subsidiaries). Control is achieved where the Company 1) has the power over the investee, 2) is exposed, or has rights, to variable returns from its involvement with the investee, and 3) has the ability to use its power to affect its returns. The Company reassesses whether or not it controls an investee if facts and circumstances indicate that there are changes to one or more of the three elements of control listed above.

When the Company has less than a majority of the voting rights of an investee, it has power over the investee when the voting rights are sufficient to give it the practical ability to direct the relevant activities of the investee unilaterally. The Company considers all relevant facts and circumstances in assessing whether or not the Company's voting rights in an investee are sufficient to give it power, including:

- The size of the Company's holding of voting rights relative to the size and dispersion of holdings of the other voteholders;
- Potential voting rights held by the Company, other voteholders or other parties;
- Rights arising from other contractual arrangements; and
- Any additional facts and circumstances that indicate that the Company has, or does not have, the current ability to direct the relevant activities at the time that decisions need to be made, including voting patterns at previous shareholders' meetings.

Income and expenses of subsidiaries acquired or disposed of during the year are included in the consolidated statement of comprehensive income from the date the Company gains control until the date when the Company ceases to control the subsidiary. Profit or loss and each component of other comprehensive income are attributed to the owners of the Company and to the non-controlling interests. Total comprehensive income of subsidiaries is attributed to the owners of the Company and to the non-controlling interests even if this results in the non-controlling interests having a deficit balance.

When necessary, adjustments are made to the financial statements of subsidiaries to bring their accounting policies into line with the Group's accounting policies.

All intragroup transactions and related assets and liabilities, income and expenses are eliminated in full on consolidation.

Changes in the Group's ownership interests in subsidiaries that do not result in the Group losing control over the subsidiaries are accounted for as equity transactions. The carrying amounts of the Group's interests and the non-controlling interests are adjusted to reflect the changes in their relative interests in the subsidiaries. Any differences between the amount by which the non-controlling interests are adjusted, and the fair value of the consideration paid or received is recognized directly in equity and attributed to owners of the Company.

When the Group loses control of a subsidiary, a gain or loss on disposal is calculated as the difference between (i) the aggregate of the fair value of the consideration received and the fair value of any retained interest and (ii) the previous carrying amount of the assets (including goodwill), and liabilities of the subsidiary and any non-controlling interests. When assets of the subsidiary are carried at revalued amounts or fair values and the related cumulative gain or loss has been recognized in other comprehensive income and accumulated in equity, the amounts previously recognized in other comprehensive income and accumulated in equity are accounted for as if the Company had directly disposed of the relevant assets (i.e., reclassified to profit or loss or transferred directly to retained earnings). The fair value of any investment retained in the former subsidiary at the date when control is lost is recognized as the fair value on initial recognition for subsequent accounting under K-IFRS 1039, *Financial Instruments: Recognition and Measurement*, or, when applicable, the cost on initial recognition of an investment in an associate or a joint venture.

(3) Business combination

Acquisitions of businesses are accounted for using the acquisition method. The consideration transferred in a business combination is measured at fair value, which is calculated as the sum of the fair values of the assets transferred by the Group, liabilities incurred by the Group to the former owners of the venture and the equity interests issued by the Group in exchange for control of the venture. Acquisition-related costs are generally recognized in profit or loss as incurred.

At the acquisition date, the identifiable assets acquired and the liabilities assumed are recognized at their fair value at the acquisition date, except that:

- Deferred tax assets or liabilities and assets related to employee benefit arrangements are recognized and measured in accordance with K-IFRS 1012 and K-IFRS 1019, respectively;
- Liabilities or equity instruments related to share-based payment arrangements of the venture or share-based payment arrangements of the Group entered into to replace share-based payment arrangements of the venture are measured in accordance with K-IFRS 1102, *Share-Based Payment*, at the acquisition date; and
- Assets (or disposal groups) that are classified as held for sale in accordance with K-IFRS 1105, *Non-Current Assets Held for Sale and Discontinued Operations*, are measured in accordance with that standard.

Goodwill is measured as the excess of the sum of a) the consideration transferred, b) the amount of any non-controlling interests in the venture and c) the fair value of the acquirer's previously held equity interest in the venture (if any), over the net of the acquisition-date amounts of the identifiable assets acquired and the liabilities assumed. If, after reassessment, the net of the acquisition-date amounts of the identifiable assets acquired and liabilities assumed exceed the sum of a) the consideration transferred, b) the amount of any non-controlling interests in the venture and c) the fair value of the acquirer's previously held interest in the venture (if any), the excess is recognized immediately in profit or loss as a bargain purchase gain.

Non-controlling interests that are present ownership interests and entitle their holders to a proportionate share of the entity's net assets in the event of liquidation may be initially measured either at fair value or at the non-controlling interests' proportionate share of the recognized amounts of the acquiree's identifiable net assets. The choice of measurement is made on a transaction-by-transaction basis. Other types of non-controlling interests are measured at fair value or, when applicable, on the basis specified in another K-IFRS.

When the consideration transferred by the Group in a business combination includes assets or liabilities resulting from a contingent consideration arrangement, the contingent consideration is measured at its acquisition-date fair value and included as part of the consideration transferred in a business combination. Changes in the fair value of the contingent consideration that qualify as measurement-period adjustments are adjusted retrospectively, with corresponding adjustments against goodwill. Measurement-period adjustments are adjustments that arise from additional information obtained during the 'measurement period' (which cannot exceed one year from the acquisition date) about facts and circumstances that existed at the acquisition date.

The subsequent accounting for changes in the fair value of the contingent consideration that do not qualify as measurement-period adjustments depends on how the contingent consideration is classified. Contingent consideration that is classified as equity is not remeasured at subsequent reporting dates and its subsequent settlement is accounted for within equity. Contingent consideration that is classified as an asset or a liability is remeasured at subsequent reporting dates in accordance with K-IFRS 1039 or K-IFRS 1037, *Provisions, Contingent Liabilities and Contingent Assets*, as appropriate, with the corresponding gain or loss being recognized in profit or loss.

When a business combination is achieved in stages, the Group's previously held equity interest in the venture is remeasured to fair value at the acquisition date and the resulting gain or loss, if any, is recognized in profit or loss. Amounts arising from interests in the venture prior to the acquisition date that have previously been recognized in other comprehensive income are reclassified to profit or loss where such treatment would be appropriate if that interest were disposed of.

If the initial accounting for a business combination is incomplete by the end of the reporting period in which the combination occurs, the Group reports provisional amounts for the items for which the accounting is incomplete. Those provisional amounts are adjusted during the measurement period (see above), or additional assets or liabilities are recognized, to reflect new information obtained about facts and circumstances that existed at the acquisition date that, if known, would have affected the amounts recognized at that date.

(4) Investments in associates and joint ventures

An associate is an entity over which the Group has significant influence. Significant influence is the power to participate in the financial and operating policy decisions of the investee but is not control or joint control over those policies.

A joint venture is a joint arrangement whereby the parties that have joint control of the arrangement have rights to the net assets of the joint arrangement. Joint control is the contractually agreed sharing of control of an arrangement, which exists only when decisions about the relevant activities require unanimous consent of the parties sharing control.

The results and assets and liabilities of associates or joint ventures are incorporated in these consolidated financial statements using the equity method of accounting, except when the investment is classified as held for sale, in which case it is accounted for in accordance with K-IFRS 1105, *Non-current Assets Held for Sale and Discontinued Operations*. Under the equity method, an investment in an associate or a joint venture is initially recognized in the consolidated statement of financial position at cost and adjusted thereafter to recognize the Group's share of the profit or loss and other comprehensive income of the associate or joint venture. When the Group's share of losses of an associate or a joint venture exceeds the Group's interest in that associate or joint venture (which includes any long-term interests that, in substance, form part of the Group's net investment in the associate or joint venture), the Group discontinues recognizing its share of further losses. Additional losses are recognized only to the extent that the Group has incurred legal or constructive obligations or made payments on behalf of the associate or joint venture.

Any excess of the cost of acquisition over the Group's share of the net fair value of the identifiable assets, liabilities and contingent liabilities of an associate or a joint venture recognized at the date of acquisition is recognized as goodwill, which is included within the carrying amount of the investment. Any excess of the Group's share of the net fair value of the identifiable assets, liabilities and contingent liabilities over the cost of acquisition, after reassessment, is recognized immediately in profit or loss.

Upon disposal of an associate or a joint venture that results in the Group losing significant influence over that associate or joint venture, any retained investment is measured at fair value at that date and the fair value is regarded as its fair value on initial recognition as a financial asset in accordance with K-IFRS 1039. The difference between the previous carrying amount of the associate or joint venture attributable to the retained interest and its fair value is included in the determination of the gain or loss on disposal of the associate or joint venture. In addition, the Group accounts for all amounts previously recognized in other comprehensive income in relation to that associate or joint venture on the same basis we would be required if that associate or joint venture had directly disposed of the related assets or liabilities. Therefore, if a gain or loss previously recognized in other comprehensive income by that associate or joint venture would be reclassified to profit or loss on the disposal of the related assets or liabilities, the Group reclassifies the gain or loss from equity to profit or loss (as reclassification adjustment) when it loses significant influence over that associate or joint venture.

When the Group reduces its ownership interest in an associate or a joint venture but the Group continues to use the equity method, the Group reclassifies to profit or loss the proportion of the gain or loss that had previously been recognized in other comprehensive income relating to that reduction in ownership interest if that gain or loss would be reclassified to profit or loss on the disposal of the related assets or liabilities. In addition, the Group applies K-IFRS 5 to a portion of investment in an associate or a joint venture that meets the criteria to be classified as held for sale.

The requirements of K-IFRS 1039, *Financial Instruments: Recognition and Measurement*, are applied to determine whether it is necessary to recognize any impairment loss with respect to the Group's investment in an associate or a joint venture. When necessary, the entire carrying amount of the investment (including goodwill) is tested for impairment in accordance with K-IFRS 1036, *Impairment of Assets*, by comparing its recoverable amount (higher of value in use and fair value less costs to sell) with its carrying amount, any impairment loss recognized forms part of the carrying amount of the investment. Any reversal of that impairment loss is recognized in accordance with K-IFRS 1036 to the extent that the recoverable amount of the investment subsequently increases.

The Group continues to use the equity method when an investment in an associate becomes an investment in a joint venture or an investment in a joint venture becomes an investment in an associate. There is no remeasurement to fair value upon such changes in ownership interests.

When a group entity transacts with an associate or a joint venture of the Group, profits and losses resulting from the transactions with the associate or joint venture are recognized in the Group's consolidated financial statements only to the extent of interests in the associate or joint venture that are not related to the Group.

(5) Goodwill

Goodwill arising on an acquisition of a business is carried at cost as established at the date of acquisition of the business, less accumulated impairment losses, if any.

For the purpose of impairment testing, goodwill is allocated to each of the Group's cash-generating units (or groups of cash-generating units) that is expected to benefit from the synergies of the combination.

A cash-generating unit to which goodwill has been allocated is tested for impairment annually, or more frequently, when there is an indication that the unit may be impaired. If the recoverable amount of the cash-generating unit is less than its carrying amount, the impairment loss is allocated first to reduce the carrying amount of any goodwill allocated to the unit and then to the other assets of the unit on a pro rata basis based on the carrying amount of each asset in the unit. Any impairment loss for goodwill is recognized directly in profit or loss in the consolidated statements of comprehensive income. An impairment loss recognized for goodwill is not reversed in the subsequent periods.

On disposal of the relevant cash-generating unit, the attributable amount of goodwill is included in the determination of the profit or loss on disposal.

The Group's policy for goodwill arising on the acquisition of an associate is described in Note 2. (4).

(6) Non-current assets held for sale

Non-current assets and disposal groups are classified as held for sale if their carrying amount will be recovered principally through a sale transaction rather than through continued use. This condition is regarded as met only when the sale is highly probable and the non-current asset (or disposal group) is available for immediate sale in its present condition. Management must be committed to the sale, which should be expected to qualify for recognition as a completed sale within one year from the date of classification.

When the Group is committed to a sale plan involving loss of control of a subsidiary, all of the assets and liabilities of that subsidiary are classified as held for sale when the criteria described above are met, regardless of whether the Group will retain a non-controlling interest in its former subsidiary after the sale.

Non-current assets (and disposal groups) classified as held for sale are measured at the lower of their previous carrying amount and fair value, less costs to sell.

(7) Revenue recognition

Revenue is measured at the fair value of the consideration received or receivable. Revenue is reduced for estimated customer returns, rebates and other similar allowances. The Group recognizes revenue when the amount of revenue can be measured reliably, when it is probable that the economic benefits associated with the transaction will flow to the Group and when the following criteria specific to each of the Group's activities are met:

1) Sale of goods

Revenue from the sale of goods is recognized when the Group has transferred to the buyer the significant risks and rewards of ownership of the goods.

2) Dividend

Dividend income from investments is recognized when the shareholders' right to receive payment has been established.

3) Interest income

Interest income is accrued on a timely basis, by reference to the principal outstanding and at the effective interest rate applicable, which is the rate that exactly discounts estimated future cash receipts through the expected life of the financial asset to that asset's net carrying amount on initial recognition.

(8) Lease

Leases are classified as finance leases whenever the terms of the lease transfer substantially all the risks and rewards of ownership to the lessee. All other leases are classified as operating leases.

Assets held under finance leases are initially recognized as assets of the Group at their fair value at the inception of the lease or, if lower, at the present value of the minimum lease payments. The corresponding liability to the lessor is included in the consolidated statements of financial position as a finance lease obligation.

Lease payments are apportioned between finance expenses and reduction of the lease obligation to achieve a constant rate of interest on the remaining balance of the liability. Finance expenses are recognized immediately in profit or loss, unless they are directly attributable to qualifying assets; in which case, they are capitalized in accordance with the Group's general policy on borrowing costs (see Note 2. (10)). Contingent rentals are recognized as expenses in the periods in which they are incurred.

Operating lease payments are recognized as an expense on a straight-line basis over the lease term, except where another systematic basis is more representative of the time pattern in which economic benefits from the leased asset are consumed. Contingent rentals arising under operating leases are recognized as an expense in the period in which they are incurred.

In the event that lease incentives are received to enter into operating leases, such incentives are recognized as a liability. The aggregate benefit of incentives is recognized as a reduction of rental expense on a straight-line basis, except where another systematic basis is more representative of the time pattern in which economic benefits from the leased asset are consumed.

(9) Borrowing costs

Borrowing costs directly attributable to the acquisition, construction or production of qualifying assets, which are assets that necessarily take a substantial period of time to get ready for their intended use or sale, are added to the cost of those assets, until such time as the assets are substantially ready for their intended use or sale.

Investment income earned on the temporary investment of specific borrowings pending their expenditure on qualifying assets is deducted from the borrowing costs eligible for capitalization.

All other borrowing costs are recognized in profit or loss in the period in which they are incurred.

(10) Inventories

Inventories are stated at the lower of cost or net realizable value. Cost of inventories, except for those in transit, is measured under the weighted-average method and consists of the purchase price, cost of conversion and other costs incurred in bringing the inventories to their present location and condition. Net realizable value represents the estimated selling price for inventories, less all estimated costs of completion and costs necessary to make the sale.

When inventories are sold, the carrying amount of those inventories shall be recognized as an expense in the period in which the related revenue is recognized. The amount of any write-down of inventories shall be recognized as an expense in the period write-down or loss occurs. The amount of any reversal in the period of any write-down of the inventories, arising from an increase in net realizable value, shall be recognized as a reduction in the amount of inventories recognized as an expense in the period in which the reversal occurs.

(11) Property, plant and equipment

Property, plant and equipment are stated at cost, less subsequent accumulated depreciation and accumulated impairment losses. The cost of an item of property, plant and equipment is directly attributable to their purchase or construction, which includes any costs directly attributable to bringing the asset to the location and condition necessary for it to be capable of operating in the manner intended by management. It also includes the initial estimate of the costs of dismantling and removing the item and restoring the site on which it is located.

Subsequent costs are recognized in the carrying amount of an asset or as an asset if it is probable that future economic benefits associated with the assets will flow to the Group, and the cost of an asset can be measured reliably. Transferred parts are removed from the carrying amount of an asset. Routine maintenance and repairs are expensed as incurred.

The Group does not depreciate land. Depreciation expense is computed using the straight-line method based on the estimated useful lives of the assets as follows:

	<i>Useful lives (years)</i>
Buildings	10-47
Structures	10-40
Machinery	5-25
Vehicles	4-8
Others	3-15

If each part of an item of property, plant and equipment has a cost that is significant in relation to the total cost of the item, it is depreciated separately.

The Group reviews the depreciation method and the estimated useful lives and residual values of property, plant and equipment at the end of each annual reporting period. If expectations differ from previous estimates, the changes are accounted for as a change in an accounting estimate.

Property, plant and equipment are derecognized upon disposal or when they are permanently withdrawn from use and no future economic benefits are expected from the disposal. Any gain or loss arising on derecognition of the property (calculated as the difference between the net disposal proceeds and the carrying amount of the asset) is included in profit or loss in the period in which the property is derecognized.

(12) Investment properties

Investment properties are properties held to earn rentals and/or for capital appreciation (including property under construction for such purposes). Investment properties are measured initially at cost, including transaction costs. Subsequent to initial recognition, investment property is measured at cost, less accumulated depreciation and accumulated impairment losses.

Subsequent costs are recognized in the carrying amount of an asset or as an asset if it is probable that future economic benefits associated with the assets will flow to the Group, and the cost of an asset can be measured reliably. Transferred parts are removed from the carrying amount of an asset. Routine maintenance and repairs are expensed as incurred.

While land is not depreciated, all other investment property is depreciated based on the respective assets' estimated useful lives ranging 40 years using the straight-line method.

The estimated useful lives, residual values and depreciation method are reviewed at the end of each reporting period, with the effect of any changes in estimate accounted for on a prospective basis.

An investment property is derecognized upon disposal or when the investment property is permanently withdrawn from use and no future economic benefits are expected from the disposal. Any gain or loss arising on derecognition of the property (calculated as the difference between the net disposal proceeds and the carrying amount of the asset) is included in profit or loss in the period in which the property is derecognized.

(13) Intangible assets

1) Intangible assets acquired separately

Intangible assets with finite useful lives that are acquired separately are carried at cost, less accumulated amortization and accumulated impairment losses. Amortization is recognized on a straight-line basis over their estimated useful lives. The estimated useful life and amortization method are reviewed at the end of each reporting period, with the effect of any changes in estimate being accounted for on a prospective basis. Intangible assets with indefinite useful lives that are acquired separately are carried at cost, less accumulated impairment losses.

Amortization expense is computed using the straight-line method based on the estimated useful lives of the assets as follows:

	<i>Useful lives (years)</i>
Industrial property rights	7–21
Software	3–10
Membership	33
Development	5

2) Internally generated intangible assets – research and development expenditure

Expenditure on research activities is recognized as an expense in the period in which it is incurred.

An internally generated intangible asset arising from development (or from the development phase of an internal project) is recognized if, and only if, all of the following have been demonstrated:

- Improvement of technical feasibility and development of new product; and
- The ability to measure reliably the expenditure attributable to the intangible asset during its development.

The amount initially recognized for internally generated intangible assets is the sum of the expenditure incurred from the date when the intangible asset first meets the recognition criteria listed above. Where no internally generated intangible asset can be recognized, development expenditure is recognized in profit or loss in the period in which it is incurred.

Subsequent to initial recognition, internally generated intangible assets are reported at cost, less accumulated amortization and accumulated impairment losses.

3) Intangible assets acquired in a business combination

Intangible assets that are acquired in a business combination are recognized separately from goodwill and are initially recognized at their fair value at the acquisition date (which is regarded as their cost). Subsequent to initial recognition, intangible assets acquired in a business combination are reported at cost, less accumulated amortization and accumulated impairment losses, on the same basis as intangible assets that are acquired separately.

4) Derecognition of intangible assets

An intangible asset is derecognized on disposal, or when no future economic benefits are expected from its use or disposal. Gains or losses arising from derecognition of an intangible asset, measured as the difference between the net disposal proceeds and the carrying amount of the asset, are recognized in profit or loss when the asset is derecognized.

(14) Impairment of tangible and intangible assets other than goodwill

At the end of each reporting period, the Group reviews the carrying amounts of its tangible and intangible assets to determine whether there is any indication that those assets have suffered an impairment loss. If any such indication exists, the recoverable amount of the asset is estimated in order to determine the extent of the impairment loss (if any). Where it is not possible to estimate the recoverable amount of an individual asset, the Group estimates the recoverable amount of the cash-generating unit to which the asset belongs. Where a reasonable and consistent basis of allocation can be identified, corporate assets are also allocated to individual cash-generating units or, otherwise, they are allocated to the smallest group of cash-generating units for which a reasonable and consistent allocation basis can be identified.

Intangible assets with indefinite useful lives and intangible assets not yet available for use are tested for impairment at least annually and whenever there is an indication that the asset may be impaired.

Recoverable amount is the higher of fair value, less costs to sell and value in use. If the recoverable amount of an asset (or a cash-generating unit) is estimated to be less than its carrying amount, the carrying amount of the asset (or the cash-generating unit) is reduced to its recoverable amount. An impairment loss is recognized immediately in profit or loss.

Where an impairment loss subsequently reverses, the carrying amount of the asset (or the cash-generating unit) is increased to its recoverable amount, but the increased carrying amount does not exceed the carrying amount that would have been determined had no impairment loss been recognized for the asset in prior years. A reversal of an impairment loss is recognized immediately in profit or loss.

(15) Government grants

Government grants are not recognized until there is a reasonable assurance that the Group will comply with the conditions attached to them and that the grants will be received.

The benefit of a government loan at a below-market rate of interest is treated as a government grant, measured as the difference between proceeds received and the fair value of the loan based on prevailing market interest rates.

Government grants whose primary condition is that the Group should purchase, construct or otherwise acquire assets are recognized as deduction of the related assets in the consolidated statements of financial position, and transferred to profit or loss on a systematic and rational basis over the useful lives of the related assets.

Other government grants are recognized as revenue over the periods to correspond to the costs it intends to compensate, on a systematic basis. Government grants that are receivable as compensation for expenses or losses already incurred or for the purpose of giving immediate financial support to the Group with no future-related costs are recognized in profit or loss in the period in which they become receivable.

(16) Retirement benefit costs and termination benefits

Contributions to defined contribution retirement benefit plans are recognized as an expense when employees have rendered service entitling them to the contributions.

For defined benefit retirement benefit plans, the cost of providing benefits is determined using the Projected Unit Credit Method, with actuarial valuations being carried out at the end of each reporting period. Remeasurement, comprising actuarial gains and losses, the effect of the changes to the asset ceiling (if applicable) and the return on plan assets (excluding interest), is reflected immediately in the statement of financial position with a charge or credit recognized in other comprehensive income in the period in which they occur. Remeasurement recognized in other comprehensive income is reflected immediately in retained earnings and will not be reclassified to profit or loss. Past service cost is recognized in profit or loss in the period of a plan amendment. Net interest is calculated by applying the discount rate at the beginning of the period to the net defined benefit liability or asset. Defined benefit costs are composed of service cost (including current service cost, past service cost, as well as gains and losses on curtailments and settlements), net interest expense (income), and remeasurement.

The Group presents the service cost and net interest expense (income) components in profit or loss, and the remeasurement component in other comprehensive income. Curtailment gains and losses are accounted for as past service costs.

The retirement benefit obligation recognized in the consolidated statement of financial position represents the actual deficit or surplus in the Group's defined benefit plans. Any surplus resulting from this calculation is limited to the present value of any economic benefits available in the form of refunds from the plans or reductions in future contributions to the plans.

A liability for a termination benefit is recognized at the earlier of when the entity can no longer withdraw the offer of the termination benefit and when the entity recognizes any related restructuring costs.

(17) Foreign currency translation

The Group's consolidated financial statements are presented in the currency of the primary economic environment in which the Group operates (its functional currency), and the functional and reporting currency of the Group is Korean won ("KRW").

Transactions in currencies other than the entity's functional currency (foreign currencies) are recognized at the exchange rates prevailing at the dates of the transactions. At the end of each reporting period, monetary items denominated in foreign currencies are retranslated at the rates prevailing at that date. Non-monetary items carried at fair value that are denominated in foreign currencies are retranslated at the rates prevailing at the date when the fair value was determined. Non-monetary items that are measured at historical cost in a foreign currency are not retranslated.

Exchange differences are recognized in profit or loss in the period in which they arise, except for:

- Exchange differences on foreign currency borrowings related to assets under construction for future productive use, which are included in the cost of those assets when they are regarded as an adjustment to interest costs on those foreign currency borrowings;
- Exchange differences on transactions entered into in order to hedge certain foreign currency risks (see Note 2 (22) below for hedging accounting policies); and
- Exchange differences on monetary items receivable from or payable to a foreign operation for which settlement is neither planned nor likely to occur (therefore, forming part of the net investment in the foreign operation), which are recognized initially in other comprehensive income and reclassified from equity to profit or loss on disposal or partial disposal of the net investment.

For the purpose of presenting consolidated financial statements, the assets and liabilities of the Company's foreign operations are expressed in KRW using exchange rates prevailing at the end of the reporting period. Income and expense items are translated at the average exchange rates for the period, unless exchange rates fluctuated significantly during that period, in which case the exchange rates at the dates of the transactions are used. Exchange differences arising, if any, are recognized in other comprehensive income and accumulated in equity (attributed to non-controlling interests as appropriate).

On the disposal of a foreign operation (i.e., a disposal of the Group's entire interest in a foreign operation, or a disposal involving loss of control over a subsidiary that includes a foreign operation, or partial disposal of an interest in a joint arrangement or an associate that includes a foreign operation of which the retained interest becomes a financial asset), all of the accumulated exchange differences in respect of that operation attributable to the owners of the Company are reclassified to profit or loss. Any exchange differences that have previously been attributed to non-controlling interests are derecognized, but they are not reclassified to profit or loss.

In the case of a partial disposal (i.e., no loss of control) of a subsidiary that includes a foreign operation, the proportionate share of accumulated exchange differences are reattributed to non-controlling interests in equity and are not recognized in profit or loss. For all other partial disposals (i.e., partial disposals of associates or joint arrangements that do not result in the Group losing significant influence or joint control), the proportionate share of the accumulated exchange differences is reclassified to profit or loss.

Goodwill and fair value adjustments arising on the acquisition of a foreign operation are treated as assets and liabilities of the foreign operation and translated at the closing rate. Exchange differences arising are recognized in other comprehensive income.

(18) Taxation

Income tax expense represents the sum of the tax currently payable and deferred tax.

1) Current tax

The tax currently payable is based on taxable profit for the year. Taxable profit differs from profit as reported in the consolidated statements of comprehensive income because of items of income or expense that are taxable or deductible in other years and items that are never taxable or deductible. The Group's liability for current tax is calculated using tax rates that have been enacted or substantively enacted by the end of the reporting period.

2) Deferred tax

Deferred tax is recognized on temporary differences between the carrying amounts of assets and liabilities in the consolidated financial statements and the corresponding tax bases used in the computation of taxable profit. Deferred tax liabilities are generally recognized for all taxable temporary differences. Deferred tax assets are generally recognized for all deductible temporary differences to the extent that it is probable that taxable profits will be available against which those deductible temporary differences can be utilized.

Such deferred tax assets and liabilities are not recognized if the temporary difference arises from goodwill or from the initial recognition (other than in a business combination) of other assets and liabilities in a transaction that affects neither the taxable profit nor the accounting profit.

Deferred tax liabilities are recognized for taxable temporary differences associated with investments in subsidiaries and associates, and interests in joint ventures, except where the Group is able to control the reversal of the temporary difference, and it is probable that the temporary difference will not reverse in the foreseeable future. Deferred tax assets arising from deductible temporary differences associated with such investments and interests are only recognized to the extent that it is probable that there will be sufficient taxable profits against which to utilize the benefits of the temporary differences and they are expected to reverse in the foreseeable future.

The carrying amount of deferred tax assets is reviewed at the end of each reporting period and reduced to the extent that it is no longer probable that sufficient taxable profits will be available to allow all or part of the asset to be recovered.

Deferred tax assets and liabilities are measured at the tax rates that are expected to apply in the period in which the liability is settled or the asset realized, based on tax rates (and tax laws) that have been enacted or substantively enacted by the end of the reporting period. The measurement of deferred tax liabilities and assets reflects the tax consequences that would follow from the manner in which the Group expects, at the end of the reporting period, to recover or settle the carrying amount of its assets and liabilities.

Deferred tax assets and liabilities are offset if there is a legally enforceable right to offset current tax liabilities and assets, and they relate to income taxes levied by the same tax authority and the Group has the intent to settle current tax liabilities and assets on a net basis.

For the purpose of measuring deferred tax liabilities and deferred tax assets for investment properties that are measured using the fair value model, the carrying amounts of such properties are presumed to be recovered entirely through sale, unless the presumption is rebutted. The presumption is rebutted when the investment property is depreciable and is held within a business model whose objective is to consume substantially all of the economic benefits embodied in the investment properties over time, rather than through sale.

3) Current and deferred taxes for the year

Current and deferred taxes are recognized in profit or loss, except when they relate to items that are recognized in other comprehensive income or directly in equity; in which case, the current and deferred taxes are also recognized in other comprehensive income or directly in equity. Where current tax or deferred tax arises from the initial accounting for a business combination, the tax effect is included in the accounting for the business combination.

(19) Financial Instruments

Financial assets and financial liabilities are recognized when a group entity becomes a party to the contractual provisions of the instruments. Financial assets and financial liabilities are initially measured at fair value. Transaction costs that are directly attributable to the acquisition or issue of financial assets and financial liabilities are added to or deducted from the fair value of the financial assets or financial liabilities, as appropriate, on initial recognition. Transaction costs directly attributable to the acquisition of financial assets or financial liabilities at FVTPL are recognized immediately in profit or loss.

All regular-way purchases or sales of financial assets are recognized and derecognized on a trade-date basis. Regular-way purchases or sales are purchases or sales of financial assets that require delivery of assets within the time frame established by regulation or convention in the marketplace.

Financial assets are classified into the following specified categories: 'financial assets at FVTPL,' 'held-to-maturity investments,' 'available-for-sale ("AFS") financial assets' and 'loans and receivables.' The classification depends on the nature and purpose of the financial assets and is determined at the time of initial recognition.

1) Effective interest method

The effective interest method is a method of calculating the amortized cost of a debt instrument and allocating interest income over the relevant period. The effective interest rate is the rate that exactly discounts estimated future cash receipts (including all fees and points paid or received that form an integral part of the effective interest rate, transaction costs and other premiums or discounts) through the expected life of the debt instrument, or, where appropriate, a shorter period, to the net carrying amount on initial recognition.

Income is recognized on an effective interest basis for debt instruments other than those financial assets classified as FVTPL.

2) Financial assets at FVTPL

Financial assets are classified as at FVTPL when the financial asset is either held for trading or it is designated as at FVTPL upon initial recognition. Every financial instrument, containing one or more embedded derivatives, treated separately from the host contract, is classified as held for trading if it is a derivative that is not designated and effective as a hedge.

Financial assets at FVTPL are stated at fair value, with any gains or losses arising on remeasurement recognized in profit or loss. Transaction costs attributable to acquisition upon initial recognition are immediately recognized in profit or loss in the period they occur.

A financial asset is classified as held for trading if:

- It has been acquired principally for the purpose of selling in the near term;
- On initial recognition, it is part of a portfolio of identified financial instruments that the Company manages together and has a recent actual pattern of short-term profit taking; or
- It is a derivative that is not designated and effective as a hedging instrument.

A financial asset other than a financial asset held for trading may be designated as at FVTPL upon initial recognition if:

- Such designation eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise;
- The financial asset forms part of a group of financial assets or financial liabilities or both, which is managed and its performance is evaluated on a fair value basis, in accordance with the Group's documented risk management or investment strategy, and information about the grouping is provided internally on that basis; or
- It forms part of a contract containing one or more embedded derivatives, and K-IFRS 1039 permits the entire combined contract (asset or liability) to be designated as at FVTPL.

Financial assets at FVTPL are stated at fair value, with any gains or losses arising on remeasurement recognized in profit or loss. The net gain or loss recognized in profit or loss incorporates any dividend or interest earned on the financial asset and is included in the 'other gains and losses' line item in the consolidated statements of comprehensive income.

3) Held-to-maturity investments

Non-derivative financial assets with fixed or determinable payments and fixed maturity dates that the Group has the positive intent and ability to hold to maturity are classified as held-to-maturity investments. Held-to-maturity investments are measured at amortized cost using the effective interest method, less any impairment, with revenue recognized on an effective yield basis.

4) Financial assets AFS

Non-derivative financial assets that are not classified as at held to maturity or held for trading, designated as at FVTPL or loans and receivables are classified as at financial assets AFS.

They are subsequently measured at fair value at the end of each reporting period. Changes in the carrying amount of AFS monetary financial assets related to changes in foreign currency rates (see below), interest income calculated using the effective interest method and dividends on AFS equity investments are recognized in profit or loss. Other changes in the carrying amount of AFS financial assets are recognized in other comprehensive income and accumulated under the heading of investments revaluation reserve. When the investment is disposed of or is determined to be impaired, the cumulative gain or loss previously accumulated in the investments revaluation reserve is reclassified to profit or loss.

Dividends on AFS equity instruments are recognized in profit or loss when the Group's right to receive the dividends is established.

The fair value of AFS monetary financial assets denominated in a foreign currency is determined in that foreign currency and translated at the spot rate prevailing at the end of the reporting period. The foreign exchange gains and losses that are recognized in profit or loss are determined based on the amortized cost of the monetary asset. Other foreign exchange gains and losses are recognized in other comprehensive income.

Unquoted AFS financial assets whose fair value cannot be measured reliably and derivative assets linked with unquoted equity financial assets whose pay for the equity financial assets are carried at acquisition cost, less impairment.

5) Loans and receivables

Trade receivables, loans and other receivables that have fixed or determinable payments that are not quoted in an active market are classified as 'loans and receivables.' Loans and receivables are measured at amortized cost using the effective interest method, less any impairment. Interest income is recognized by applying the effective interest rate, except for short-term receivables when the effect of discounting is immaterial.

6) Impairment of financial assets

Financial assets, other than those at FVTPL, are assessed for indicators of impairment at the end of each reporting period. Financial assets are considered to be impaired when there is objective evidence that more events that occurred after the initial recognition of the financial asset and the estimated future cash flows of the investment have been affected.

For listed and unlisted equity investments classified as AFS, a significant or prolonged decline in the fair value of the security below its cost is considered to be objective evidence of impairment.

For all other financial assets, including redeemable notes classified as AFS and finance lease receivables, the objective evidence of impairment could include:

- Significant financial difficulty of the issuer or counterparty;
- Default or delinquency in interest or principal payments;
- It becoming probable that the borrower will enter bankruptcy or financial reorganization; or
- The disappearance of an active market for that financial asset because of financial difficulties.

For certain categories of financial asset, such as trade receivables, assets that are assessed not to be impaired individually are, in addition, assessed for impairment on a collective basis. Objective evidence of impairment for a portfolio of receivables could include the Group's past experience of collecting payments, as well as observable changes in national or local economic conditions that correlate with default on receivables.

For financial assets carried at amortized cost, the amount of the impairment loss recognized is the difference between the asset's carrying amount and the present value of estimated future cash flows, discounted at the financial asset's original effective interest rate.

For financial assets that are carried at cost, the amount of the impairment loss recognized is the difference between the asset's carrying amount and the present value of estimated future cash flows, discounted at the financial asset's original effective interest rate. Such impairment loss will not be reversed in the subsequent period.

The carrying amount of the financial asset is reduced by the impairment loss directly for all financial assets with the exception of trade receivables, where the carrying amount is reduced through the use of an allowance account. When a trade receivable is considered uncollectible, it is written off against the allowance account. Subsequent recoveries of amounts previously written off are credited against the allowance account. Changes in the carrying amount of the allowance account are recognized in profit or loss.

When an AFS financial asset is considered to be impaired, cumulative gains or losses previously recognized in other comprehensive income are reclassified to profit or loss in that period.

For financial assets measured at amortized cost, if, in a subsequent period, the amount of the impairment loss decreases and the decrease can be related objectively to an event occurring after the impairment was recognized, the previously recognized impairment loss is reversed through profit or loss to the extent that the carrying amount of the investment at the date the impairment is reversed does not exceed what the amortized cost would have been had the impairment not been recognized.

With respect to AFS equity securities, impairment losses previously recognized in profit or loss are not reversed through profit or loss. With respect to AFS debt securities, impairment losses are subsequently reversed through profit or loss if an increase in the fair value of the investment can be objectively related to an event occurring after the recognition of the impairment loss.

7) Derecognition of financial assets

The Group derecognizes a financial asset only when the contractual rights to the cash flows from the asset expire, or when it transfers the financial asset and substantially all the risks and rewards of ownership of the asset to another entity. If the Group neither transfers nor retains substantially all the risks and rewards of ownership and continues to control the transferred asset, the Group recognizes its retained interest in the asset and an associated liability for amounts it may have to pay. If the Group retains substantially all the risks and rewards of ownership of a transferred financial asset, the Group continues to recognize the financial asset and also recognizes a collateralized borrowing for the proceeds received.

On derecognition of a financial asset in its entirety, the difference between the asset's carrying amount and the sum of the consideration received and receivable and the cumulated gain or loss that had been recognized in other comprehensive income and accumulated in equity is recognized in profit or loss.

On derecognition of a financial asset other than in its entirety (e.g., when the Group retains an option to repurchase part of a transferred asset), the Group allocates the previous carrying amount of the financial asset between the part it continues to recognize under continuing involvement and the part it no longer recognizes on the basis of the relative fair value of those parts on the date of the transfer. The difference between the carrying amount allocated to the part that is no longer recognized and the sum of the consideration received for the part that is no longer recognized and any cumulative gain or loss allocated to it that had been recognized in other comprehensive income is recognized in profit or loss. A cumulative gain or loss that had been recognized in other comprehensive income is allocated between the part that continues to be recognized and the part that is no longer recognized on the basis of the relative fair value of those parts.

(20) Financial liabilities and equity instruments

1) Classification as debt or equity

Debt and equity instruments are classified as either financial liabilities or equity in accordance with the substance of the contractual arrangement and the definitions of financial liability and an equity instrument.

2) Equity instruments

An equity instrument is any contract that evidences a residual interest in the assets of an entity after deducting all of its liabilities. Equity instruments issued by the Group are recognized when the proceeds are received, net of direct issue costs. Repurchase of the Group's own equity instruments is recognized and deducted directly in equity.

When the Group reacquires the Controlling Company's stocks, it is less on the equity directly. The profit or loss on disposal of the treasury stock is not recognized as profit or loss.

3) Compound financial instruments

The component parts of compound instruments (convertible bonds) issued by the Group are classified separately as financial liabilities and equity in accordance with the substance of the contractual arrangement. At the date of issue, the fair value of the liability component is estimated using the prevailing market interest rate for a similar non-convertible instrument. This amount is recorded as a liability on an amortized cost basis using the effective interest method until extinguished upon conversion or at the instrument's maturity date. The equity component is determined by deducting the amount of the liability component from the fair value of the compound instrument as a whole. This is recognized and included in equity, net of income tax effects, and is not subsequently remeasured.

4) Financial liabilities

Financial liabilities are recognized when the Group becomes a party to the contractual provisions of the instruments. Financial liabilities are initially measured at fair value. Transaction costs that are directly attributable to the issue of financial liabilities are added to or deducted from the fair value of the financial liabilities, as appropriate, on initial recognition. Transaction costs directly attributable to acquisition of financial liabilities at FVTPL are recognized immediately in profit or loss.

Financial liabilities are classified as either financial liabilities at FVTPL or other financial liabilities.

5) Financial liabilities at FVTPL

Financial liabilities are classified as at FVTPL when the financial liability is either held for trading or it is designated as at FVTPL.

A financial liability is classified as held for trading if:

- It has been acquired principally for the purpose of repurchasing it in the near term;
- On initial recognition, it is part of a portfolio of identified financial instruments that the Group manages together and has a recent actual pattern of short-term profit taking; or
- It is a derivative that is not designated and effective as a hedging instrument.

A financial liability other than a financial liability held for trading may be designated as at FVTPL upon initial recognition if:

- Such designation eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise;
- The financial liability forms part of a group of financial assets or financial liabilities or both, which is managed and its performance is evaluated on a fair value basis, in accordance with the Group's documented risk management or investment strategy, and information about the grouping is provided internally on that basis; or
- It forms part of a contract containing one or more embedded derivatives, and K-IFRS 1039 permits the entire combined contract (asset or liability) to be designated as at FVTPL.

Financial liabilities at FVTPL are stated at fair value, with any gains or losses arising on remeasurement recognized in profit or loss. The net gain or loss recognized in profit or loss incorporates any interest paid on the financial liability and is included in its profit and loss.

6) Other financial liabilities

Other financial liabilities are subsequently measured at amortized cost using the effective interest method, with interest expense recognized on an effective yield basis.

The effective interest method is a method of calculating the amortized cost of a financial liability and allocating interest expense over the relevant period. The effective interest rate is the rate that exactly discounts estimated future cash payments through the expected life of the financial liability, or (where appropriate) a shorter period, to the net carrying amount on initial recognition.

7) Financial guarantee contract liabilities

A financial guarantee contract is a contract that requires the issuer to make specified payments to reimburse the holder for a loss it incurs because a specified debtor fails to make payments when due in accordance with the terms of debt instruments.

Financial guarantee contract liabilities are initially measured at their fair values and, if not designated as at FVTPL, are subsequently measured at the higher of:

- The amount of the obligation under the contract, as determined in accordance with K-IFRS 1037; and
- The amount initially recognized, less cumulative amortization recognized in accordance with the K-IFRS 1018, *Revenue*.

8) Derecognition of financial liabilities

The Group derecognizes financial liabilities when the Group's obligations are discharged, canceled or they expire. The difference between the carrying amount of the financial liability derecognized and the consideration paid and payable is recognized in profit or loss.

(21) Derivative financial instruments

The Group enters into a variety of derivative financial instruments to manage its exposure to interest rate and foreign exchange rate risk, including foreign exchange forward contracts, interest rate swaps and cross-currency swaps.

Derivatives are initially recognized at fair value at the date the derivative contract is entered into and are subsequently remeasured to their fair value at the end of each reporting period. The resulting gain or loss is recognized in profit or loss immediately, unless the derivative is designated and effective as a hedging instrument; in which case, the timing of the recognition in profit or loss depends on the nature of the hedge relationship.

A derivative with a positive fair value is recognized as a financial asset; a derivative with a negative fair value is recognized as a financial liability. A derivative is presented as a non-current asset or a non-current liability if the remaining maturity of the instrument is more than 12 months and it is not expected to be realized or settled within 12 months. Other derivatives are presented as current assets or current liabilities.

1) Embedded derivatives

Derivatives embedded in other financial instruments or other host contracts are treated as separate derivatives when their risks and characteristics are not closely related to those of the host contracts and the host contracts are not measured as at FVTPL.

An embedded derivative is presented as a non-current asset or a non-current liability if the remaining maturity of the hybrid instrument to which the embedded derivative relates is more than 12 months and it is not expected to be realized or settled within 12 months. Other embedded derivatives are presented as current assets or current liabilities.

2) Hedge accounting

The Group designates certain hedging instruments, which include derivatives, embedded derivatives and non-derivatives with respect to foreign currency risk, as either fair value hedges, cash flow hedges or hedges of net investments in foreign operations. Hedges of foreign exchange risk on firm commitments are accounted for as cash flow hedges.

At the inception of the hedge relationship, the entity documents the relationship between the hedging instrument and the hedged item, along with its risk management objectives and its strategy for undertaking various hedge transactions.

Furthermore, at the inception of the hedge and on an ongoing basis, the Group documents whether the hedging instrument is highly effective in offsetting changes in fair values or cash flows of the hedged item.

3) Fair value hedges

Changes in the fair value of derivatives that are designated and qualify as fair value hedges are recognized in profit or loss immediately, together with any changes in the fair value of the hedged asset or liability that are attributable to the hedged risk. The changes in the fair value of the hedging instrument and the change in the hedged item attributable to the hedged risk are recognized in the line item of the consolidated statements of comprehensive income related to the hedged item.

Hedge accounting is discontinued when the Group revokes the hedging relationship; when the hedging instrument expires or is sold, terminated or exercised; or when it no longer qualifies for hedge accounting. The fair value adjustment to the carrying amount of the hedged item arising from the hedged risk is amortized to profit or loss from that date.

4) Cash flow hedges

The effective portion of changes in the fair value of derivatives that are designated and qualify as cash flow hedges are recognized in other comprehensive income. The gain or loss related to the ineffective portion is recognized immediately in profit or loss.

Amounts previously recognized in other comprehensive income and accumulated in equity are reclassified to profit or loss in the periods when the hedged item is recognized in profit or loss, in the same line of the consolidated statements of comprehensive income as the recognized hedged item. However, when the forecast transaction that is hedged results in the recognition of a non-financial asset or a non-financial liability, the gains and losses previously accumulated in equity are transferred from equity and included in the initial measurement of the cost of the non-financial asset or liability.

Hedge accounting is discontinued when the Group revokes the hedging relationship; when the hedging instrument expires or is sold, terminated or exercised; or it no longer qualifies for hedge accounting. Any gain or loss accumulated in equity at that time remains in equity and is recognized when the forecast transaction is ultimately recognized in profit or loss. When a forecast transaction is no longer expected to occur, the gain or loss accumulated in equity is recognized immediately in profit or loss.

5) Hedges of net investments in foreign operations

Hedges of net investments in foreign operations are accounted for similarly to cash flow hedges. Any gain or loss on the hedging instrument relating to the effective portion of the hedge is recognized in other comprehensive income and accumulated in the foreign currency translation reserve. The gain or loss relating to the ineffective portion is recognized immediately in profit or loss, and is included in the ‘other gains and losses.’

Gains and losses on the hedging instrument relating to the effective portion of the hedge accumulated in the foreign currency translation reserve are reclassified to profit or loss in the same way as exchange differences relating to the foreign operation.

(22) Fair value

Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date, regardless of whether that price is directly observable or estimated using another valuation technique. In estimating the fair value of an asset or a liability, the Group takes into account the characteristics of the asset or liability if market participants would take those characteristics into account when pricing the asset or liability at the measurement date. Fair value for measurement and/or disclosure purposes in these consolidated financial statements is determined on such a basis, except for share-based payment transactions that are within the scope of K-IFRS 1102, *Share-Based Payment*, leasing transactions that are within the scope of K-IFRS 1017, *Leases*, and measurements that have some similarities to fair value but are not fairly valued, such as net realizable value in K-IFRS 1002, *Inventories*, or value in use in K-IFRS 1036, *Impairment of Assets*.

In addition, for financial reporting purposes, fair value measurements are categorized into Level 1, 2 or 3 based on the degree to which the inputs to the fair value measurements are observable and the significance of the inputs to the fair value measurement in its entirety, which are described as follows:

- Level 1 inputs are quoted prices (unadjusted) in active markets for identical assets or liabilities that the entity can access at the measurement date;
- Level 2 inputs are inputs, other than quoted prices included within Level 1, that are observable for the asset or liability, either directly or indirectly; and
- Level 3 inputs are unobservable inputs for the asset or liability.

3. CRITICAL ACCOUNTING JUDGMENTS AND KEY SOURCES OF ESTIMATION UNCERTAINTY

In the application of the Group's accounting policies, which are described in Note 2, management is required to make judgments, estimates and assumptions about the carrying amounts of assets and liabilities that are not readily apparent from other sources. The estimates and associated assumptions are based on historical experience and other factors that are considered to be relevant. Actual results may differ from those estimates.

The estimates and associated assumptions are based on historical experience and other factors that are considered to be relevant. Actual results may differ from those estimates.

4. TRADE AND OTHER RECEIVABLES:

(1) Details of trade and other receivables as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Trade receivables	₩ 362,116	₩ 6,893	₩ 378,737	₩ 8,815
Less: Allowances for doubtful accounts	(4,049)	(2,768)	(6,618)	(4,228)
Other accounts receivable	11,493	-	11,498	-
Accrued income	542	4,691	823	4,761
Less: Allowances for doubtful accounts	-	(4,691)	-	(4,761)
Loans	508	24,933	13,924	25,040
Less: Allowances for doubtful accounts	-	(24,282)	-	(24,646)
Guarantee deposits	498	4,190	74	4,157
	₩ 371,108	₩ 8,966	₩ 398,438	₩ 9,138

(2) Management policy of trade and other receivables

Regarding trade and other receivables, the Group holds certificate of guarantees and real estate as a collateral, and collateral levels are readjusted by periodically reviewing the credit limit and reassessing the customer's credit.

The Group recognizes allowances for doubtful accounts based on its past experience of collecting payments.

The Group estimates a recoverable amount of a receivable of which loss event has been identified on an individual basis through individual assessment, and recognizes the difference between the estimated recoverable amount and the carrying amount as an impairment loss. To determine the possibility for the recovery of receivables, the Group considers the trade receivables' credit rating changes from the granting of credit date until the end of the reporting period. On the other hand, concentration of credit risk is limited since the Group has a large number of customers and each customer is correlated.

The client whose receivables account for more than 5% of the total of trade receivables is Plains Marketing, LLC, and it amounts to ₩34,505 million. Meanwhile, there is no client whose receivables account for more than 5% as of December 31, 2012.

(3) Aging analysis of the trade and other receivables that are past due but not impaired as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Trade receivables	Other accounts receivable	Trade receivables	Other accounts receivable
0~90 days	₩ 4,976	₩ -	₩ 2,434	₩ -
90~180 days	-	-	-	-
180~360 days	-	-	429	-
More than 360 days	125	-	321	-
Total	₩ 5,101	₩ -	₩ 3,184	₩ -

(4) Changes in allowance for doubtful accounts for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013		
	Trade receivables	Loans	Accrued income
W	W	W	W
Beginning balance	10,846	24,646	4,761
Bad debt expenses			
(Reversal of allowance for doubtful accounts)	(2,338)	-	-
Write-off	(1,643)	-	-
Collection	12	-	-
Effect of foreign currency translation	(60)	(364)	(70)
Ending balance	6,817	24,282	4,691

	2012		
	Trade receivables	Loans	Accrued income
W	W	W	W
Beginning balance	5,448	-	-
Bad debt expenses			
(Reversal of allowance for doubtful accounts)	9,452	25,996	4,943
Write-off	(3,924)	-	-
Collection	3	-	-
Changes in scope of consolidation	8	-	-
Effect of foreign currency translation	(141)	(1,350)	(182)
Ending balance	10,846	24,646	4,761

(5) Aging analysis of the trade and other receivables that are individually impaired as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013		
	Trade receivables	Loans	Accrued income
W	W	W	W
Less than 6 months	47	-	-
6 months to 1 year	951	-	-
More than 1 year	5,962	24,282	4,691
Total	6,960	24,282	4,691

	2012		
	Trade receivables	Loans	Accrued income
W	W	W	W
Less than 6 months	1,783	24,646	4,761
6 months to 1 year	2,898	-	-
More than 1 year	3,718	-	-
Total	8,399	24,646	4,761

Impairment losses of the Group's trade receivables assessed on a collective basis are classified as less than six months.

5. OTHER FINANCIAL ASSETS:

(1) Details of other financial assets as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Short- or long-term financial instrument	₩ 18,680	₩ 366	₩ 60,729	₩ 149
Derivative assets held for trading purposes	1	-	-	-
Financial assets designated as at FVTPL (*1)	10,026	12,413	2,092	10,904
AFS financial assets	-	92,589	-	95,274
	₩ 28,707	₩ 105,368	₩ 62,821	₩ 106,327

(*1) Security-based derivatives that are required to be recognized separately from the host contracts, but unable to be measured separately from the host contracts, are classified as financial assets designated as at FVTPL, and the entire hybrid contracts were designated as at FVTPL.

(2) Changes in financial assets designated as at FVTPL for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Description	2013						End of year
	Beginning of year	Acquisition	Disposal	Gain on valuation	Loss on valuation		
Equity-linked securities (ELS)	₩ 6,200	₩ 2,000	₩ (4,012)	₩ 1,279	₩ -	₩ -	₩ 5,467
Derivative-linked securities (DLS)	2,092	20,000	(12,092)	26	(45)	-	9,981
Funds	4,704	2,000	-	287	-	-	6,991
	₩ 12,996	₩ 24,000	₩ (16,104)	₩ 1,592	₩ (45)	₩ -	₩ 22,439

Description	2012						End of year
	Beginning of year	Acquisition	Disposal	Gain on valuation	Loss on valuation		
ELS	₩ 8,396	₩ 8,000	₩ (10,396)	₩ 209	₩ (9)	₩ -	₩ 6,200
DLS	-	6,625	(4,624)	91	-	-	2,092
Funds	-	5,000	-	-	(296)	₩ -	4,704
	₩ 8,396	₩ 19,625	₩ (15,020)	₩ 300	₩ (305)	₩ -	₩ 12,996

(3) AFS financial assets as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Equity securities:				
Marketable equity securities	₩ -	₩ 61,233	₩ -	₩ 66,735
Non-marketable equity securities	-	29,840	-	27,749
Bonds:				
Government and public bonds	-	1,516	-	790
	₩ -	₩ 92,589	₩ -	₩ 95,274

Impairment losses from AFS financial assets for the year ended December 31, 2012, are ₩4,000 million and have occurred in non-marketable equity securities. There has not been any reversal of impairment loss from AFS financial assets for the year ended December 31, 2013.

6. OTHER ASSETS:

Details of other assets as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Advance payments	₩ 15,380	₩ -	₩ 18,652	₩ -
Prepaid expenses	2,511	1,541	3,202	2,103
Others	39	22	36	39
	₩ 17,930	₩ 1,563	₩ 21,890	₩ 2,142

7. INVENTORIES:

Details of inventories as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		
	Acquisition cost	Valuation allowance	Carrying amount
		₩	₩
Merchandise	₩ 191,510	₩ -	₩ 191,510
Finished goods	104,366	4,795	99,571
Semifinished goods	24,627	811	23,816
Work in process	13,744	-	13,744
By-products	3,251	-	3,251
Raw materials	79,257	2,062	77,195
Submaterials	9,110	-	9,110
Supplies	6,650	-	6,650
Goods in transit	17,179	-	17,179
	₩ 449,694	₩ 7,668	₩ 442,026

	December 31, 2012		
	Acquisition cost	Valuation allowance	Carrying amount
		₩	₩
Merchandise	₩ 182,178	₩ -	₩ 182,178
Finished goods	101,260	3,282	97,978
Semifinished goods	31,090	598	30,492
Work in process	11,517	-	11,517
By-products	3,942	-	3,942
Raw materials	77,923	3,246	74,677
Submaterials	8,139	-	8,139
Supplies	6,879	-	6,879
Goods in transit	30,903	-	30,903
	₩ 453,831	₩ 7,126	₩ 446,705

Costs of goods that have been recognized for the year ended December 31, 2013, included losses of valuation of ₩1,726 million (previous period: ₩431 million) and reversal of valuation loss of ₩1,184 million (previous period: ₩390 million).

8. PROPERTY, PLANT AND EQUIPMENT:

- (1) The carrying value of property, plant and equipment as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	December 31, 2013				
	Acquisition costs	Accumulated depreciation	Government grants	Carrying value	
Land	₩ 308,240	₩ -	₩ -	₩ 308,240	
Buildings	234,452	(54,010)	-	180,442	
Structures	20,426	(8,791)	-	11,635	
Machinery	585,928	(287,284)	-	298,644	
Vehicles	2,702	(2,009)	-	693	
Machinery in transit	586	-	-	586	
Others	19,076	(10,261)	(898)	7,917	
Construction in progress	50,588	-	(233)	50,355	
	₩ 1,221,998	₩ (362,355)	₩ (1,131)	₩ 858,512	

	December 31, 2012				
	Acquisition costs	Accumulated depreciation	Government grants	Carrying value	
Land	₩ 291,274	₩ -	₩ -	₩ 291,274	
Buildings	204,195	(48,416)	-	155,779	
Structures	16,718	(7,122)	-	9,596	
Machinery	509,949	(268,871)	-	241,078	
Vehicles	2,753	(1,884)	-	869	
Machinery in transit	5,529	-	-	5,529	
Others	14,502	(9,705)	(610)	4,187	
Construction in progress	92,035	-	(222)	91,813	
	₩ 1,136,955	₩ (335,998)	₩ (832)	₩ 800,125	

- (2) Changes in property, plant and equipment for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013						
	Beginning of year	Acquisition	Disposal	Transfer (*1)	Depreciation	Exchange rate fluctuation effect	End of year
Land	₩ 291,274	₩ -	₩ (1,054)	₩ 18,278	₩ -	₩ (258)	₩ 308,240
Buildings	155,779	-	(574)	32,950	(7,063)	(650)	180,442
Structures	9,596	-	(17)	3,153	(1,028)	(69)	11,635
Machinery	241,078	74	(375)	85,081	(26,687)	(527)	298,644
Vehicles	869	58	(29)	92	(289)	(8)	693
Machinery in transit	5,529	7,869	-	(12,812)	-	-	586
Others	4,797	154	(4)	5,268	(1,353)	(47)	8,815
Government grants	(610)	(340)	-	-	52	-	(898)
Construction in progress	92,035	95,502	-	(136,257)	-	(692)	50,588
Government grants	(222)	-	-	(11)	-	-	(233)
	₩ 800,125	₩ 103,317	₩ (2,053)	₩ (4,258)	₩ (36,368)	₩ (2,251)	₩ 858,512

(*1) The transfer amount of ₩4,258 million consists of the transfer to government grants of ₩11 million, transfer to intangible assets of ₩241 million, transfer to investment property of ₩3,987 million and transfer to prepaid expenses of ₩19 million.

	2012								
	Beginning of year	Acquisition	Disposal	Transfer (*1)	Depreciation	Change of consolidation scope	Exchange rate fluctuation effect	End of year	
Land	₩ 273,451	₩ 161	₩ (40)	₩ 19,129	₩ -	₩ -	₩ (1,427)	₩ 291,274	
Buildings	125,406	1,381	(101)	3,049	(6,442)	35,485	(2,999)	155,779	
Structures	8,584	-	(24)	383	(852)	1,637	(132)	9,596	
Machinery	176,568	150	(3,285)	36,558	(21,373)	56,117	(3,657)	241,078	
Vehicles	1,125	135	-	10	(390)	53	(64)	869	
Machinery in transit	1,548	7,252	-	(3,271)	-	-	-	5,529	
Others	3,800	145	-	1,307	(761)	417	(111)	4,797	
Government grants	(492)	-	-	(175)	57	-	-	(610)	
Construction in progress	19,160	108,933	-	(68,982)	-	33,249	(325)	92,035	
Government grants	(598)	-	-	376	-	-	-	(222)	
	₩ 608,552	₩ 118,157	₩ (3,450)	₩ (11,616)	₩ (29,761)	₩ -	₩ (8,715)	₩ 800,125	

(*1) The transfer amount of ₩11,616 million consists of the transfer to government grants of ₩262 million, transfer to intangible assets of ₩2,698 million and transfer to investment property of ₩8,656 million.

9. INVESTMENT PROPERTY:

- (1) Details of investment property as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		
	Acquisition cost	Accumulated depreciation	Carrying value
Land	₩ 6,392	₩ -	₩ 6,392
Buildings	8,041	(1,992)	6,049
Total	₩ 14,433	₩ (1,992)	₩ 12,441

	December 31, 2012		
	Acquisition cost	Accumulated depreciation	Carrying value
Land	₩ 4,823	₩ -	₩ 4,823
Buildings	5,474	(1,641)	3,833
Total	₩ 10,297	₩ (1,641)	₩ 8,656

- (2) Changes in investment property for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013				
	Beginning balance	Acquisition	Depreciation	Transfer	Ending balance
Land	₩ 4,823	₩ -	₩ -	₩ 1,569	₩ 6,392
Buildings	3,833	-	(202)	2,418	6,049
	₩ 8,656	₩ -	₩ (202)	₩ 3,987	₩ 12,441

	2012				
	Beginning balance	Acquisition	Depreciation	Transfer	Ending balance
Land	₩ -	₩ -	₩ -	₩ 4,823	₩ 4,823
Buildings	₩ -	-	-	3,833	3,833
	₩ -	₩ -	₩ -	₩ 8,656	8,656

- (3) Rent income or operating expense from investment property for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions)

	2013	2012
Rent income	₩ 748	₩ -
Operating expense	₩ (136)	₩ -
	<u>₩ 612</u>	<u>₩ -</u>

- (4) Details of fair value of investment property as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Carrying value	Fair value	Carrying value	Fair value
Land	₩ 6,392	₩ 6,392	₩ 4,823	₩ 4,823
Buildings	₩ 6,049	₩ 6,049	₩ 3,833	₩ 3,833
	<u>₩ 12,441</u>	<u>₩ 12,441</u>	<u>₩ 8,656</u>	<u>₩ 8,656</u>

For the year ended December 31, 2013, the fair value of some land in investment property is based on the valuation carried out by Pacific Appraisal Co., Ltd., an independent evaluator, on December 31, 2009, and the other land in investment property was appraised by Hana Appraisal and advisory Co., Ltd. The Group has not reassessed the fair value of land since such date, as it was anticipated that the change in fair value between the revaluation date and December 31, 2013, was not significant.

- (5) All the investment property is directly owned by the Group.

10. INTANGIBLE ASSETS:

- (1) Details of other intangible assets as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013				
	Acquisition costs	Accumulated amortization	Accumulated impairment loss	Government grant	Book value
Goodwill	₩ 714	₩ -	₩ -	₩ -	₩ 714
Industrial property rights	39	(27)	-	-	12
Development	871	(213)	-	(366)	292
Software	16,856	(12,372)	-	-	4,484
Membership	3,826	(7)	-	-	3,819
	<u>₩ 22,306</u>	<u>₩ (12,619)</u>	<u>₩ -</u>	<u>₩ (366)</u>	<u>₩ 9,321</u>

	December 31, 2012				
	Acquisition costs	Accumulated amortization	Accumulated impairment loss	Government grant	Book value
Goodwill	₩ 725	₩ -	₩ -	₩ -	₩ 725
Industrial property rights	39	(25)	-	-	14
Development	871	(45)	-	(455)	371
Software	16,834	(11,469)	(186)	-	5,179
Membership	3,865	(4)	-	-	3,861
	<u>₩ 22,334</u>	<u>₩ (11,543)</u>	<u>₩ (186)</u>	<u>₩ (455)</u>	<u>₩ 10,150</u>

(2) Details of changes in other intangible assets for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013								
	Beginning of year	Acquisition	Disposals	Transfer (*1)	Amortization	Exchange rate fluctuation effect	End of year		
Goodwill	₩ 725	₩ -	₩ -	₩ -	₩ -	₩ (11)	₩ 714		
Industrial property rights	14	-	-	-	-	(2)	-	12	
Development	826	-	-	-	-	(168)	-	658	
Government grants	(455)	-	-	-	-	89	-	(366)	
Software	5,179	-	-	241	(930)	(6)	4,484		
Membership	3,861	96	(135)	241	(1)	(2)	3,819		
	₩ 10,150	₩ 96	₩ (135)	₩ 241	₩ (1,012)	₩ (19)	₩ 9,321		

	2012								
	Beginning of year	Acquisition	Disposals	Transfer (*1)	Amortization	Impairment	Change of consolidation scope	Exchange rate fluctuation effect	End of year
Goodwill	₩ 780	₩ -	₩ -	₩ -	₩ -	₩ -	₩ -	₩ (55)	₩ 725
Industrial property rights	14	-	-	2	(2)	-	-	-	14
Development	-	-	-	871	(14)	-	-	-	857
Government grants	-	-	-	(493)	7	-	-	-	(486)
Software	3,678	-	-	2,318	(803)	(186)	202	(30)	5,179
Membership	3,069	889	(93)	-	(1)	-	-	(3)	3,861
	₩ 7,541	₩ 889	₩ (93)	₩ 2,698	₩ (813)	₩ (186)	₩ 202	₩ (88)	₩ 10,150

(*1) Transferred from property, plant and equipment.

11. INVESTMENTS IN ASSOCIATES:

(1) Details of the Group's investments in associates as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Company	Primary business	Location	December 31, 2013		
			Ownership percentage (%)	Acquisition costs	Book value
United Spiral Pipe, LLC	Manufacturing and distributing steel pipe	USA	30.00	₩ 32,707	₩ -

December 31, 2012					
Company	Primary business	Location	Ownership percentage (%)	Acquisition costs	Book value
United Spiral Pipe, LLC	Manufacturing and distributing steel pipe	USA	30.00	₩ 32,707	₩ -

- (2) The summarized financial information of investments in associates as of and for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013	2012
Current assets	₩ 9,978	₩ 30,717
Non-current assets	133,148	143,811
Total assets	143,126	174,528
Current liabilities	119,912	121,966
Non-current liabilities	66,891	66,885
Total liabilities	186,803	188,851
Equity attributable to owners of the Group	(43,677)	(14,323)
Total shareholders' equity	(43,677)	(14,323)
 Sales	₩ 27,884	₩ 53,133
Operating income(loss)	(16,496)	(24,249)
Net income(loss)	(29,849)	(30,360)
Other comprehensive income(loss)	495	1,260
Total comprehensive income(loss)	(29,354)	(29,100)

The amount above includes the fair value adjustment occurred on the date of acquisition. The transaction within the Group has not been deducted from the amount above.

- (3) The details of the adjustments to the book value from the net assets of associates for the years ended on December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013	December 31, 2012
Net assets (A)	₩ (43,677)	₩ (14,323)
Ownership rate (B)	30%	30%
Ownership amount (A*B)	₩ (13,103)	₩ (4,297)
Unrecognized share of losses	13,103	4,297
Book value	-	-

- (4) The unrecognized share of losses of associates, if the Group has stopped recognizing its share of losses of associates, is as follows (Unit: Korean won in millions):

	2013	2012
Unrecognized share of losses of United Spiral Pipe, LLC	₩ 8,806	₩ 4,297
	December 31, 2013	December 31, 2012
Cumulatively unrecognized share of losses of United Spiral Pipe, LLC	₩ 13,103	₩ 4,297

12. INVESTMENTS IN JOINT VENTURES:

- (1) Details of the Group's investments in joint ventures as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Company	Primary business	Location	Ownership percentage (%)	
			December 31, 2013	December 31, 2012
Landmark Steel	Manufacturing and distributing steel pipe	China	50.00	50.00
Vietnam Pipe	Manufacturing and distributing steel pipe	Vietnam	50.00	50.00
Company	December 31, 2013		December 31, 2012	
	Acquisition cost	Book value	Acquisition cost	Book value
Landmark Steel	₩ 2,909	₩ 5,337	₩ 2,909	₩ 5,819
Vietnam Pipe	₩ 1,757	₩ 2,670	₩ 1,757	₩ 2,622
	₩ 4,666	₩ 8,007	₩ 4,666	₩ 8,441

- (2) The changes in investments in joint ventures for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Company	2013					
	Beginning of year	Acquisition	Dividends received	Equity in income	Changes in capital variation of equity method	End of year
Landmark Steel	₩ 5,819	₩ -	₩ -	₩ (570)	₩ 88	₩ 5,337
Vietnam Pipe	₩ 2,622	₩ -	₩ (330)	₩ 473	₩ (95)	₩ 2,670
	₩ 8,441	₩ -	₩ (330)	₩ (97)	₩ (7)	₩ 8,007
Company	2012					
	Beginning of year	Acquisition	Dividends received	Equity in income	Changes in capital variation of equity method	End of year
Landmark Steel	₩ 6,775	₩ -	₩ -	₩ (583)	₩ (373)	₩ 5,819
Vietnam Pipe	₩ 2,575	₩ -	₩ (147)	₩ 361	₩ (167)	₩ 2,622
	₩ 9,350	₩ -	₩ (147)	₩ (222)	₩ (540)	₩ 8,441

- (3) The summarized financial information of investments in joint ventures as of and for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013		
	Landmark Steel	Vietnam Pipe	
Current assets	₩ 20,694	₩ 9,373	
Non-current assets	₩ 7,865	₩ 1,027	
Total assets	₩ 28,559	₩ 10,400	
Current liabilities	₩ 17,885	₩ 5,060	
Total liabilities	₩ 17,885	₩ 5,060	
Equity attributable to owners of the Group	₩ 10,674	₩ 5,340	
Total shareholders' equity	₩ 10,674	₩ 5,340	
Sales	₩ 5,684	₩ 30,724	
Operating income(loss)	₩ (614)	₩ 2,052	
Net income(loss)	₩ (1,140)	₩ 946	
Other comprehensive income(loss)	₩ 175	₩ (188)	
Total comprehensive income(loss)	₩ (965)	₩ 758	

	2012	
	Landmark Steel	Vietnam Pipe
Current assets	₩ 20,240	₩ 14,050
Non-current assets	8,746	992
Total assets	28,986	15,042
Current liabilities	17,347	9,799
Total liabilities	17,347	9,799
Equity attributable to owners of the Group	11,639	5,243
Total shareholders' equity	11,639	5,243
Sales	₩ 8,497	₩ 29,352
Operating income(loss)	(685)	1,275
Net income(loss)	(1,165)	721
Other comprehensive income(loss)	(746)	(335)
Total comprehensive income(loss)	(1,911)	386

The amount above includes the fair value adjustment occurred on the date of acquisition. The transaction within the Group has not been deducted from the amount above.

- (4) Primary components of financial performances summary in joint ventures as of and for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	
	Landmark Steel	Vietnam Pipe
Cash and cash equivalents	₩ 19	₩ 4,634
Current financial liabilities (*1)	4,945	4,670
Depreciation	1,100	187
Amortization	43	-
Interest income	-	251
Interest expenses	428	590

	2012	
	Landmark Steel	Vietnam Pipe
Cash and cash equivalents	₩ 14	₩ 6,395
Current financial liabilities(*1)	5,378	9,191
Depreciation	1,095	177
Amortization	45	-
Interest income	-	219
Interest expenses	377	551

(*1) Excluding trade and other payables and provisions.

- (5) The details of the adjustments to the book value from the net assets of joint ventures for the years ended on December 31, 2013 and 2012, are as follows:

	2013	
	Landmark Steel	Vietnam Pipe
Net assets (A)	₩ 10,674	₩ 5,340
Ownership rate (B)	50%	50%
Ownership amount (A*B)	5,337	2,670
Book value	5,337	2,670

	2012	
	Landmark Steel	Vietnam Pipe
Net assets (A)	₩ 11,639	₩ 5,243
Ownership rate (B)	50%	50%
Ownership amount (A*B)	5,819	2,622
Book value	5,819	2,622

13. TRADE AND OTHER PAYABLES:

Details of trade and other payables as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Trade payables	₩ 160,189	₩ -	₩ 160,189	₩ -
Other accounts payable	61,187	1,124	61,187	1,124
Accrued expenses	4,032	-	4,032	-
Dividend payables	3	-	3	-
Deposit	-	694	-	694
Financial guarantee contracts	28	-	28	-
	₩ 225,439	₩ 1,818	₩ 225,439	₩ 1,818

14. BORROWINGS:

(1) Details of borrowings as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Current	Non-current	Current	Non-current
Borrowings	₩ 286,568	₩ 27,324	₩ 381,189	₩ 26,143
Debentures	-	129,652	49,988	49,805
Exchangeable bonds	114,035	-	-	109,028
Financial lease liabilities	27	76	35	130
	₩ 400,630	₩ 157,052	₩ 431,212	₩ 185,106

(2) Short-term borrowings as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions and U.S. dollars in thousands):

Type	Bank	Interest rate (%)	Foreign currency		Domestic currency	
			Currency	December 31, 2013	December 31, 2012	December 31, 2013
Domestic currency borrowings:						
Bank overdraft (*1)	Shinhan Bank and others	-	KRW	-	-	₩ 3,195 ₩ 3,095
General loans	Hana Bank	-	KRW	-	-	-
Loans for equipment purchases	Woori Bank Korea	-	KRW	-	-	30,000
Operating financing	Development Bank	-	KRW	-	-	-
	Subtotal		KRW	-	-	₩ 3,195 ₩ 6,000
Foreign currency borrowings:						
USANCE and others	Hana Bank and others	0.52–0.65	USD	97,848	108,454	₩ 103,260 ₩ 116,165
Operating financing	Wells Fargo Trade Bank and others	LIBOR+0.80–2.00	USD	109,276	99,285	₩ 115,386 106,344
Operating financing	RESONA and others	0.66–0.83	JPY	900,000	2,215,712	9,042 27,641
Foreign currency financing	Hana Bank	LIBOR+1.90	USD	10,000	15,000	10,553 16,067
Loans for equipment purchases	Korea Exchange Bank	LIBOR+1.70	AED	73,500	-	21,117 -
Transfer of trade receivables	Shinhan Bank and others	LIBOR+0.65–0.90	USD	20,924	15,133	22,100 16,205
	SBJ and others	0.77	JPY	78,139	860,876	785 10,740
	Subtotal		KRW	-	-	₩ 282,243 ₩ 293,162
	Total		KRW		₩ 285,438	₩ 352,257

(*1) The amount paid by notes among purchase payments. There is no significant interest cost for the Group since it is paid on the next day.

(3) Long-term borrowings as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions and U.S. dollars in thousands):

Type	Bank	Interest rate (%)	2013		Foreign currency		Domestic currency	
			Currency	December 31, 2013	December 31, 2012	December 31, 2013	December 31, 2012	
Domestic currency borrowings:								
Operating financing	Korea Housing Guarantee	1.15	KRW	-	-	₩ 4,800	₩ 4,800	
Loans for equipment purchases	Shinhan Bank Korea	-	KRW	-	-	-	7,000	
Operating financing (CP)	Investment & Securities	3.36	KRW	-	-	20,000	20,000	
	Subtotal		KRW	-	-	24,800	31,800	
	Less current portion			-	-	-	(7,000)	
	Subtotal			-	-	24,800	24,800	
Foreign currency borrowings:								
Loans for equipment purchases	Korea Exim Bank	-	AED	-	73,500	-	21,433	
Operating financing	SYOKO TYUKIN	1.25	JPY	330,000	120,000	3,315	1,498	
Operating financing	Shinhan Vina Bank	5.5	USD	321	321	339	344	
	Subtotal		USD	321	321	-	-	
			JPY	330,000	120,000	-	-	
			AED	-	73,500	3,654	23,275	
			USD	(214)	-	-	-	
			JPY	(90,000)	40,000	-	-	
	Less current portion		AED	-	73,500	(1,130)	(21,932)	
			USD	107	321	-	-	
			JPY	240,000	80,000	-	-	
	Total foreign currency long-term borrowings		AED	-	-	2,524	1,343	
	Total					₩ 27,324	₩ 26,143	

(4) Debentures as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Description	Interest rate (%)	Issue date	Maturity	December 31, 2013	December 31, 2012
38 th publicly placed bonds (*1)	-	2010.04.02	2013.04.02	₩ -	₩ 50,000
40 th publicly placed bonds (*1)	3.60	2012.07.10	2015.07.10	50,000	50,000
41 th publicly placed bonds (*1)	3.56	2013.11.25	2016.11.25	80,000	-
Subtotal				130,000	100,000
Discount on debentures				(348)	(207)
Current portion				-	(49,988)
Total				₩ 129,652	₩ 49,805

(*1) On the other hand, for the 40th and 41th debentures, the parent has to maintain financial ratios (debt-to-equity ratio below 400% and 300%, respectively) and limit collateral set in accordance with arrangements.

(5) Exchangeable bonds

1) The description of exchangeable bonds is as follows:

Type of bond	Description
Issuance amount	Non-registered, non-guaranteed exchangeable bond with coupon ₩ 152,100 million
Interest rate	Coupon rate: 1.0% (premium rate: 2.5%)
Issuance date	February 25, 2011
Date of expiration	February 25, 2014
Exchangeable equity	SeAH Besteel Corporation registered common stock
Exercise price and ratio	₩ 50,700 per share, 100%
Exercise period	From March 25, 2011, to January 25, 2014

2) Exchangeable bonds as of issue date and December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Description	Issue date	December 31, 2013	December 31, 2012
Issuance price	₩ 152,100	₩ 109,676	₩ 109,676
Carrying amount	139,118	114,035	109,028
Consideration for exchange rights	10,127	-	85

Consideration for exchange rights embedded in the exchangeable bond is recognized separately since it meets the condition for the separate recognition for a component of financial instrument, and recognized with the fair value an independent evaluator has provided. The fair value of exchange rights has been derived from the backwardation method in which the probability tree of the stock price of SeAH Besteel, the underlying asset of the rights, is calculated and discounted in consideration with the volatility of the stock and risk-free forward rate.

In regard to the consideration for exchange rights, the Group has recognized ₩85 million as other financial liabilities as of the end of December 31, 2012, and there is no value of exchange rights as of the end of December 31, 2013. The Group has recognized ₩85 million and ₩6,418 million as gain on valuation of consideration for exchange rights for the years ended December 31, 2013 and 2012, respectively.

On the other hand, there are 2,163,284 shares outstanding as of the end of December 31, 2013, as there has not been any exercise of exchange rights for the year ended December 31, 2013.

(6) Assets provided as collateral

The securities of Korea Housing Guarantee Co., Ltd. (379,179 shares), are provided to secure the Company's borrowing and assets provided to financial institutions as collateral related to the borrowings of the subsidiaries are as follows (Unit: USD in thousands, Dong in millions):

Subsidiary	Name of bank	Assets provided as collateral	Carrying amount	Credit line	Related borrowing
SeAH Steel America	Wells Fargo	Trade receivables and inventories	USD 148,164	USD 48,000	USD 48,000
SeAH Steel Vina	HSBC	Inventories	USD 15,200	USD 2,418	USD 2,418
	Shin Han Bank	Buildings and machinery	USD 12,615	USD 3,929	USD 3,929
	Commonwealth Bank	Deposit	VND 42,373	USD 1,851	USD 1,851
State Pipe & Supply	Korea Exchange Bank	Trade receivables, inventories and others	USD 53,672	USD 5,000	USD 4,700
	Wells Fargo	Trade receivables, inventories and others	USD 55,996	USD 30,000	USD 17,600

SeAH Steel America is required to comply with certain restrictions and covenants, including certain level of tangible net worth and financial ratios. As of December 31, 2013, SeAH Steel America was in compliance with these covenants.

15. LEASE:

(1) The Group has acquired equipment through financial lease from Wells Fargo Financial Lease and others. Financial lease liabilities as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions and U.S. dollars in thousands):

Year	Currency	December 31, 2013	December 31, 2012
2013	USD	-	38
2014	USD	29	39
2015	USD	20	28
2016	USD	20	27
2017	USD	20	20
2018	USD	19	19
Total	USD	108	171
Adjusted for present value	USD	(10)	(17)
Net value	USD	98	154
Converted in KRW	KRW	₩ 103	₩ 165
Current liabilities	KRW	(27)	(35)
Non-current liabilities	KRW	₩ 76	₩ 130

(2) Operating lease

The Group has been using land under operating lease. The lease period is from 2010 to 2034. The lease contracts that exceed 11 years in a period have condition for market lease price consideration for every five years, and for certain lands have condition for lease price renewal for every five years. The Group does not have an option to buy back the land once the lease contract expires.

- 1) Minimum lease payment recognized as expenses for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

Description		2013		2012
	₩	₩	₩	₩
Minimum lease payments		1,236		1,088

- 2) Minimum lease payments from non-cancelable operating leases as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Description		December 31, 2013		December 31, 2012
	₩	₩	₩	₩
Less than 1 year		1,010		1,124
1-5 years		2,121		2,830
More than 5 years		7,307		8,290
Total	₩	10,438	₩	12,244

16. RETIREMENT BENEFIT PLAN:

- (1) Defined contribution retirement plans

The Group operates a defined contribution plan for qualified employees, under which the Group is obligated to make payments to third-party funds. The contribution of the Group is reduced by losing contributions when employees retire before meeting the vesting condition.

The Group recognized ₩520 million and ₩301 million of the Group's contribution portion in the consolidated statements of comprehensive income under its defined contribution plan for the years ended December 31, 2013 and 2012, respectively. The Group has no amount payable for the year ended December 31, 2013.

- (2) Defined Benefit Retirement plans

The Group operates a defined benefit plan for qualified employees. The valuation of related plan assets and the defined benefit liability is performed by Sam Sung Securities Co., Ltd. Also, the present value of defined benefit obligation, current service cost and past service cost is determined using the projected unit credit method.

- (3) As of December 31, 2013 and 2012, amounts recognized in the consolidated statements of financial position related to retirement benefit obligations are as follows (Korean won in millions):

		December 31, 2013		December 31, 2012
	₩	₩	₩	₩
Present value of defined benefit obligation		36,064		32,701
Fair value of plan assets		(33,272)		(30,545)
Retirement benefit obligation	₩	2,792	₩	2,156

- (4) Changes in present value of defined benefit obligations for the years ended December 31, 2013 and 2012, are as follows (Korean won in millions):

	Defined benefit obligations	Pension plan assets	Total
	₩	₩	₩
Beginning balance	32,701	(30,545)	2,156
Current service cost	3,764	-	3,764
Interest cost (income)	1,443	(1,356)	87
Employer's contribution	-	(6,700)	(6,700)
Benefit paid	(6,002)	5,015	(987)
Remeasurement components	4,179	314	4,493
Effect of foreign currency translation	(21)	-	(21)
Ending balance	36,064	(33,272)	2,792
		December 31, 2012	

	Defined benefit obligations	Pension plan assets	Total
	₩	₩	₩
Beginning balance	36,296	(29,047)	7,249
Current service cost	4,944	-	4,944
Interest cost (income)	2,019	(1,512)	507
Employer's contribution	-	(2,555)	(2,555)
Benefit paid	(3,303)	2,424	(879)
Remeasurement components	(7,234)	145	(7,089)
Effect of foreign currency translation	(21)	-	(21)
Ending balance	32,701	(30,545)	2,156

The Group has invested full amount of plan assets in time deposit for securing stable finance.

Actual returns on plan assets for the years ended December 31, 2013 and 2012, are ₩1,042 million and ₩1,367 million, respectively.

- (5) The effect of change of significant actuarial assumptions within a reasonable range to defined benefit obligation given other assumptions not changed for the years ended December 31, 2013 and 2012, is as follows (Unit: % and Korean won in millions):

	Increase in rate	Decrease in rate
1% change in discount rate	(1,263)	2,046
1bp change in future salary increase rate	2,042	(1,275)

The sensitivity analysis above does not represent the actual change of the defined benefit obligation since the changes of assumptions shall not occur independently as there are correlations among the actuarial assumptions. The present value of the defined benefit obligation in the sensitivity analysis above has been derived from the projected unit credit method which was applied to measurement of the defined benefit obligation of the consolidated financial statements.

17. OTHER FINANCIAL LIABILITIES:

Details of other financial liabilities as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012			
	Current		Non-current			
	₩	₩	₩	₩		
Derivative liabilities held for trading purposes	112	₩	-	234	₩	-
Consideration for exchange rights	-	₩	-	-	₩	85
	112	₩	-	234	₩	85

18. OTHER LIABILITIES:

Details of other liabilities as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012			
	Current		Non-current			
	₩	₩	₩	₩		
Advance receipts	2,199	₩	-	6,676	₩	-
Withholdings	1,772	₩	-	2,385	₩	-
Others	-	₩	351	-	₩	263
	3,971	₩	351	9,061	₩	263

19. SHAREHOLDERS' EQUITY:

- (1) Details of capital stock as of December 31, 2013 and 2012, are as follows:

	December 31, 2013	December 31, 2012
Authorized (common stock)	12,000,000 shares	12,000,000 shares
Par value	₩ 5,000	₩ 5,000
Issued	6,000,000 shares	6,000,000 shares
Capital stock	30,000,000,000	30,000,000,000

20. OTHER PAID-IN CAPITAL:

- (1) Details of other paid-in capital as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013	December 31, 2012
Additional paid-in capital	₩ 25,494	₩ 25,494
Treasury stock	(2,361)	(2,361)
Gain on disposal of treasury stock	3,394	3,394
Consolidated capital reserve	849	895
Others	47	47
Total	<u>₩ 27,423</u>	<u>₩ 27,469</u>

21. RETAINED EARNINGS AND DIVIDENDS:

- (1) Details of retained earnings as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013	December 31, 2012
Legal reserve:		
Earned surplus reserve (*1)	₩ 6,300	₩ 5,400
Voluntary reserve:		
Legal revaluation reserve (*2)	224,454	224,454
Revaluation reserve	121,655	121,655
Actuarial loss	(13,907)	(10,502)
Others	518,725	472,925
Inappropriate retained earnings	<u>₩ 129,755</u>	<u>₩ 71,736</u>
	<u>₩ 986,982</u>	<u>₩ 885,668</u>

(*1) In accordance with the Commercial Code of Korea, 10% of cash dividends are retained every fiscal year until the accumulated amount reaches 50% of capital stock. The retained amount cannot be used for cash dividend, but only for capitalization or setting off losses.

(*2) Gain from valuation of assets in accordance with former revaluation of assets in the Commercial Code of Korea. The amount cannot be used for cash dividend, but only for capitalization or setting off losses.

- (2) Details of changes in retained earnings for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
Beginning balance	₩ 885,668	₩ 792,490
Net income	113,440	96,505
Dividend	(8,721)	(8,700)
Actuarial gains (losses) on defined benefit plans	(4,493)	7,089
Tax effects	1,088	(1,716)
Ending balance	<u>₩ 986,982</u>	<u>₩ 885,668</u>

(3) Details of dividends for the years ended December 31, 2013 and 2012, are as follows:

Description	Issued	The number of treasury stock	Shares for dividends	2013		Dividends per share	Total
				W	1,500		
Common stock	6,000,000 shares	186,012 shares	5,813,988 shares	W	1,500	W	8,721,000,000
2012							
Description	Issued	The number of treasury stock	Shares for dividends	Dividends per share		Total	
				W	1,500	W	8,700,000,000
Common stock	6,000,000 shares	200,009 shares	5,799,991 shares	W	1,500	W	8,700,000,000

22. OTHER CAPITAL COMPONENTS:

(1) Details of other capital components as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	December 31, 2013					
	Before tax		Income tax effect		After tax	
	W	52,124	W	(12,614)	W	39,510
Gain on valuation of AFS financial assets	W	52,124	W	(12,614)	W	39,510
Changes in capital variation of equity method		(103)		25		(78)
Difference on overseas operations translation		(9,937)		2,054		(7,883)
	W	42,084	W	(10,535)	W	31,549
December 31, 2012						
	Before tax		Income tax effect		After tax	
	W	57,016	W	(13,797)	W	43,219
	W	57,016	W	(13,797)	W	43,219
Gain on valuation of AFS financial assets	W	57,016	W	(13,797)	W	43,219
Changes in capital variation of equity method		(95)		22		(73)
Difference on overseas operations translation		(2,613)		283		(2,330)
	W	54,308	W	(13,492)	W	40,816

(2) Changes in gain on valuation of AFS financial assets for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013		2012	
	W	43,219	W	73,198
Beginning balance				
Current-term valuation:				
Gain on valuation of AFS financial assets		(4,215)		(39,615)
Income tax effect		1,020		9,587
Reclassification adjustments (profit or loss):				
Gain on valuation of AFS financial assets		(678)		64
Income tax effect		164		(15)
Ending balance	W	39,510	W	43,219

(3) Changes in capital variation of equity method for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013		2012	
	W	(73)	W	337
Beginning balance				
Current-term valuation:				
Changes in capital variation of equity method		(7)		(540)
Income tax effect		2		130
Ending balance	W	(78)	W	(73)

(4) Changes in difference on overseas operations translation for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012	
W	(2,330)	W	14,609
Beginning balance			
Current-term valuation:			
Difference on overseas operations translation	(7,325)		(22,105)
Income tax effect	1,772		5,166
Ending balance	<u>(7,883)</u>	<u>W</u>	<u>(2,330)</u>

23. SALES:

Details of sales for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012	
W	1,042,606	W	1,177,470
Sale of merchandise	1,113,580		1,222,880
Sale of finished goods	62,969		70,064
Others	<u>2,219,155</u>	<u>W</u>	<u>2,470,414</u>

24. SELLING AND ADMINISTRATIVE EXPENSES:

Details of selling and administrative expenses for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012	
W	31,719	W	32,252
Salaries	1,623		1,867
Severance and retirement benefits	4,052		3,495
Employee benefits	3,220		2,375
Rent	1,174		1,141
Entertainment	3,059		2,793
Depreciation	963		751
Amortization	3,646		3,207
Taxes and dues	790		778
Advertising	1,641		1,712
Research and development expense	(2,338)		9,452
Bad debt	1,848		1,843
Travel	532		586
Communications	9,919		8,206
Commissions and fees	812		829
Insurance	369		424
Training	29,794		30,583
Transportation expenses	401		456
Vehicle maintenance	53,841		52,757
Export expenses	3,019		3,096
Others	<u>150,084</u>	<u>W</u>	<u>158,603</u>

25. FINANCIAL INCOME AND EXPENSES:

(1) Details of financial income for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
W	W	W
Interest income	2,395	6,019
Dividend income	2,839	2,696
Gain on disposal of AFS financial assets	785	48
Gain on disposal of derivatives	141	181
Gain on valuation of derivatives	1	-
Gain on disposal of financial assets designated as at FVTPL	457	876
Gain on valuation of financial assets designated as at FVTPL	1,592	300
Gain on valuation of consideration for exchange rights	85	6,418
Gain on foreign currency transactions	25,089	24,601
Gain on foreign currency translation	2,300	4,062
	<u>W</u>	<u>W</u>
	<u>35,684</u>	<u>45,201</u>

(2) Details of financial expenses for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
W	W	W
Interest expense	14,965	19,499
Loss on disposal of derivatives	148	786
Loss on valuation of derivatives	112	234
Loss on valuation of financial assets designated as at FVTPL	45	305
Impairment of AFS financial assets	-	4,000
Loss on foreign currency transactions	24,050	18,806
Loss on foreign currency translation	4,757	2,594
Subtotal	<u>44,077</u>	<u>46,224</u>
Less: Capitalization of financial costs	<u>(877)</u>	<u>(471)</u>
	<u>W</u>	<u>W</u>
	<u>43,200</u>	<u>45,753</u>

Weighted-average capitalization interest rate of the borrowings for the years ended December 31, 2013 and 2012, is 2.95% and 3.33%, respectively.

(3) Classification of the Group's financial income and expenses as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013	2012
W	W	W
Loans and receivables (*1)	1,227	(1,669)
AFS financial assets	3,624	(955)
Financial assets at FVTPL	2,146	(268)
Financial liabilities measured at amortized cost	(14,338)	(4,079)
Financial liabilities at FVTPL	(175)	6,418
	<u>W</u>	<u>W</u>
	<u>(7,516)</u>	<u>(553)</u>

(*1) Cash and cash equivalent included.

26. OTHER NON-OPERATING INCOME AND EXPENSES:

Details of other non-operating income and expenses for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

(1) Other non-operating income

	2013	2012
	₩	₩
Rent income	2,163	1,524
Gain on disposal of property, plant and equipment	622	256
Commission received	275	62
Gain on bargain purchase	-	35,303
Miscellaneous income	<u>2,058</u>	<u>3,629</u>
	<u>₩</u>	<u>₩</u>
	<u>5,118</u>	<u>40,774</u>

(2) Other non-operating expenses

	2013	2012
	₩	₩
Other bad debts	-	30,939
Loss on disposal of property, plant and equipment	374	697
Loss on disposal of intangible assets	63	26
Impairment of intangible assets	-	186
Donations and contributions	319	353
Miscellaneous loss	<u>1,045</u>	<u>26,796</u>
	<u>₩</u>	<u>₩</u>
	<u>1,801</u>	<u>58,997</u>

27. TAXATION:

(1) Composition of income tax expense for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013	2012
	₩	₩
Current income tax payable	29,771	43,633
Changes in deferred taxes due to carryover of tax credits (*1)	(108)	(1,696)
Income tax expenses directly adjusted to capital	3,999	12,876
Income tax expense	33,662	54,813
(*1) Deferred tax liabilities from temporary differences, net at the end of year	(97,019)	(97,096)
Deferred tax liabilities from temporary differences, net at the beginning of year	(97,096)	(98,771)
Change in consolidation scope	-	(132)
Effect on deferred tax due to variation of exchange rate	31	153
Changes in deferred tax from temporary differences	<u>₩</u>	<u>₩</u>
	<u>108</u>	<u>1,696</u>

(2) A reconciliation between income before income tax and income tax expense of the Group is as follows (Unit: Korean won in millions):

	2013	2012
	₩	₩
Income before income tax expense	150,312	154,452
Income tax expense by applying income tax rate	49,214	47,850
Adjustments:		
Non-taxable income and non-deductible expenses	1,755	6,736
Tax credit (special taxes for rural and fishing villages included)	(4,957)	(5,209)
Additional income taxes for prior periods	-	473
Changes in unrecognized deferred tax	-	4,894
Others	<u>(12,350)</u>	<u>69</u>
Income tax expense	<u>₩</u>	<u>₩</u>
	<u>33,662</u>	<u>54,813</u>
Effective tax rate (income tax expense/income before income tax)	22.39%	35.5%

(3) Changes in temporary differences and deferred tax assets (liabilities) for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Description	Year ended December 31, 2013		
	Beginning balance	Increase (decrease)	Ending balance
AFS financial assets	₩ (45,255)	₩ 6,255	₩ (39,000)
Investments in subsidiaries, joint ventures and associates	(79,053)	12,978	(66,075)
Property, plant and equipment	(261,374)	(37,156)	(298,530)
Intangible assets	(3,682)	184	(3,498)
Defined benefit obligation	(3,459)	97	(3,362)
Exchangeable bonds	142	4,319	4,461
Consideration for exchange rights	85	(85)	-
Loans	24,646	(364)	24,282
Deficit carried forward	39,622	1,083	40,705
Others	22,133	(246)	21,887
	(306,195)	(12,935)	(319,130)
Unrealizable temporary differences	156,956		159,297
Realizable temporary differences	(463,151)		(478,427)
Tax rate	24.2%~40%		24.2%~40%
Deferred tax liabilities due to temporary differences	(111,506)		(115,113)
Deduction carried forward	14,410		18,094
Deferred tax liabilities	₩ (97,096)		₩ (97,019)
Year ended December 31, 2012			
Description	Beginning balance	Increase (decrease)	Ending balance
AFS financial assets	₩ (88,806)	₩ 43,551	₩ (45,255)
Investments in subsidiaries, joint ventures and associates	(112,498)	33,445	(79,053)
Property, plant and equipment	(246,442)	(14,932)	(261,374)
Intangible assets	(3,088)	(594)	(3,682)
Defined benefit obligation	(32)	(3,427)	(3,459)
Exchangeable bonds	(3,963)	4,105	142
Consideration for exchange rights	6,503	(6,418)	85
Loans	-	24,646	24,646
Deficit carried forward	5,288	34,334	39,622
Others	12,860	9,273	22,133
	(430,178)	123,983	(306,195)
Unrealizable temporary differences	29,202		156,956
Realizable temporary differences	(459,380)		(463,151)
Tax rate	24.2%~40%		24.2%~40%
Deferred tax liabilities due to temporary differences	(110,022)		(111,506)
Deduction carried forward	11,251		14,410
Deferred tax liabilities	₩ (98,771)		₩ (97,096)

(4) Deferred tax expense directly adjusted to capital as of December 31, 2013 and 2012, is summarized as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	₩	₩	₩	₩
Gain on valuation of AFS financial assets	1,184		9,572	
Actuarial gain or loss	1,087		(1,716)	
Gain on disposal of treasury stock	-		(322)	
Changes in capital variation of equity method	2		130	
Consolidated equity reserve	(46)		46	
Difference on overseas operations translation	1,772		5,166	
	₩ 3,999		₩ 12,876	

(5) Deductible temporary differences, not recognized due to uncertainty of their realization, are as follows (Unit: Korean won in millions):

	December 31, 2013	December 31, 2012
W	W	W
Investments in subsidiaries	60,578	60,384
Investment in associates	30,872	31,334
Loans	24,282	24,646
Accrued income	4,691	4,761
Deficit	38,874	35,830
Others	-	1
	W 159,297	W 156,956

28. EARNINGS PER SHARE:

(1) Net earnings per share, which are computed by dividing net income by the weighted-average number of shares, for the years ended December 31, 2013 and 2012, are as follows

Description	2013	2012
W	W	W
Net income attributable to owners of the Group (A)	113,440 million	96,505 million
Weighted-average number of shares outstanding during the year (B)	5,813,988 shares	5,810,183 shares
Net earnings per share (C=A/B)	W 19,512	W 16,610

(2) The changes in the number of treasury stocks for the years ended December 31, 2013 and 2012, are as follows (Unit: share):

Description	2013	2012
W	W	W
Beginning	5,813,988	5,799,991
Disposal of treasury stocks	-	13,997
Ending	5,813,988	5,813,988

(3) Details of weighted-average number of shares outstanding for the years ended December 31, 2013 and 2012, are as follows:

Description	Period	2013		
		The number of shares outstanding	Weights	Weighted value
Beginning	2013.01.01–12.31	5,813,988	365	W 2,122,105,620

(*) Weighted-average number of shares outstanding during the year: $2,122,105,620 \div 365 \text{ days} = 5,813,988 \text{ shares}$.

Description	Period	2012		
		The number of shares outstanding	Weights	Weighted value
Beginning	2012.1.1–2012.3.12	5,799,991	72	W 417,599,352
Disposal of treasury stocks	2012.3.13–2012.3.15	5,800,811	3	17,402,433
Disposal of treasury stocks	2012.3.16–2012.3.18	5,803,811	3	17,411,433
Disposal of treasury stocks	2012.3.19–2012.3.19	5,806,611	1	5,806,611
Disposal of treasury stocks	2012.3.20–2012.3.20	5,807,493	1	5,807,493
Disposal of treasury stocks	2012.3.21–2012.4.8	5,808,493	19	110,361,367
Disposal of treasury stocks	2012.4.9–2012.4.24	5,808,588	16	92,937,408
Disposal of treasury stocks	2012.4.25–2012.5.16	5,808,988	22	127,797,736
Disposal of treasury stocks	2012.5.17–2012.12.31	5,813,988	229	1,331,403,252
			366	W 2,126,527,085

Weighted-average number of shares outstanding during the year: $2,126,527,085 \div 366 \text{ days} = 5,810,183 \text{ shares}$.

29. RELATED-PARTY TRANSACTIONS:

(1) Details of related parties as of December 31, 2013, are as follows:

Description	Name of companies
Subsidiaries	SeAH Steel America, State Pipe & Supply, SeAH Steel Vina, SeAH Japan, SeAH Steel California, SeAH Steel UAE and SeAH Steel Pipe
Associates	United Spiral Pipe, LLC
Joint ventures	Vietnam Steel Pipe, Landmark Steel
Others	SeAH Besteel, SeAH Holdings and others

(2) Transactions between the Group and other related parties are removed in consolidation and not presented in notes.

Transactions between the Group and other related parties for the years ended December 31, 2013 and 2012, are as follows
(Unit: Korean won in millions):

1) Transactions between the Group and other related parties are as follows (refer to notes below for financial transactions):

2013							
Description	Name of companies	Sales	Other income	Purchases of goods	Purchases of tangible assets	Other costs	
Associates	United Sprial Pipe	W -	W 342	W 1,034	W -	W -	W -
Joint ventures	Landmark Steel	-	16	-	-	-	-
	Vietnam Steel Pipe	-	338	-	-	-	-
Others	SeAH Besteel	67,127	2,647	71,173	-	-	-
	Seah Lns (formerly, SeAH Logis)	557	2	172	4	43,192	
	SeAH E&T	91	-	-	11,705	1,202	
	Haiduk Steel	10,076	31	297	-	-	
	Sedae Steel	-	3	-	-	-	
	SeAH Holdings, etc	1	2,162	7,167	2,300	5,679	
		W 77,582	W 5,541	W 79,843	W 14,009	W 50,073	

2012							
Description	Name of companies	Sales	Other income	Purchases of goods	Purchases of tangible assets	Other costs	
Associates	United Sprial Pipe	W -	W 774	W -	W -	W -	W -
Joint ventures	Landmark Steel	-	9	-	-	-	-
	Vietnam Steel Pipe	-	156	-	-	-	-
Others	SeAH Besteel	65,826	2,766	75,964	-	-	-
	Seah Lns (formerly, SeAH Logis)	8	-	7,180	2	41,256	
	SeAH E&T	80	-	-	4,147	2,358	
	Haiduk Steel	1,092	19	72	-	-	
	Sedae Steel	14,583	50	640	-	-	
	SeAH Holdings, etc	565	1,793	13,070	886	7,635	
		W 82,154	W 5,567	W 96,926	W 5,035	W 51,249	

2) The related outstanding balances with related parties as of December 31, 2013 and 2012, are summarized as follows (loans and borrowings not included):

2013							
Description	Name of companies	Trade receivables	Other accounts receivables	Others	Trade payables	Other accounts payables	
Associates	United Sprial Pipe	W 16	W -	W -	W -	W -	W -
Others	SeAH Besteel	2,756	31	-	17,775	-	-
	Seah Lns (formerly, SeAH Logis)	1,026	2	-	-	6,197	
	SeAH E&T	24	-	-	-	816	
	SeAH Holdings, etc	-	115	35	805	2,240	
		W 3,822	W 148	W 35	W 18,580	W 9,253	

		2012					
Description	Name of companies	Trade receivables	Other accounts receivables	Others	Trade payables	Other accounts payables	
Associates	United Sprial Pipe	₩ 57	₩	-	₩	-	-
Others	SeAH Besteel	3,834	-	-	-	1,008	-
	Seah Lns (formerly, SeAH Logis)	-	-	-	-	77	5,060
	SeAH E&T	47	-	-	-	1,051	2,108
	Haiduk Steel	1,026	-	-	-	-	-
	Sedae Steel	551	1	-	-	-	-
	SeAH Holdings, etc	-	121	35	1,474	4,139	
		₩ 5,515	₩ 122	₩ 35	₩ 3,610	₩ 11,307	

There are no allowances for doubtful accounts or bad debts recognized by the Group related to the accounts above as of December 31, 2013 and 2012.

- 3) Transactions of equity between the Group and related parties for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

2013							
Name	Account	Beginning	Increase	Decrease	Exchange rate fluctuations	Ending	
Investments in associates:							
United Spiral Pipe, LLC	Long-term loans	₩ 24,646	₩	-	₩ (364)	₩ 24,282	
	Allowance for doubtful accounts	(24,646)	-	-	364	(24,282)	
	Accrued income	4,761	-	-	(70)	4,691	
	Allowance for doubtful accounts	(4,761)	-	-	70	(4,691)	
		₩ -	₩ -	₩ -	₩ -	₩ -	
2012							
Name	Account	Beginning	Increase	Decrease	Exchange rate fluctuations	Ending	
Investments in associates:							
United Spiral Pipe, LLC	Long-term loans	₩ 26,537	₩	-	₩ (1,891)	₩ 24,646	
	Allowance for doubtful accounts	-	(25,996)	-	1,350	(24,646)	
	Accrued income	4,024	1,078	-	(341)	4,761	
	Allowance for doubtful accounts	-	(4,943)	-	182	(4,761)	
		₩ 30,561	₩ (29,861)	₩ -	₩ (700)	₩ -	

- 4) There are no transactions of equity with related parties for the years ended December 31, 2013 and 2012.

- 5) Loans receivable to employees for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
Short-term loan receivable to employees	₩ 308	₩ 224
Long-term loan receivable to employees	650	394
	₩ 958	₩ 618

(3) The compensation for the key management of the Company

The compensation for the key management of the Company for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	2013	2012
W	W	W
Short-term salaries	1,170	1,576
Severance and retirement benefits	136	697
	<u>1,306</u>	<u>2,273</u>

The key management above consists of registered executives that have critical authorities and responsibilities for strategy, operation and control of the Company.

30. PAYMENT GUARANTEES:

- (1) Payment guarantees provided by others as of December 31, 2013, are as follows (Unit: Korean won in millions):

	Description	Amount
Shinhan Bank	Local L/C, import L/C and others (*1)	W 25,000
Hana Bank	Local L/C, import L/C and others (*1)	17,613
Woori Bank	Local L/C, import L/C and others (*1)	20,877
Korea Exchange Bank	Local L/C, import L/C and others (*1)	19,381
Korea Development Bank	Local L/C, import L/C and others (*1)	12,174
Nonghyup	Local L/C, import L/C and others (*1)	2,560
HSBC and others	Local L/C, import L/C and others (*1)	47,930
Seoul Guarantee Insurance	Payment guarantee and impairment insurance	<u>29,405</u>
Total		<u>W 174,940</u>

(*1) The amount that has not been acquired from banks among L/Cs issued.

- (2) Payment guarantees provided to others as of December 31, 2012, are as follows (Unit: Korean won in millions, U.S. dollars in thousands and Chinese yuan in thousands):

Company name	Foreign currency	Domestic currency
Landmark Steel	USD	600
Landmark Steel	CNY	19,600
United Spiral Pipe	USD	<u>21,000</u>
	USD	21,600
	CNY	19,600
		<u>W 633</u>
		<u>3,413</u>
		<u>22,161</u>
		<u>W 22,794</u>
		<u>W 3,413</u>

31. COMMITMENTS AND CONTINGENCIES:

- (1) The Group is committed to a purchase loan contract from Hana Bank with the limit of W120,000 million and is borrowing W46,832 million as of December 31, 2013.
- (2) The Group has been under review by U.S. Department of Commerce ("DOC") with respect to applicability of antidumping duties on imported goods. In 2012, the Company paid additional duties of approximately \$610,000 for certain product lines based on the DOC review. The Company is continuously subject to such reviews.
- (3) Litigation

As of December 31, 2013, four lawsuits (amounting W2,100 million) are under a lawsuit regarding violation against monopoly regulations and fair trade law, cancelation of correction order and others. The results of lawsuits cannot be expectable.

- (4) The Supreme Court decision was made regarding "ordinary wages" which expands the scope of it clearly. However, it is estimated that the outflow of economic benefit caused by the court decision is not probable than it would be otherwise considering the Company's status. The possible impact following the court decision on the consolidated financial statements is not stated in accordance with paragraph 92 of K-IFRS 1037, Provision, Contingent Liabilities and Contingent Assets.

32. FINANCIAL ASSETS AND RISK MANAGEMENT:

(1) Capital risk management

The Group performs capital management to maintain its ability to continuously provide profits to shareholders and parties in interest, and to maintain optimum capital structure to reduce capital expenses. The overall capital risk management policy of the Group is unchanged from the year ended December 31, 2012. The Group uses debt ratio for the capital risk management and the ratio is derived by dividing total debt with total equity. The total debt and total equity are calculated from the consolidated financial statements.

Debt ratio as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

	December 31, 2013	December 31, 2012
Total borrowings	896,116	1,026,411
Total shareholders' equity	1,009,445	1,003,940
Borrowings to equity ratio	81.51%	102%

(2) Classification of the Group's financial instruments as of December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

1) Financial assets

Description	December 31, 2013					
	Assets at FVTPL	Financial assets held for trading purposes	Financial assets designated as at FVTPL	Loans and receivables	AFS financial assets	
Cash and cash equivalents	₩	-	₩	-	₩	-
Short-term financial instruments	-	-	-	18,680	-	-
Long-term financial instruments	-	-	-	366	-	-
Assets at FVTPL:						
Current	-	-	10,026	-	-	-
Non-current	-	-	12,413	-	-	-
Trade and other receivables:						
Current	-	-	-	371,108	-	-
Non-current	-	-	-	8,966	-	-
AFS financial assets	-	-	-	-	92,589	-

Description	December 31, 2012					
	Assets at FVTPL	Financial assets held for trading purposes	Financial assets designated as at FVTPL	Loans and receivables	AFS financial assets	
Cash and cash equivalents	₩	-	₩	-	₩	-
Short-term financial instruments	-	-	-	60,729	-	-
Long-term financial instruments	-	-	-	149	-	-
Assets at FVTPL:						
Current	-	-	2,092	-	-	-
Non-current	-	-	10,904	-	-	-
Trade and other receivables:						
Current	-	-	-	398,438	-	-
Non-current	-	-	-	9,138	-	-
AFS financial assets	-	-	-	-	95,274	-

2) Financial liabilities

Description	2013		
	Financial liabilities held for trading purposes	Financial liabilities designated as at FVTPL	Financial liabilities measured at amortized cost
Liabilities at FVTPL:			
Current	W	W	- W
Non-current		112	-
Trade and other payables:			
Current	-	-	225,439
Non-current	-	-	1,818
Borrowings:			
Current	-	-	430,630
Non-current	-	-	157,052
2012			
Description	Financial liabilities at FVTPL		
	Financial liabilities held for trading purposes	Financial liabilities designated as at FVTPL	Financial liabilities measured at amortized cost
Liabilities at FVTPL:			
Current	W	234 W	- W
Non-current		85	-
Trade and other payables:			
Current	-	-	281,764
Non-current	-	-	1,463
Borrowings:			
Current	-	-	431,212
Non-current	-	-	185,106

(3) Financial risk

The Group is exposed to various risks related to its financial instruments, such as foreign currency risk, liquidity risk, credit risk, interest risk and price risk.

1) Foreign currency risk

The Group undertakes transactions denominated in foreign currencies; consequently, exposures to exchange rate fluctuations arise. The Group periodically evaluates and manages the exchange exposure risk through the payable management system and foreign currency bonds.

The carrying amounts of the Group's foreign currency-denominated monetary assets and monetary liabilities at the end of the reporting period are as follows (Unit: Korean won in millions):

	December 31, 2013		December 31, 2012	
	Assets	Liabilities	Assets	Liabilities
USD	W 74,847	W 174,948	W 62,755	W 173,760
EUR	92	-	497	-
JPY	3,891	-	9,149	-
AED	1,352	-	-	-
CAD	824	1,487	-	-

A sensitivity analysis on the Group's net income before income tax for the period, assuming a 10% increase or decrease in currency exchange rates, as of December 31, 2013 and 2012, is presented in the table below (Unit: Korean won in millions):

Description	December 31, 2013		December 31, 2012	
	10% increase	10% decrease	10% increase	10% decrease
USD	W (9,269)	W 9,269	W (10,618)	W 10,618
EUR	9	(9)	50	(50)
JPY	389	(389)	915	(915)
AED	135	(135)	-	-
CAD	(66)	66	-	-

2) Interest rate risk

The Group is exposed to interest rate risk due to its borrowing with floating interest rates. The Group maintains a balance between borrowings with variable interest rate and fixed interest rate.

The items exposed to interest risk as of December 31, 2013, are ₩147,395 million of borrowings, and the effects on the net income from the increase and decrease of interest rate of 1% point are ₩(1,474) million and ₩1,474 million, respectively.

3) Price risk

The Group is exposed to equity price risks arising from its equity-based securities, consideration for exchangeable rights and AFS financial assets. Given all the other variables constant, the effect of increase or decrease of the underlying assets by 10% for the equity investments on net income before income tax and comprehensive income before income tax is as follows:

Description	Account under effect	Carrying amount		Effect of underlying asset price by 10%		December 31, 2013	
						2013	2012
		December 31, 2013	December 31, 2012	W	W	W	W
Financial assets at FVTPL	Income before income tax expense	₩ 22,440	₩ 12,996	₩ 2,244	₩ 1,300		
AFS financial assets	Other comprehensive income	91,378	94,450	9,138	9,445		
Derivative liabilities held for trading purposes	Income before income tax expense	(112)	234	11	(23)		
Consideration for exchange rights	Income before income tax expense	-	85	-	(9)		

4) Credit risk

The Group makes transactions with reputable financial institutions to manage credit risk and operating with policy and procedures for credit enhancement of financial assets. The Group decides credit transaction limits based on evaluation of client's credit, through information obtained from the credit bureau, and disclosed financial position at committing contracts. Also, the Group provides collateral or payment guarantees. The Group continually reviews the credit and the limits of credit of clients to adjust necessary collateral. For delayed collection of financial assets, appropriate actions are taken in accordance with the reason for any delays. Accounts receivable are diverse to a large number of customers, and it is also distributed to a variety of industries and geographies. Credit rating for trade receivables is continuously practiced and, if necessary, the Group enters into guaranteed interest contract. As the Group makes transactions with reputable financial institutions, the credit risk from liquidities and derivatives are considered limited.

As of December 31, 2013 and 2012, the maximum exposed amounts of credit risk for financial assets maintained by the Group are as follows (Unit: Korean won in millions):

Description	December 31, 2013		December 31, 2012	
Financial guarantee contract (*1)	₩ 26,207		₩ 24,829	
Loan commitments	25,441		38,965	

(*1) The maximum exposed amounts of financial guarantee contract represent a limit of payment guarantee, which is the maximum amount payable by the Controlling Company in case the debtor claims for the full guaranteed amount.

The carrying amount of financial assets exposed to credit risk, except for financial guarantee and loan commitments, best represents a limit of payment, so the carrying amount is excluded from the above disclosure.

5) Liquidity risk

The Group has established an appropriate liquidity risk management framework for the management of the Group's short-, medium- and long-term funding and liquidity management requirements. The Group manages liquidity risk by maintaining adequate reserves, banking facilities and reserve borrowing facilities, by continuously monitoring forecast and actual cash flows, and by matching the maturity profiles of financial assets and liabilities.

The table below analyzes the Group's non-derivative financial liabilities into relevant maturity groupings based on the remaining period at the consolidated statements of financial position date to the contractual maturity date. The table below is based on the earliest maturity date the Group has to pay for the undiscounted cash flows of financial liabilities. For the contractual maturity, it is based on the possibly earliest date the Group will be asked to pay back (Unit: Korean won in millions):

	December 31, 2013				
	Within a year	1–5 years	More than 5 years	Total	
Trade payables	₩ 160,189	₩	₩	₩ 160,189	
Other accounts payable	61,187	1,125	-	62,312	
Borrowings	288,754	24,705	2,996	316,455	
Publicly placed bonds	4,650	137,051	-	141,701	
Exchangeable bonds (*1)	115,080	-	-	115,080	
Financial lease liabilities	27	76	-	103	
Financial guarantee contract	26,207	-	-	26,207	
	₩ 656,094	₩ 162,957	₩ 2,996	₩ 822,047	

(*1) The amount includes redemption premium.

Amount included above is the maximum amount that the Group has to pay for financial guarantee contract. Based on current expectations, the Group assumes there is a strong possibility not to pay guarantee in accordance with financial guarantee contract. However, for the case of credit loss possibility on financial receivables that possess warrantee, the warrantee may ask the Group to pay in accordance with guarantee contract; hence, probability estimates made above are subject to change.

The following table shows expected maturity of non-derivative financial assets that the Group owns in detail. The following table was prepared based on undiscounted contractual maturity of financial assets, including accrued interest. Since the Group manages its liquidity based on net assets and liabilities, the Group needs to involve information of non-derivative financial assets to understand the liquidity risk management (Unit: Korean won in millions):

	December 31, 2013				
	Within a year	1–5 years	More than 5 years	Total	
Cash and cash equivalent	₩ 129,144	₩	₩	₩ 129,144	
Trade receivables	358,067	4,125	-	362,192	
Other accounts receivable	11,493	-	-	11,493	
Loans	508	650	-	1,158	
Guarantee deposits	498	2,603	1,587	4,688	
Short- and long-term financial instrument	18,680	366	-	19,046	
Financial assets designated as at FVTPL	10,026	12,413	-	22,439	
	₩ 528,416	₩ 20,157	₩ 1,587	₩ 550,160	

The following table shows the liquidity of derivative analysis in detail. Derivatives in the following table were prepared based on undiscounted cash inflows and outflows.

	December 31, 2013				
	Within a year	1–5 years	More than 5 years	Total	
Currency swap	USD 7,000	-	-	USD 7,000	

Liquidity analysis for consideration for exchangeable rights is omitted since it bears no effect on liquidity risk.

6) Derivative

The Group has currency forward contracts from financial institutions for the purpose of trading and used valuation from the financial institutions as fair value of the contracts.

Contractor	Contract date	Maturity	Buying (selling) amount	Contract exchange rate	Fair value
Citi Bank	2013.09.23	2014.02.28	USD 3,000	1,086.90	₩ (83)
Citi Bank	2013.10.17	2014.02.28	USD 2,000	1,073.85	(29)
Citi Bank	2013.12.09	2014.02.28	USD 2,000	1,058.57	1
			USD 7,000		₩ (111)

The Group has classified gain and loss on valuation from the forward contracts of ₩1 million and ₩ 112 million, respectively, as financial expenses for the year ended December 31, 2013.

33. FAIR VALUE OF FINANCIAL INSTRUMENTS:

- (1) Details of carrying and fair value of the financial assets and liabilities, which were measured subsequently, as of December 31, 2013 and 2012, are as follows (Korean won in millions):

	December 31, 2013					
	Level 1	Level 2	Level 3		Total	
Financial assets:						
Financial assets at FVTPL	₩	₩	22,440	₩	-	₩ 22,440
Financial assets AFS:						
Marketable equity securities	61,233	-	-	-	-	61,233
Non-marketable equity securities	-	-	-	28,629	-	28,629
National and public bonds	1,516	-	-	-	-	1,516
	₩	₩	22,440	₩	28,629	₩ 113,818
Financial liabilities:						
Financial liabilities at FVTPL	₩	₩	(112)	₩	-	₩ (112)
	₩	₩	(112)	₩	-	₩ (112)
	December 31, 2012					
	Level 1	Level 2	Level 3		Total	
Financial assets:						
Financial assets at FVTPL	₩	-	₩	12,996	₩	₩ 12,996
Financial assets AFS:						
Marketable equity securities	66,735	-	-	-	-	66,735
Non-marketable equity securities	-	-	-	-	27,501	27,501
National and public bonds	790	-	-	-	-	790
	₩	₩	12,996	₩	27,501	₩ 108,022
Financial liabilities:						
Financial liabilities at FVTPL	₩	-	₩	319	₩	₩ 319
	₩	-	₩	319	₩	₩ 319

- (2) The Group regards that the carrying amount of loans and receivables (financial assets) and financial liabilities, subsequently measured at amortized cost as of December 31, 2013 and 2012, are similar to fair value.
- (3) The following table explains the valuation methods used to measure the Levels 2 and 3 fair values, the input variables which are material but not observable, and their relations with fair value estimation:

Description	Fair value (won in millions)	Valuation method	Non-observable input variable	Range (weighted average)	Relation between non- observable input variable and fair value
Non-marketable equity securities	₩ 28,629	Discounted cash flow	Sales growth rate Before-tax operating income rate Weighted- average capital cost	0.91%–1.90% (1.01%) 34.66%–71.21% (67.64%) 4.14%–16.96% (6.87%)	As perpetuity growth rate, sales growth rate, before-tax operating income rate increase and weighted- average capital cost decreases, fair value of non- marketable equity securities shall increase

- (4) Changes in Level 3 financial assets for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013			
	Beginning balance	Valuation	Acquisition	Ending balance
Financial assets:				
Financial assets AFS	W 27,501	W 1,128	W -	W 28,629
	2012			
	Beginning balance	Valuation	Acquisition	Ending balance
Financial assets:				
Financial assets AFS	W 2,801	W (300)	W 25,000	W 27,501

- (5) The Group reclassifies level when certain events or changes in circumstance occur. There has not been any change to the valuation methods used to measure the Levels 2 and 3 fair values.
- (6) Details of the financial assets and liabilities, which are subsequently measured at fair value in principal but are not measured at fair value because the fair value cannot be measured reliably as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Classification	Description	December 31, 2013	December 31, 2012
Financial assets AFS (*)	Non-marketable equity securities	W 1,211	W 248

(*1) They are measured at cost method because they were unavailable to get financial information, which is needed on valuation, or fair value by other proper methods cannot be measured reliably.

- (7) The effects the input variables that are significant but not observable regarding measurement of fair value of the Level 3 consolidated financial instruments have on the net income and other comprehensive income for the year ended December 31, 2013, are as follows (Unit: Korean won in millions):

	2013			
	Non-observable input variable	Change of input variable	Positive change	Negative change
Financial assets AFS:				
Non-marketable equity securities	Perpetuity growth rate	±1.00%	W 387	W (260)
	Value of property	±1.00%	221	(221)
	Weighted-average capital cost	±1.00%	1,931	(1,462)

- (8) Key assumptions used to determine the fair value of the following financial assets and liabilities which are categorized within Level 2 and Level 3 are described below

- Non-marketable equity securities

The Group measures unlisted stock at fair value, using discounted cash flow models. The measurement contains assumption, such as rate of sales increase, rate of pretax operating income, weighted-average cost of capital and others, which is unobservable. The weighted-average cost of capital to discount future cash flow is calculated by Capital Asset Pricing Model (CAPM). The Group categorizes unlisted stock within Level 3 because the assumption is significant to the entire measurement.

- (9) There has not been any change to the valuation methods used to measure the Levels 2 and 3 fair values.

- (10) The Group performs fair value measurement of the Level 2 and Level 3 for the purpose of financial reporting in the accounting and finance departments and uses the valuation amount from the independent outside institutions which do not have direct relations with the Group. On the other hand, the result of fair value measurement is reported directly to the chief financial officer.

- The sales growth rate and before-tax income rate applied to the fair value measurement of non-marketable equity securities are estimated from the analysis of operation performance, forecast on future market size, operation environments, and mid-term and long-term operation plan.

- The weighted-average capital cost used in the fair value measurement as the discount rate is estimated from the weighted average of the cost of equity derived from CAPM with the beta (β) based on the beta of a comparable listed company reflecting the target capital structure of the company and the cost of debt after tax of the company.

(11) The Group expects that changing one or more of the unobservable inputs to reflect reasonably possible alternative assumptions would change fair value significantly.

(12) Reclassification of financial assets

There has not been any reclassification of financial instruments due to change of purpose or use.

(13) Derecognition of financial assets

On derecognition of a financial asset other than in its entirety, the Group recognized trading receivables, which amount to ₩22,885 million and ₩26,945 million as of December 31, 2013 and 2012, respectively. Related short-term borrowings amount to ₩22,885 million and ₩26,945 million as of December 31, 2013 and 2012, respectively. If those trading receivables are not reimbursed until maturity, the Group has an obligation to pay total amount of trading receivables.

The Group retains substantially all the risks and rewards of ownership of a transferred financial asset. The Group continues to recognize the trading receivables and also recognizes a collateralized borrowing for the proceeds received.

34. CASH AND CASH EQUIVALENTS:

Details of cash and cash equivalents as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

		December 31, 2013	December 31, 2012
Cash	₩	4,505	460
Ordinary deposit		1,121	15,655
Current deposit		15,903	20,614
Fixed time deposit and others		<u>107,615</u>	<u>115,224</u>
Total	₩	<u>129,144</u>	<u>151,953</u>

The cash and cash equivalents in the consolidated statements of cash flows are the same as the cash and cash equivalents in the consolidated statements of financial position.

35. RESTRICTED FINANCIAL INSTRUMENTS:

Details of restricted deposits as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

Account	Bank	December 31, 2013	December 31, 2012	Remark
Long-term financial instruments	SBJ Bank	₩ 355	₩ 135	Collateral
Short-term financial instruments	Commonwealth Bank of Australia	<u>2,126</u> ₩ 2,481	<u>1,444</u> ₩ 1,579	Collateral

36. CASH FLOW STATEMENTS:

(1) Details of restricted deposits as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
Adjustments to reconcile net income to net cash provided by operating activities:		
Income tax expense	₩ 33,662	₩ 54,813
Interest income	(2,395)	(6,019)
Interest expense	14,088	19,028
Dividend income	(2,839)	(2,696)
Gain on valuation of derivatives	(1)	-
Loss on valuation of derivatives	112	234
Gain on valuation of consideration for exchange rights	(85)	(6,418)
Gain on disposal of financial assets designated as at FVTPL	(457)	(876)
Gain on valuation of financial assets designated as at FVTPL	(1,592)	(300)
Loss on valuation of financial assets designated as at FVTPL	45	305
Gain on foreign currency translation	(2,300)	(4,062)
Loss on foreign currency translation	4,757	2,594
Severance and retirement benefits	3,851	5,451
Depreciation	36,570	29,761
Amortization	1,012	813
Bad debts	(2,338)	9,452
Other bad debts	-	30,939
Gain on disposal of property, plant and equipment	(622)	(256)
Loss on disposal of property, plant and equipment	374	697
Loss on disposal of intangible assets	63	26
Impairment of intangible assets	-	186
Loss on valuation of inventories	1,726	431
Reversal on valuation of inventories	(1,184)	(390)
Gain on disposal of AFS financial assets	(785)	(48)
Impairment of AFS financial assets	-	4,000
Gain from investments in associates and joint ventures	(473)	(361)
Loss from investments in associates and joint ventures	570	583
Gain on bargain purchase	-	(35,303)
Long-term payroll	(161)	(794)
	₩ 81,598	₩ 101,790

	2013	2012
	₩	₩
Changes in working capital:		
Increase in trade receivables	1,152	(10,763)
Decrease (increase) in other accounts payable	(242)	2,520
Decrease in accrued income	(11)	240
Decrease (increase) in short-term guarantee deposits	(443)	150
Decrease in derivative assets held for trading purposes	-	279
Increase in advance payments	(63)	(8,866)
Decrease (increase) in prepaid expenses	30	472
Decrease in short-term others	(4)	12
Decrease (increase) in inventories	(2,007)	15,111
Decrease in long-term trade receivables	1,420	5,996
Increase in long-term guarantee deposits	(103)	(1,694)
Increase in long-term prepaid expenses	567	(274)
Decrease in long-term others	18	1
Increase (decrease) in trade payables	(10,802)	(32,471)
Increase in other accounts payable	8,777	14,344
Increase (decrease) in accrued expenses	(693)	(1,475)
Increase (decrease) in financial guarantee contracts	24	(10)
Increase in derivative liabilities held for trading purposes	(234)	-
Increase (decrease) in advance receipts	(4,461)	2,426
Increase (decrease) in short-term withholdings	(251)	(509)
Increase in long-term deposits	649	30
Increase (decrease) in long-term other accounts payable	(164)	(246)
Increase in other long-term liabilities	89	350
Payment of severance pay	(6,002)	(3,303)
Increase in plan assets	(1,685)	(131)
	₩	₩
	(14,439)	(17,811)

(2) Significant non-cash transactions from investment and financing activities that are not included in the consolidated statements of cash flows for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
	₩	₩
Transfer to short-term trade receivables from long-term trade receivables	1,171	10,273
Transfer to AFS financial assets from trade receivables	47	
Transfer to short-term loans from long-term loans	312	187
Transfer to PPEs from construction in progress	148,828	69,061
Transfer to intangible assets from construction in progress	241	3,192
Transfer to construction in progress from machinery in transit	12,812	3,271
Transfer to investment property from PPEs	3,987	8,656
Transfer to short-term borrowings from long-term borrowings	1,363	55,464
Transfer to short-term financial lease liabilities from long-term financial lease liabilities	54	60
Transfer to short-term exchangeable bonds from long-term exchangeable bonds	114,035	-
Transfer to short-term borrowings from long-term borrowings	-	50,000

37. EXPENSE CLASSIFICATION BY NATURE:

Expenses classified by nature for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
	₩	₩
Purchase of inventories	1,666,998	1,886,117
Changes in inventories	3,173	15,111
Payroll	80,489	84,317
Severance and retirement benefits	4,371	5,752
Employee benefits	12,947	12,353
Rent	4,772	3,536
Commissions and fees	22,019	17,725
Depreciation	36,570	29,761
Amortization	1,012	813
Others	232,197	241,479
Total	₩ 2,064,548	₩ 2,296,964

38. SEGMENT INFORMATION:

(1) General information

Operating segments of the Group are identified in accordance with K-IFRS 1108 on the basis of internal reports about components of the entity that are regularly reviewed by the chief operating decision maker in order to allocate resources to the segment and to assess its performance.

(2) Type of goods and services provided by reportable segment:

Segment	Type of goods and services
Manufacturing of steel pipe	Manufacturing of steel pipe
Manufacturing of flat rolled products	Manufacturing of flat rolled products
Manufacturing and distributing steel pipe and flat rolled products	Manufacturing and distributing steel pipe and flat rolled products

(3) Analysis by reportable segment

1) Operating results by reportable segment for the years ended December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013	2012
	₩	₩
Revenue by reportable segment:		
Manufacturing of steel pipe	1,326,938	1,551,875
Manufacturing of flat rolled products	393,735	369,491
Manufacturing and distributing steel pipe and flat rolled products	1,274,521	1,410,657
Consolidation adjustment	(776,039)	(861,609)
	₩ 2,219,155	₩ 2,470,414
Income (loss) by reportable segment:		
Manufacturing of steel pipe	80,363	111,043
Manufacturing of flat rolled products	13,459	5,986
Manufacturing and distributing steel pipe and flat rolled products	53,456	53,823
Consolidation adjustment	7,330	2,598
Operating income	154,608	173,450
Financial income and cost	(7,516)	(551)
Gain and loss from investments in associates and joint ventures	(97)	(222)
Other non-operating income and expense	3,317	(18,224)
Net income before income tax	150,312	154,453
Income tax expense	33,662	54,813
Net income	₩ 116,650	₩ 99,640

2) Assets and liabilities by reportable segments as of December 31, 2013 and 2012, are as follows (Unit: Korean won in millions):

	2013		2012	
Assets by reportable segments:				
Manufacturing of steel pipe	₩	994,209	₩	996,737
Manufacturing of flat rolled products		232,355		244,401
Manufacturing and distributing steel pipe and flat rolled products		424,896		420,316
Non-assigned		629,356		793,630
Consolidation adjustment		(285,255)		(424,734)
	₩	1,995,561	₩	2,030,350
Liabilities by reportable segments:				
Manufacturing of steel pipe	₩	125,570	₩	218,352
Manufacturing of flat rolled products		20,560		24,769
Manufacturing and distributing steel pipe and flat rolled products		192,638		210,976
Non-assigned		562,104		646,950
Consolidation adjustment		(4,756)		(74,636)
	₩	896,116	₩	1,026,411

Assignment of assets and liabilities of steel pipe and sheets of wholesale segments is omitted because of the inapplicability of the characteristic of the segments.

(4) Revenue by goods and services

Revenue by goods and services for the years ended December 31, 2013 and 2012, is as follows (Unit: Korean won in millions):

Major goods and services	2013		2012	
Steel pipe	₩	2,404,394	₩	2,770,485
Stainless pipe		184,592		173,998
Color flat rolled products		255,716		229,059
Galvanized flat rolled products		147,305		140,536
Others		3,187		17,945
Consolidation adjustment		(776,039)		(861,609)
	₩	2,219,155	₩	2,470,414

(5) Operating results by geography

Details of operating income and non-current assets by geography are as follows (Unit: Korean won in millions):

	Revenue		Non-current assets	
	2013	2012	2013	2012
Korea	₩ 1,720,005	₩ 1,955,357	₩ 1,095,680	₩ 1,148,092
USA	810,187	856,903	34,406	35,327
Vietnam	115,606	119,983	32,828	24,315
UAE	22,485	16,213	62,110	59,618
Japan	326,911	383,567	1,539	1,608
Consolidation adjustment	(776,039)	(861,609)	(220,597)	(322,342)
	₩ 2,219,155	₩ 2,470,414	₩ 1,005,966	₩ 946,618

(6) Information of key customers

Due to the nature of the Group's operation, there are no major clients that possess more than 10% of the sales revenue.

39. BUSINESS COMBINATION:

- (1) Details of business combination for the year ended December 31, 2012, are as follows (Unit: Korean won in millions):

Name	Primary business	Date of acquisition	Ratio of ownership (%)	The consideration transferred
SeAH Steel Pipe	Manufacturing and distributing steel pipe	2012.3.12	100%	₩ 6,034

The Group has acquired entire equity (100% of shares) and control of SeAH Steel Pipe (formerly, SSP Steel Pipe) on March 12, 2012, to obtain long-term growth motor and sustain competitiveness in the steel pipe segment.

- (2) Details of the fair value of consideration transferred from the business combination for the year ended December 31, 2012, are as follows (Unit: Korean won in millions):

Description	Amount
Cash	₩ 6,034

Cost of ₩92 million that occurred during the acquisition has been excluded from the amount of consideration transferred, and recognized as selling and administrative expenses in the consolidated statements of comprehensive income.

- (3) Fair value of assets and liabilities acquired through business combination on the date of acquisition is as follows (Unit: Korean won in millions):

Description	Amount
Fair value of the identifiable assets:	₩ 163,740
Current assets:	
Cash and cash equivalents	464
Trade and other accounts receivable	19,900
Inventories	15,140
Others	638
Non-current assets:	
Property, plant and equipment	126,958
Intangible assets	202
Trade and other accounts receivable	301
Others	137
Fair value of the identifiable liabilities	₩ 122,403
Current liabilities:	
Trade and other payables	67,740
Borrowings	18,200
Others	295
Non-current liabilities:	
Borrowings	36,168
Fair value of the identifiable assets and liabilities	₩ 41,337

- (4) The Group used acquisition law of accounting for business combinations. Goodwill and gain on bargain purchase are detailed as follows (Unit: Korean won in millions):

Description	Amount
I. The consideration transferred	₩ 6,034
II. Non-controlling interests	-
III. Fair value of the identifiable assets and liabilities	41,337
IV. Gain on bargain purchase	₩ (35,303)

Gain on bargain purchase that occurred from the business combination resulted from the bargaining power of the Company and recognized as other comprehensive income in the consolidated statements of comprehensive income.

(5) Net cash outflow due to business combinations is as follows (Unit: Korean won in millions):

Description	Amount
Cash paid	₩ 6,034
Less: Acquisition of cash and cash equivalents	(464)
	₩ 5,570

(6) Net loss of ₩2,979 million of SeAH Steel Pipe was resulted in regard to the new operation included in the net income. Sales of ₩42,413 million are included in the sales.

If the business combination had happened on January 1, 2012, sales of the Group would have increased by ₩10,890 million and net income would have decreased by ₩1,900 million. It is interpreted that the estimation reflects the business performance of the business combination on an annual basis and provides benchmark for the future performance.

The management used financial statements of SeAH Steel Pipe for estimating sales and net income effect of business combination on January 1, 2012.

40. SUBSEQUENT EVENTS:

(1) The Group resolved the incorporation of SeAH Steel Europe S.r.l., a subsidiary, to acquire 100% of shares of Inox Tech S.p.A., a Italian steel pipe manufacturer, at the board of directors' meeting after the reporting period.

The capital stock of SeAH Steel Europe S.r.l. invested by the Group amounts to EUR 26,060 thousand which was completed as of February 26, 2014. SeAH Steel Europe S.r.l., a subsidiary, assumed the liabilities of Inox Tech S.p.A. which was valued at EUR 25,000,000 and completed the acquisition by payment of EUR 42,000,000 as of February 28, 2014.

(2) The Group decided at the board of directors' meeting after the reporting period to provide SeAH Steel Europe S.r.l. with payment guarantee amounting to EUR 24,000,000 for the borrowings from financial institution. The borrowings are owed to Hana Bank and a guarantee for EUR 12,000,000 is to be valid for two years while the remaining amount lasts for three years.



ERW

Electric Resistance Welding

SeAH Steel



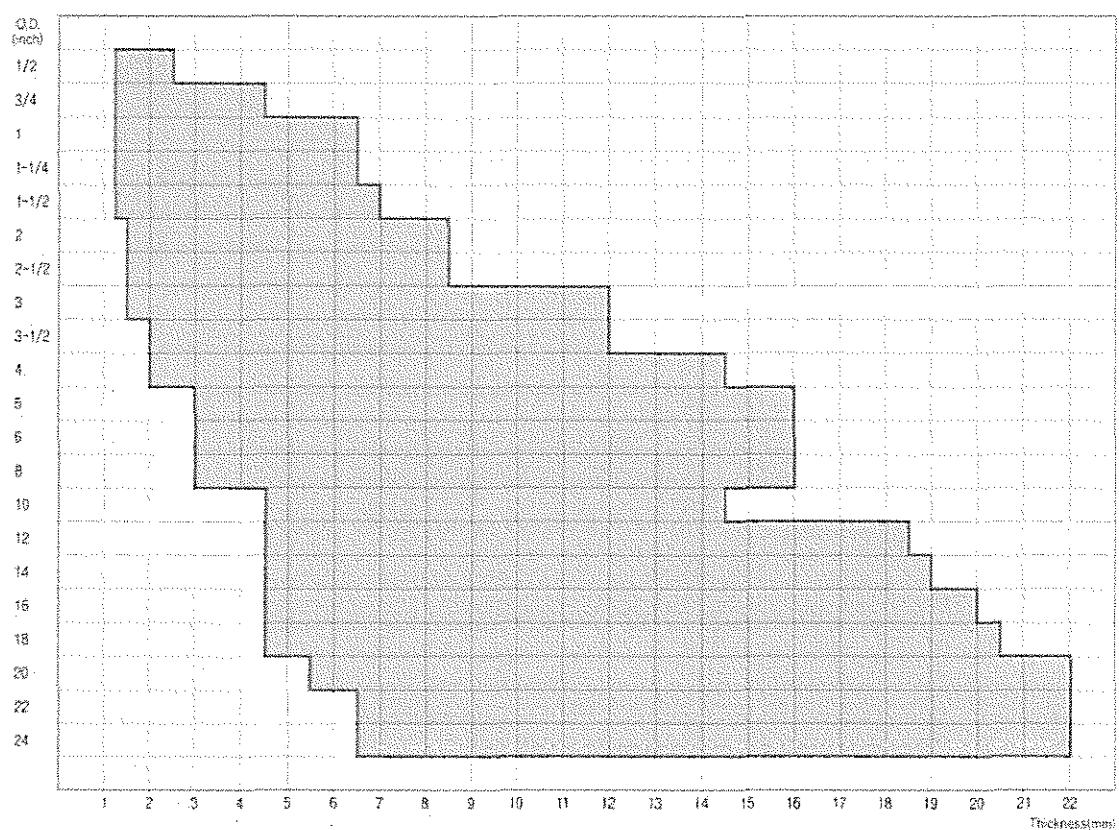
SeAH Steel

© Contact: SeAH Tower, 45 Yanghwa, Mapo-gu, Seoul 121-841, Korea / TEL. +82-2-6970-1073, 1082 / E-mail: export@seahsteel.co.kr / www.seahsteel.com

ERW(HFW) SIZE RANGE

Product	Size Range			Capacity	Location
	O.D.	Thickness (mm)	Length (m)		
ERW(Round)	1" ~ 24"	1.6 ~ 22.0	4.5 ~ 21.0	930,000Ton/Year	Pohang
ERW(Square)	200X200~400X400	4.5 ~ 14.0	5.0 ~ 20.0		
ERW(Round)	1/2" ~ 8"	1.2 ~ 11.0	4.0 ~ 15.8	240,000Ton/Year	Gunsan
ERW(Square)	25X25~150X150 30X20~200X100	1.2 ~ 9.0	4.0 ~ 15.5		
SRM	1/2" ~ 4"	2.2 ~ 15.2	4.5 ~ 12.8	85,000Ton/Year	Pohang
Galvanizing	1/2" ~ 24"	-	Max.8.0	120,000Ton/Year	Gunsan

ERW(HFW) SIZE RANGE





Strengths of SeAH-ERW(HFW) Pipe?

Based on its accumulated knowledge and innovative technology for more than 50 years,

SeAH Steel's ERW(HFW) pipe has following strengths;

- Comprehensive range of products with Large Production Capacity.
- O.D. 1/2" ~ 24" / WT. : MAX. 22mm / LENGTH MAX. 21M / CAPACITY 1.17million MT per Year
- Secures high welding quality through welding monitoring system)
- Secures stable quality through seam UT and FULL BODY UT.

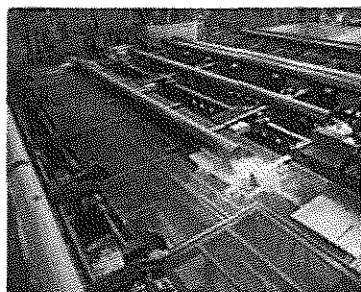
Quality Control Process



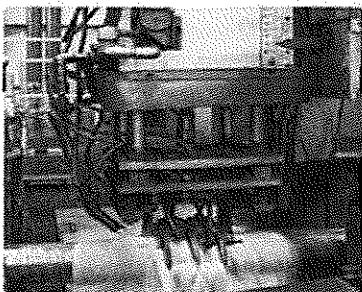
▲ Welding



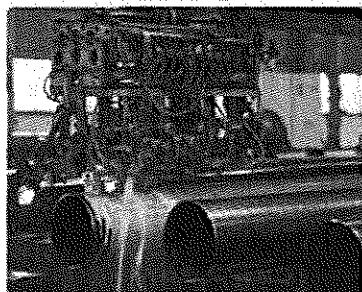
▲ Seam Heat treatment



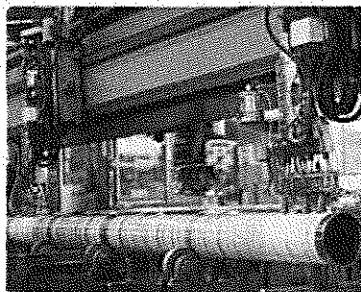
▲ Hydrostatic Test



▲ Seam Ultrasonic Test (On-line)



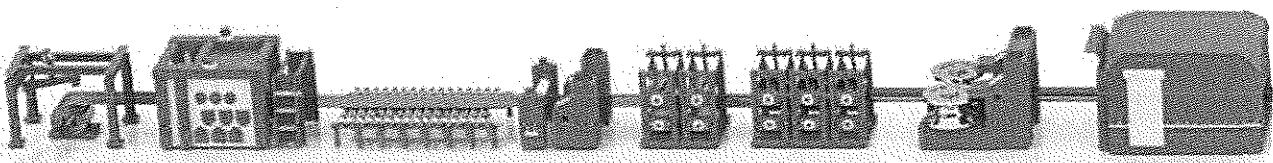
▲ Seam Ultrasonic Test (Off-line)



▲ Full Body Ultrasonic Test (Off-line)

ERW(HFW) Line

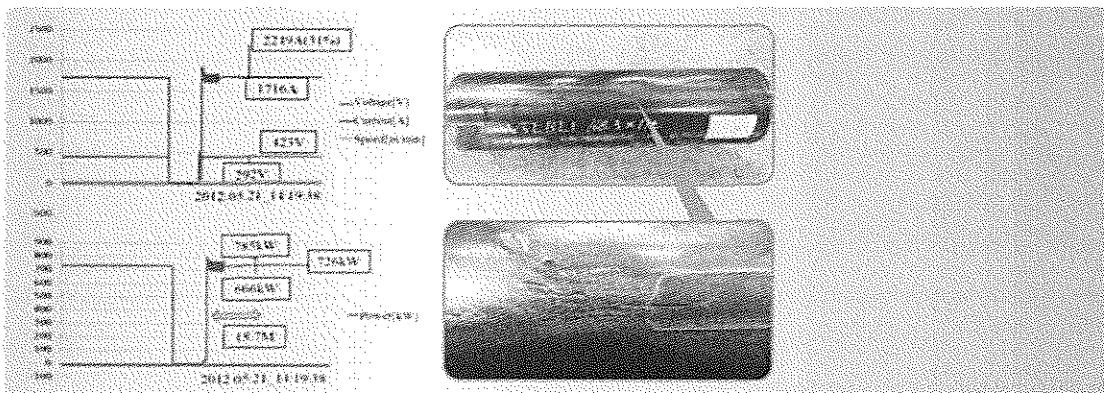
Uncoiling → Leveling → Edge Milling → Forming → Welding → Heat Treatment



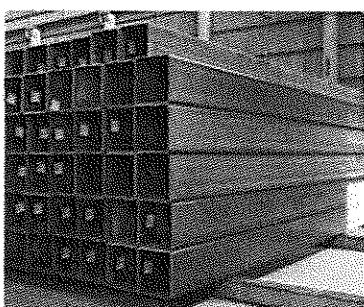


Weld Seam Spark Detecting System

- SeAH is equipped with spark detecting system for high welding quality.
- This system detects excessive sparks and guarantees excellent welding quality by sorting out cold welding and abnormal heat input during welding process.

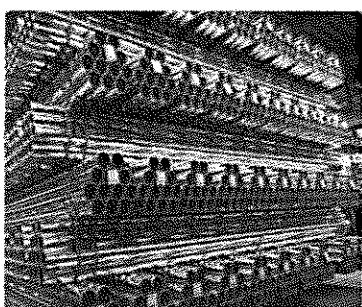


Square Pipe



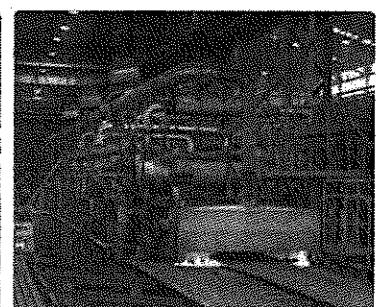
- O.D. : 25mm X 25mm ~ 400mm X 400mm
- Thickness : 1.2mm ~ 14mm
- Length : MAX, 14M

Galvanized Pipe



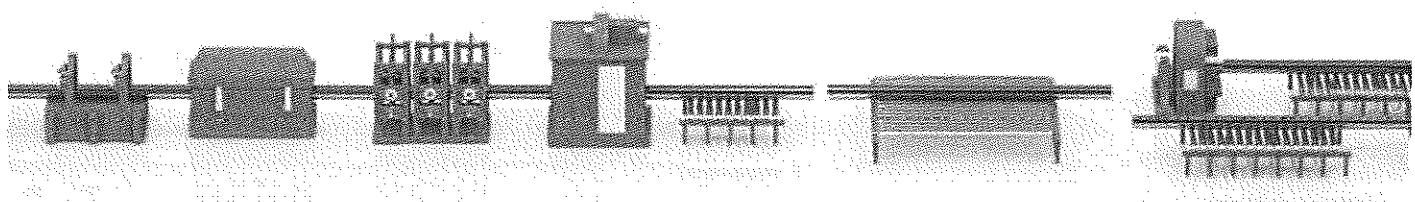
- O.D. : 21.7mm ~ 600.6mm
- Length : MAX, 8M

Heat Exchanger/Boiler Tube



- O.D. : 25.4mm ~ 88.9mm
- Length : MAX, 23M

.....> Cooling > Sizing > Cutting Off > End Facing



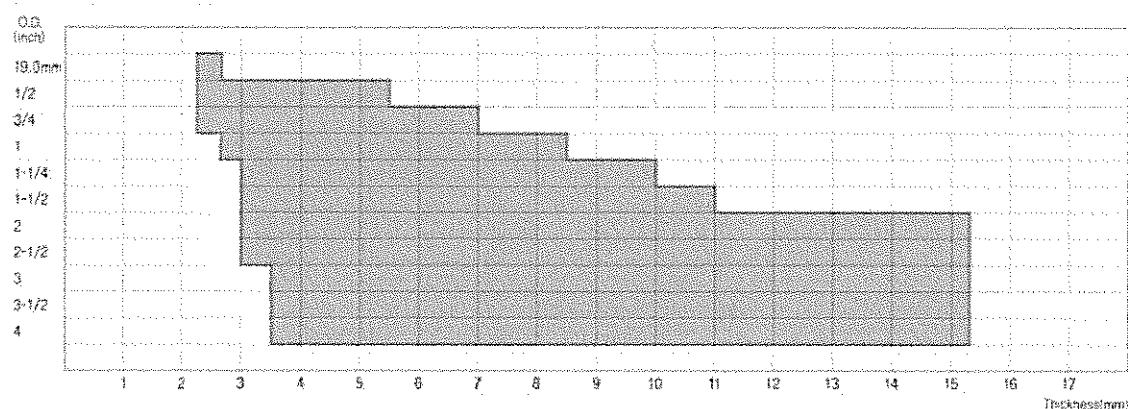


SRM

- The stretch Reducing Mill(S.R.M.) consists of 24 roll stands, each containing 3 rolls; a design that improves internal surface finish, maintains concentricity, and improves dimensional accuracy.
- Each roll stand reduces pipe diameter by approximately 5%, with the final 3 stands providing the finish diameter.
- Also, by controlling longitudinal tension between each stand at the same time, it can also reduce, maintain, or increase wall thickness, resulting in a wide variety of diameters & wall combinations to meet the customer specifications.
- O.D. : 1/2" ~ 4" • WT : 2.2mm ~ 15.2mm • LENGTH : MAX. 12.8M

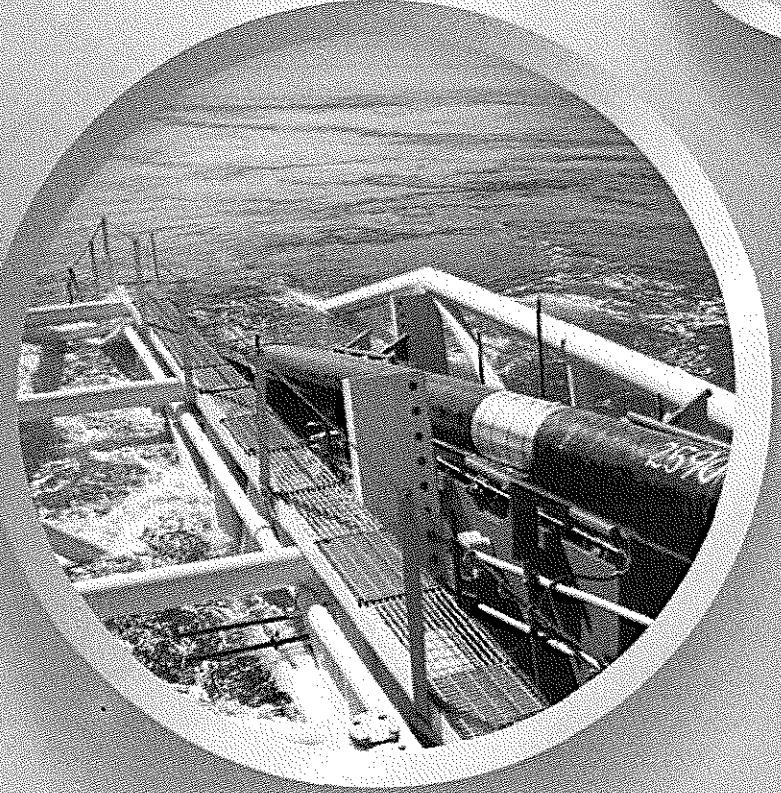


SRM SIZE RANGE



Hydrostatic Test Ultrasonic Test (Seam & Full Body) Mill Coating Dimension / Visual Inspection / Packing





SAW

Submerged Arc Welding

SěAH Steel



SeAH Steel

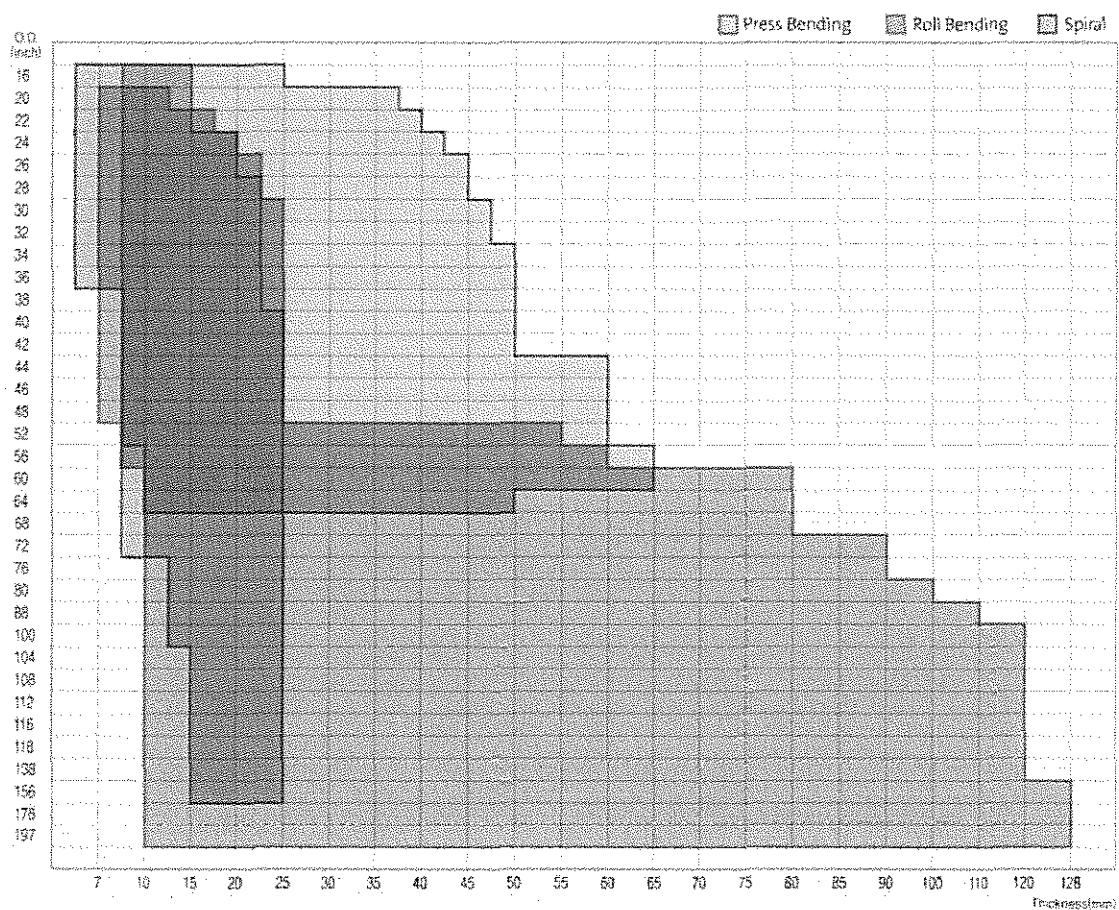
● Contact: SeAH Tower, 45 Yanghwa, Mapo-gu, Seoul 121-841, Korea / TEL +82-2-0970-1082, 1073 / E-mail: export@seahsteel.co.kr / www.seahsteel.com

www.seahsteel.com
SeAH Steel
Manufacturing
Engineering
Construction
Services

SeAH Steel

SAW SIZE RANGE

Product	Size Range			Capacity	Location
	O.D.(inch)	Thickness(mm)	Length (m)		
SeAH Steel Corporation	JCOE	16 ~ 64	Max. 65	Max. 18,288	
	Roll Bending	20 ~ 197	Max. 128	Max. 12.2	575,000MT Korea
	Spiral	16 ~ 158	Max. 25.4	Max. 70	
United Spiral Pipe	Spiral	24 ~ 64	Max. 25.4	Max. 24.4	270,000MT USA
SeAH Steel U.A.E.	JCOE	18 ~ 56	Max. 60	Max. 12.8	
	Roll Bending	40 ~ 120	Max. 50	Max. 12	150,000MT UAE



Explore Further, Deeper & Wider!

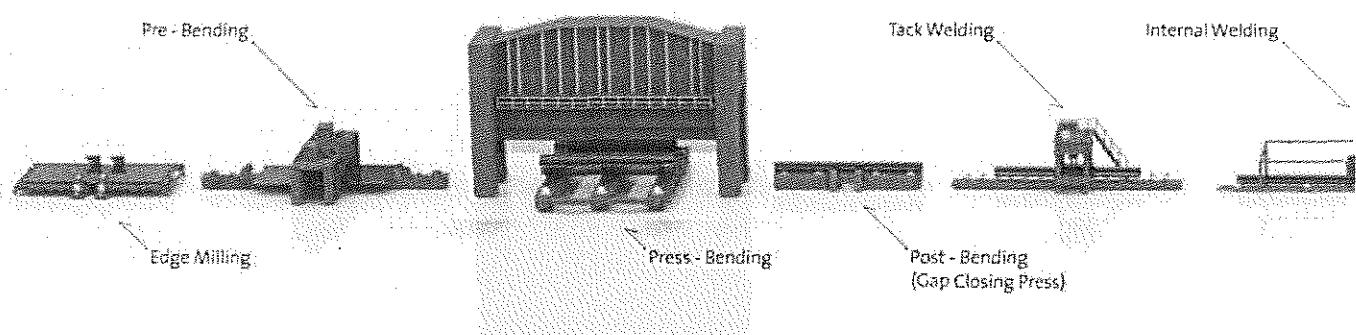
- Max. 18m Length with Cold Expander (JCOE)
- Max. 128mm WT. (Roll Bending)
- Max. 158° O.D. (Spiral)
- Make your step profitable

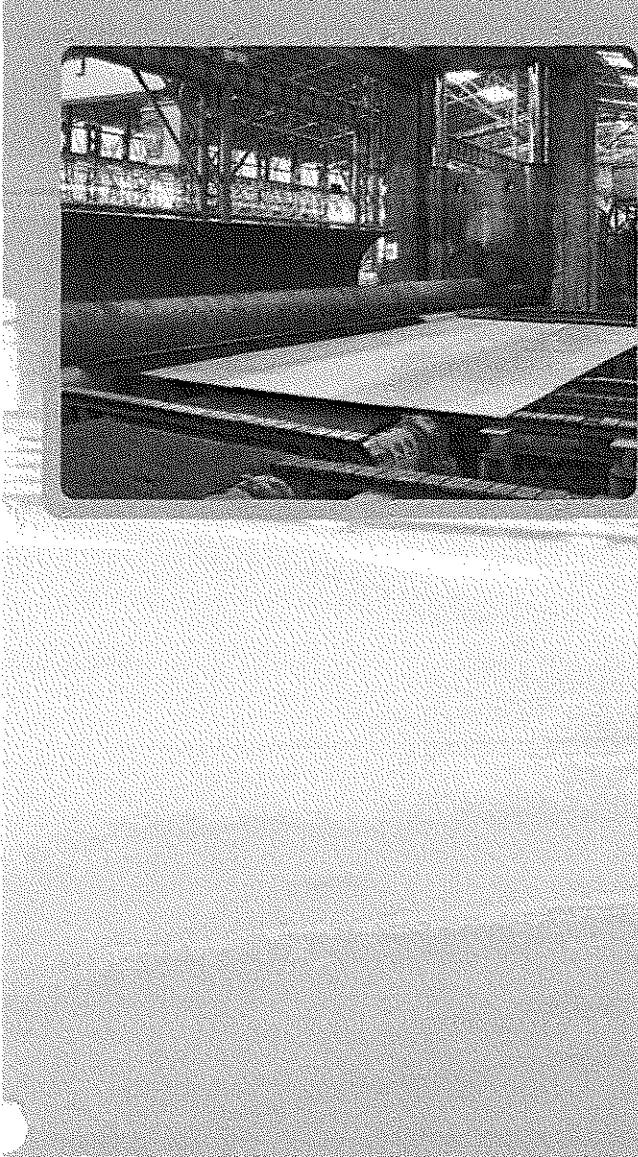
JCOE

- Outside Diameter 18" ~ 64"
- Wall Thickness max. 65mm
- Length max. 18m
- Grade max. X80



JCOE Line





Having Satisfactory Solution

Variety of Production Type (JCOE, Roll Bending & Spiral)

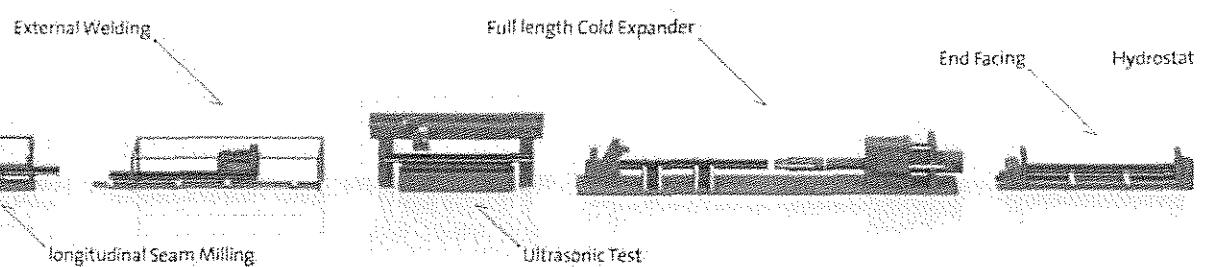
995,000 MT SAW Capacity Per Annum including SSU, USP

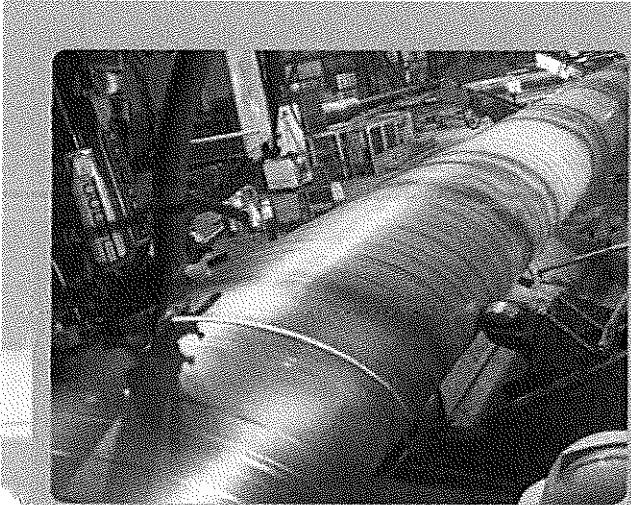
1,170,000 MT Additional ERW Capacity

Go beyond your limit with diverse options

ROLL BENDING

- Outside Diameter 20" ~ 197"
- Wall Thickness max. 128mm
- Length max. 12.2m
- Grade max. X80



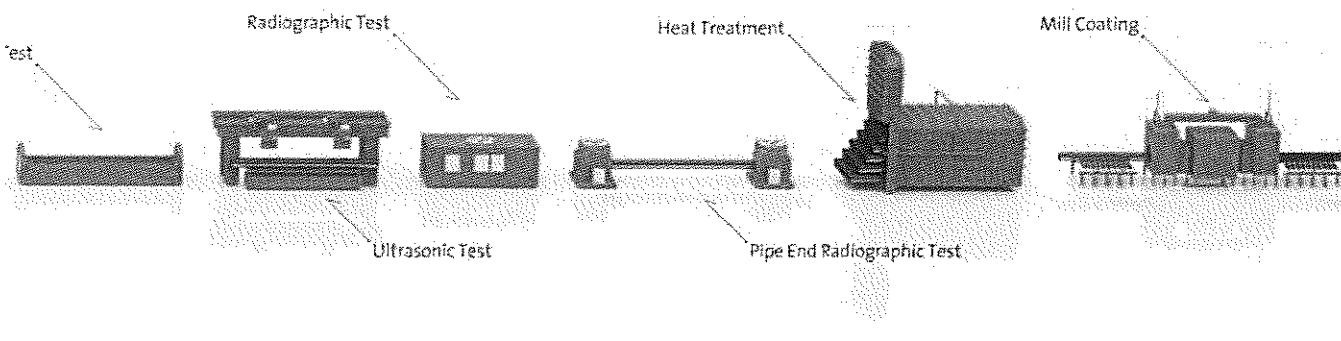


With Reliability

- Over 50 years of history
- Own R&D center for high-end technology
- High Quality Assurance System
- For your trust, **SeAH** sells its pride

SPIRAL

- Outside Diameter 16"~158"
- Wall Thickness max. 25.4mm
- Length max. 70m
- Grade max. X80



**HSB REGISTRATION SERVICES
CRITICAL LOCATION**
14F, KCCI BUILDING, 45, NAMDAEMUNRO-4GA,
JUNG-KU, SEOUL, KOREA

Certificate of Registration

This is to certify that:

**SeAH Steel Corporation, Suncheon Plant
Suncheon Plant**

Block 3, Yulchon 1st Industrial Complex Sinseong-ri, Haeryong-myeon,
Suncheon-si, Jeollanam-do, Korea

Head Office

45, Yanghwa-ro, Mapo-gu, Seoul, Korea

Has established and applied an Environmental Management System for:

**Manufacture and Service of Welded Steel Pipes and
Stainless Steel Pipes & Tubes**

Proof has been furnished that the requirements according to

ISO 14001:2004

are fulfilled.

EA Code(s): 17

Certificate Number: CL-K-E-1604

Initial Audit Date: April 05, 2011

Effective Date: April 11, 2011

Expiration Date: April 10, 2014

Revision Date: April 04, 2013



A handwritten signature in black ink that reads "Stephen C. Judd".

Signed on behalf of HSB Registration Services

*This certificate is issued under the accreditation of HSB Registration Services located at
595 East Swedesford Road, Wayne, Pennsylvania, USA.*

**HSB REGISTRATION SERVICES
CRITICAL LOCATION**
14F, KCCI BUILDING, 45, NAMDAEMUNRO-4GA,
JUNG-KU, SEOUL, KOREA

Certificate of Registration

This is to certify that:

**SeAH Steel Corporation, Suncheon Plant
Suncheon Plant**

Block 3, Yulchon 1st Industrial Complex, Sinseong-ri, Haeryong-myeon,
Suncheon-si, Jeollanam-do, Korea

Head Office

45, Yanghwado-ro, Mapo-gu, Seoul, Korea

Has established and applied a Quality Management System for:

**Manufacture and Service of Welded Steel Pipes and
Stainless Steel Pipes & Tubes**

*Proof has been furnished that the requirements according to
ISO 9001:2008
are fulfilled.*

EA Code(s): 17

Certificate Number: CL-K-Q-1604

Original Certification Date: November 01, 2010

Transfer of Certification: March 22, 2012

Expiration Date: November 01, 2013

Revision Date: April 04, 2013



Stephen C. Jost
Signed on behalf of HSB Registration Services

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