SoluForce®

Product data sheet

SOLUFORCE® Long Length Reinforced Thermoplastic Pipe (LLRTP)

REPORT NR	**SOL201606081**
REVISION	V7
DATE	01-05-2017

REPORT TITLE **Product Data SheetProduct data sheet**

REPORT NR **SOL201606081**

Revision record

DATE	REVISION	ORIGINATED	APPROVED
08-06-2016	0	P.J. Cloos	L.G.P. Dalmolen
19-10-2016	1	P.J. Cloos	L.G.P. Dalmolen
14-12-2016	2	P.J. Cloos	L.G.P. Dalmolen
20-12-2016	3	P.J. Cloos	L.G.P. Dalmolen
05-01-2017	4	P.J. Cloos	L.G.P. Dalmolen
09-01-2017	5	P.J. Cloos	L.G.P. Dalmolen
13-04-2017	6	P.J. Cloos	L.G.P. Dalmolen
01-05-2017	6	P.J. Cloos	L.G.P. Dalmolen

REVISION	DESCRIPTION
1	Textual changes
2	Textual changes
3	Textual changes
4	Recalculation of MAOP Gas application for ST types
5	HT class recalculation
6	Specification update
7	Textual changes

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1 Introduction

1.1 The Soluforce system

SoluForce provides a complete system consisting of pipes and fitting system.

SoluForce pipe systems come in Classic, Light and Heavy versions. SoluForce Classic is designed for medium to high-pressure fluid transportation and is fully resistant to all hydrocarbons and chemicals involved in water injection as well as in extreme sour applications.

SoluForce Light shares the same properties but is designed for low to medium-pressure operations. SoluForce Heavy is specially developed for very high pressure (saline) water injection and provides an excellent, flexible solution for high-pressure water transportation.
In addition to our conventional high performance pipes, we now also offer Gas Tight (GT) versions of SoluForce Classic and High Temperature versions (HT) of SoluForce Heavy. These special extensions to our portfolio are new to our programme.

Soluforce pipe systems include a full fitting solution that is specially designed for the various different SoluForce pipes. For the light and Classic pipe systems, a non-metallic electrofusion connection system id available. For the Heavy pipe system, we offer a non-metallic single swage and a high performance double swage connection system.

This document lists the general data sheets of the SoluForce pipe system products.

In case of questions or missing information, please contact SoluForce in the Netherlands.

1.2 Standards

The SoluForce pipe system complies with the following standards:

Table 1: Applicable standards

APPLICATION	STANDARD	SOLUFPRCE TYPE	DESCRIPTION
Oil field service	API RP 15S	Light Classic	“Qualification of Spoolable reinforced Plastic Line pipe”
	API 17J	Heavy	“ Specification for unbonded flexible Pipe”
Gas distribution and transport:	ISO TS 18226	Light Classic	“reinforced Thermoplastic Piping Systems for Gaseous fuels”
	DVGW VP 642	Light Classic	“faserverstärkte Pe-rohre (rTP) und zugehörige Verbinder für Gasleitungen mit Betreibsdrücken über 16 Bar”

SoluForce has a proven track record in the oil and gas industry, and has been used since 2000 for different applications, including oil and gas line pipe, water injection pipe, water transportation, and gas distribution and transport.

SoluForce maintains the highest quality levels with regard to the design, manufacturing and testing of their products, according to, or exceeding the requirements in international standards.

1.3 Qualification and Certification

The design, testing and qualification of SoluForce is verified according to the applicable standards by ISO accredited independent institutes (table 2)

Table 2: Applicable standards

APPLICATION	ACCREDITED INDEPENDENT INSTITUTES
for oilfield applications:	"Det Norske Veritas" (DNV) and "Bureau Veritas" (BV)
for gas distribution and transport:	RWTÜV.

1.4 Materials

The Soluforce pipes are build up in several layers of different materials.

Table 3: Materials used in the Soluforce pipes

APPLICATION	CLASSIC	HEAVY
Liner		
ST	HDPE type PE100, black	HDPE type PE100, black
HT	n/a	Pipeforte 10
PA	n/a	Polyamid type PA12
Anti-permeation layer GT	20µm Alu foil	20µm Alu foil
Reinforcing tape matrix	HDPE type PE80, yellow	HDPE type PE80, yellow
Reinforcement	Aramid fibre	Zink coated High strength Steel wires
Cover	HDPE type PE100, UV stabilised, white	HDPE type PE100, UV stabilised, white

2 Soluforce pipe system

2.1 Build-up of a Soluforce pipe GT version

1. Fluid-tight , corrosion resistant HDPE liner
2. Aluminium gas tight layer
3. High tensile wire or synthetic fibre reinforcement for strength
4. Ambient resistant white HDPE cover, fully desert climate proof, to protect from UV, abrasion and solar heating

2.2 Build-up of a Soluforce pipe ST, HT and PA version

1. Fluid-tight , corrosion resistant liner
2. High tensile wire or synthetic fibre reinforcement for strength
3. Ambient resistant white HDPE cover, fully desert climate proof, to protect from UV, abrasion and solar heating

3 Pipe data sheets Soluforce Heavy, zinc coated steel wire reinforced

3.1 Soluforce Heavy type description

H415 = prefix for Soluforce Heavy 4” size

H515 = prefix for Soluforce Heavy 6ND size

ST = standard pipe design (PE100 liner, Reinforcement, UV stabilized white cover)

GT = standard design plus and extra gas tight layer between the liner and the reinforcement

HT = standard design but with additives to the PE liner for high temperature resistance

PA = as standard design, however the liner is made of Polyamide 12

3.2 Sour service conditions for SoluForce heavy

Table 4: Sour service conditions Heavy non GT

SOUR SERVICE	UNIT	MAXIMUM ALLOWED CONDITION
H_2S in medium partial pressure	[bar]	0.3
	[psi]	4.5
CO_2 in medium partial pressure	[bar]	10
	[psi]	150

Table 5: Sour service conditions Heavy GT

SOUR SERVICE	UNIT	MAXIMUM ALLOWED CONDITION
H_2S in medium partial pressure	[bar]	10
	[psi]	150
CO_2 in medium partial pressure	[bar]	10
	[psi]	150

3.3 Soluforce Heavy types in 4” size (metric)

Table 6: Heavy 4” specifications (metric) (according to API 17J – 2014)

Soluforce® pipe type		**H415**			
		ST	**GT**	**PA**	**HT**
Identification print colour		red	black	black	grey
Internal diameter	[mm]	98	98	98	98
Exterior diameter	[mm]	127	127	127	127
Design temperature	[°C]	85	85	85	105
MAOT	[°C]	65	65	65	85
Minimum bursting pressure (20°C)	[Bar]	>450	>450	>450	>450
Minimum bursting pressure (85°C)	[Bar]	n.a	n.a	n.a	>410
Bursting pressure 90% UTS (20°C)	[Bar]	405	405	405	405
Bursting pressure 90% UTS (85°C)	[Bar]	n.a	n.a	n.a	370
Design pressure API 17J-2014	[Bar]	344	344	344	344
MAOP water T<65°C	[Bar]	272	272	272	272
MAOP water 65<T<85°C	[Bar]	n.a	n.a	n.a	247
MAOP sweet hydrocarbon non corrosive T<65°C (NACE MR 0175)(BV)	[Bar]	206	206	206	206
MAOP sweet hydrocarbons non corrosive 65<T<85°C (NACE MR 0175)	[Bar]	n.a	n.a	n.a	199
MAOP sour hydrocarbons corrosive T<65°C (NACE MR 0175)	[Bar]	150	150	150	150
MAOP sour hydrocarbons corrosive 65<T<85°C (NACE MR 0175)	[Bar]	n.a.	n.a	n.a	150
MAOP gas T<65°C	[Bar]	27	206	150	27
MAOP gas 65<T<85°C	[Bar]	n.a.	n.a	n.a	24
Max. Hydrostatic test pressure (ambient)	[Bar]	335	335	335	335
Design life time (surface installed)	[yrs]	20	20	20	20
Design life time (buried)	[yrs]	50	50	50	50
MBR in storage	[m]	1.25	1.25	1.25	1.25
MBR in service	[m]	3	3	3	3
Max. axial load during installation	[kN]	34	34	34	34
Pipe length on coil	[m]	220	220	220	220
Coil package dimensions (l x h x w)	[m]	4.0x4.2x1.15	4.0x4.2x1.15	4.0x4.2x1.15	4.0x4.2x1.15
Coil package weight	[kg]	1940	1940	1940	1940

3.4 Soluforce Heavy types in 4” size (imperial)

Table 7: Heavy 4” specifications (Imperial) (according to API 17J – 2014)

Soluforce® pipe type		**H415**			
		ST	**GT**	**PA**	**HT**
Identification print colour		red	black	black	grey
Internal diameter	[inch]	3.86	3.86	3.86	3.86
Exterior diameter	[inch]	5.0	5.0	5.0	5.0
Design temperature	[°F]	185	185	185	221
MAOT	[°F]	150	150	150	185
Minimum bursting pressure (68°F)	[psi]	>6527	>6527	>6527	>6527
Minimum bursting pressure (185°F)	[psi]	n.a	n.a	n.a	>5947
Bursting pressure 90% UTS (68°F)	[psi]	5874	5874	5874	5874
Bursting pressure 90% UTS (185°F)	[psi]	n.a	n.a	n.a	5366
Design pressure API 17J-2014	[psi]	4989	4989	4989	4989
MAOP water T<150°F	[psi]	3950	3950	3950	3950
MAOP water 150<T<185°F	[psi]	n.a	n.a	n.a	3580
MAOP sweet hydrocarbon non corrosive T<150°F (NACE MR 0175)	[psi]	3190	3190	3190	3190
MAOP sweet hydrocarbons non corrosive 150<T<185°F (NACE MR 0175)	[psi]	n.a	n.a	n.a	2886
MAOP sour hydrocarbons corrosive T<150°F (NACE MR 0175)	[psi]	2250	2250	2250	2250
MAOP sour hydrocarbons corrosive 150<T<185°F (NACE MR 0175)	[psi]	n.a.	n.a	n.a	2250
MAOP gas T<150°F	[psi]	392	3190	2250	392
MAOP gas 65<T<185°F	[psi]	n.a.	n.a	n.a	348
Max. Hydrostatic test pressure (ambient)	[psi]	4860	4860	4860	4860
Design life time (surface installed)	[yrs]	20	20	20	20
Design life time (buried)	[yrs]	50	50	50	50
MBR in storage	[ft]	4	4	4	4
MBR in service	[ft]	10	10	10	10
Max. axial load during installation	[lb]	7640	7640	7640	7640
Pipe length on coil	[ft]	722	722	722	722
Coil package dimensions (l x h x w)	[ft]	13.1x13.8x3.8	13.1x13.8x3.8	13.1x13.8x3.8	13.1x13.8x3.8
Coil package weight	[lbs]	4277	4277	4277	4277

3.5 Soluforce Heavy types in 6ND size (metric)

Table 8: Heavy 6ND specifications (metric) (according to API 17J – 2014)

Soluforce® pipe type		**H515**			
		ST	**GT**	**PA**	**HT**
Identification print colour		red	black	black	grey
Internal diameter	[mm]	122	122	122	122
Exterior diameter	[mm]	152	152	152	152
Design temperature	[°C]	85	85	85	105
MAOT	[°C]	65	65	65	85
Minimum bursting pressure (20°C)	[Bar]	>380	>380	>380	>380
Minimum bursting pressure (85°C)	[Bar]	n.a	n.a	n.a	>330
Bursting pressure 90% UTS (20°C)	[Bar]	342	342	342	342
Bursting pressure 90% UTS (85°C)	[Bar]	n.a	n.a	n.a	297
Design pressure API 17J-2014	[Bar]	291	291	291	291
MAOP water T<65°C	[Bar]	229	229	229	229
MAOP water 65<T<85°C	[Bar]	n.a	n.a	n.a	208
MAOP sweet hydrocarbons non corrosive T<65°C (NACE MR 0175)	[Bar]	206	206	206	206
MAOP sweet hydrocarbons non corrosive 65<T<85°C (NACE MR 0175)	[Bar]	n.a	n.a	n.a	199
MAOP sour hydrocarbons corrosive T<65°C (NACE MR 0175)	[Bar]	150	206	150	150
MAOP sour hydrocarbons corrosive 65<T<85°C (NACE MR 0175)	[Bar]	n.a.	n.a	n.a	150
MAOP gas T<65°C	[Bar]	27	206	150	27
MAOP gas 65<T<85°C	[Bar]	n.a.	n.a	n.a	24
Max. Hydrostatic test pressure (ambient)	[Bar]	311	311	311	311
Design life time (surface installed)	[yrs]	20	20	20	20
Design life time (buried)	[yrs]	50	50	50	50
MBR in storage	[m]	1.3	1.3	1.3	1.3
MBR in service	[m]	3	3	3	3
Max. axial load during installation	[kN]	42	42	42	42
Pipe length on coil	[m]	220	220	220	220
Coil package dimensions (l x h x w)	[m]	4.0x4.2x1.46	4.0x4.2x1.46	4.0x4.2x1.46	4.0x4.2x1.46
Coil package weight	[kg]	2380	2380	2380	2380

3.6 Soluforce Heavy types in 6ND size (imperial)

Table 9: Heavy 6ND specifications (imperial) (according to API 17J – 2014)

Soluforce® pipe type		**H515**			
		ST	**GT**	**PA**	**HT**
Identification print colour		red	black	black	grey
Internal diameter	[inch]	4.80	4.80	4.80	4.80
Exterior diameter	[inch]	6.0	6.0	6.0	6.0
Design temperature	[°F]	185	185	185	221
MAOT	[°F]	150	150	150	185
Minimum bursting pressure (68°F)	[psi]	>5510	>5510	>5510	>5510
Minimum bursting pressure (185°F)	[psi]	n.a	n.a	n.a	>4785
Bursting pressure 90% UTS (68°F)	[psi]	4960	4960	4960	4960
Bursting pressure 90% UTS (185°F)	[psi]	n.a	n.a	n.a	4305
Design pressure API 17J-2014	[psi]	4220	4220	4220	4220
MAOP water T<150°F	[psi]	3320	3320	3320	3320
MAOP water 150<T<185°F	[psi]	n.a	n.a	n.a	3016
MAOP sweet hydrocarbons non corrosive T<150°F (NACE MR 0175)	[psi]	3060	3060	3060	3060
MAOP sweet hydrocarbons non corrosive 150<T<185°F (NACE MR 0175)	[psi]	n.a	n.a	n.a	2886
MAOP sour hydrocarbons corrosive T<185°F (NACE MR 0175)	[psi]	2250	3060	2250	2250
MAOP sour hydrocarbons corrosive 150<T<185°F (NACE MR 0175)	[psi]	n.a.	n.a	n.a	2250
MAOP gas T<150°F	[psi]	392	3060	2250	392
MAOP gas 150<T<185°F	[psi]	n.a.	n.a	n.a	348
Max. Hydrostatic test pressure (ambient)	[psi]	4510	4510	4510	4510
Design life time (surface installed)	[yrs]	20	20	20	20
Design life time (buried)	[yrs]	50	50	50	50
MBR in storage	[ft]	4.2	4.2	4.2	4.2
MBR in service	[ft]	10	10	10	10
Max. axial load during installation	[lbs]	9440	9440	9440	9440
Pipe length on coil	[ft]	722	722	722	722
Coil package dimensions (l x h x w)	[ft]	13.1x13.8x4.8	13.1x13.8x4.8	13.1x13.8x4.8	13.1x13.8x4.8
Coil package weight	[lbs]	5247	5247	5247	5247

4 Pipe data sheets Classic, aramid fibre reinforced

4.1 Soluforce Classic type description

L450 = prefix for Soluforce Light 4” size

L540 = prefix for Soluforce Light 6ND size

M480 = prefix for Soluforce Classic 4” size

M570 = prefix for Soluforce Classic 6ND size

ST = standard pipe design (PE100 liner, Reinforcement, UV stabilized white cover

GT = standard design plus and extra gas tight layer between the liner and the reinforcement

4.2 Sour service conditions for SolufForce Classic

Table 10: Sour service conditions Classic

SOUR SERVICE	UNIT	MAXIMUM ALLOWED CONDITION
H_2S in medium partial pressure	[bar] / [psi]	Max. specified gas pressure
CO_2 in medium partial pressure	[bar] / [psi]	Max. specified gas pressure

4.3 Soluforce Light and Classic types in 4” size (metric)

Table 11: Light and Classic 4” specifications (metric)

Soluforce® pipe type		**L450**	**M480**	
		ST	**ST**	**GT**
Identification print colour		blue	green	black
Internal diameter	[mm]	98	98	98
Exterior diameter	[mm]	125	125	125
Design temperature	[°C]	85	85	85
MAOT	[°C]	65	65	65
Minimum bursting pressure	[Bar]	144	360	360
Design pressure LCL_{LTHP} characteristic pressure (API 15S)	[Bar]	45	113	113
MAOP water service (>98%) (DNV)	[Bar]	36	90	90
MAOP any hydrocarbons (>2%) (DNV)	[Bar]	26	65	65
MAOP gas T<65°C (ASTM D2992)	[Bar]	26	27	65
Max. Hydrotest pressure (ambient)	[Bar]	54	135	135
Design life time (surface installed)	[yrs]	20	20	20
Design life time (buried)	[yrs]	50	50	50
MBR in storage	[m]	1.25	1.25	1.25
MBR in service	[m]	3	3	3
Max. axial load during installation	[kN]	34	34	34
Pipe length on coil	[m]	400	400	400
Coil package dimensions (l x h x w)	[m]	4.0x4.2x1.15	4.0x4.2x1.15	4.0x4.2x1.15
Coil package weight	[kg]	2200	2240	2240

4.4 Soluforce Light and Classic types in 4” size (imperial)

Table 12: Light and Classic 4” specifications (imperial)

Soluforce® pipe type		**L450**	**M480**	
		ST	**ST**	**GT**
Identification print colour		blue	green	black
Internal diameter	[inch]	3.86	3.86	3.86
Exterior diameter	[inch]	5.0	5.0	5.0
Design temperature	[°F]	185	185	185
MAOT	[°F]	150	150	150
Minimum bursting pressure	[psi]	2090	5220	5220
Design pressure LCL_{LTHP} characteristic pressure (API 15S)	[psi]	650	1640	1640
MAOP water service (>98%) (DNV)	[psi]	522	1305	1305
MAOP any hydrocarbons (>2%) (DNV)	[psi]	377	940	940
MAOP gas T<150°F (ASTM D2992)	[psi]	377	392	940
Max. Hydrotest pressure (ambient)	[psi]	783	1960	1960
Design life time (surface installed)	[yrs]	20	20	20
Design life time (buried)	[yrs]	50	50	50
MBR in storage	[ft]	4	4	4
MBR in service	[ft]	10	10	10
Max. axial load during installation	[lb]	7640	7640	7640
Pipe length on coil	[ft]	1312	1312	1312
Coil package dimensions (l x h x w)	[ft]	13.1x13.8x3.8	13.1x13.8x3.8	13.1x13.8x3.8
Coil package weight	[lbs]	4846	4933	4933

4.5 Soluforce Light and Classic types in 6ND size (metric)

Table 13: Light and Classic 6ND specifications (metric)

Soluforce® pipe type		**L540**	**M570**	
		ST	**ST**	**GT**
Identification print colour		blue	green	black
Internal diameter	[mm]	120	120	120
Exterior diameter	[mm]	149	149	149
Design temperature	[°C]	85	85	85
MAOT	[°C]	65	65	65
Minimum bursting pressure	[Bar]	115	270	270
Design pressure LCL_{LTHP} characteristic pressure (API 15S)	[Bar]	36	90	90
MAOP water service (>98%) (DNV)	[Bar]	29	72	72
MAOP any hydrocarbons (>2%) (DNV)	[Bar]	21	52	52
MAOP gas T<65°C (ASTM D2992)	[Bar]	21	27	52
Max. Hydrotest pressure (ambient)	[Bar]	44	113	113
Design life time (surface installed)	[yrs]	20	20	20
Design life time (buried)	[yrs]	50	50	50
MBR in storage	[m]	1.3	1.3	1.3
MBR in service	[m]	3	3	3
Max. axial load during installation	[kN]	42	42	42
Pipe length on coil	[m]	400	400	400
Coil package dimensions (l x h x w)	[m]	4.0x4.2x1.46	4.0x4.2x1.46	4.0x4.2x1.46
Coil package weight	[kg]	2720	2760	2760

4.6 Soluforce Light and Classic types in 6ND size (imperial)

Table 14: Light and Classic 6ND specifications (imperial)

Soluforce® pipe type		**L540**	**M570**	
		ST	**ST**	**GT**
Identification print colour		blue	green	black
Internal diameter	[inch]	4.72	4.72	4.72
Exterior diameter	[inch]	6	6	6
Design temperature	[°F]	85	85	85
MAOT	[°F]	65	65	65
Minimum bursting pressure	[psi]	1668	3920	3920
Design pressure LCL_{LTHP} characteristic pressure (API 15S)	[psi]	520	1305	1305
MAOP water service (>98%)(DNV)	[psi]	420	1044	1044
MAOP any hydrocarbons (>2%)(DNV)	[psi]	305	755	755
MAOP gas T<150°F (ASTM D2992)	[psi]	305	392	755
Max. Hydrotest pressure (ambient)	[psi]	640	1640	1640
Design life time (surface installed)	[yrs]	20	20	20
Design life time (buried)	[yrs]	50	50	50
MBR in storage	[ft]	4.2	4.2	4.2
MBR in service	[ft]	10	10	10
Max. axial load during installation	[lb]	9440	9440	9440
Pipe length on coil	[ft]	1312	1312	1312
Coil package dimensions (l x h x w)	[ft]	13.1x13.8x4.8	13.1x13.8x4.8	13.1x13.8x4.8
Coil package weight	[lbs]	5991	6079	6079

5 Extra engineering data

5.1 SoluForce pipe specific data

Table 15: SoluForce specific data

ITEM	UNIT	VALUE	UNIT	VALUE
Flow				
Hazen Williams friction factor (C)	[-]	150		
Darcy Weisbach surface roughness (e)	[mm]	0.0015	[ft]	$5\ 10^{-6}$
Bending stiffness (E.I)				
(long term) Soluforce 4”	[Nm²]	1415		
(Short term)	[Nm²]	7075		
(long term) Soluforce 6ND	[Nm²]	2573		
(Short term)	[Nm²]	12866		
Thermal expansion				
No pressure	[m/m/°C]	$1.4\ 10^{-4}$	[ft/ft/°F]	$7.7\ 10^{-5}$
Under pressure	[m/m/°C]	$9.3\ 10^{-5}$	[ft/ft/°F]	$5.2\ 10^{-5}$
Expansion under pressure (hydrotest)				
Axial	[m/m]	0.0001	[ft/ft]	0.0001
Diameter Light & Classic	[%]	2.5	[%]	2.5
Diameter heavy	[%]	1.0	[%]	1.0
Electrical properties				
Volume resistance	[Ω m]	$6\ 10^{7}$	[Ω ft]	$3.0\ 10^{6}$
Dielectric constant	[Hz]	$2.2\ 10^{7}$		
Thermal conductivity	[W/m/°C]	0.49	[W/ft/°F]	$8.3\ 10^{-2}$

6 Soluforce fitting system

6.1 Soluforce fitting system overview

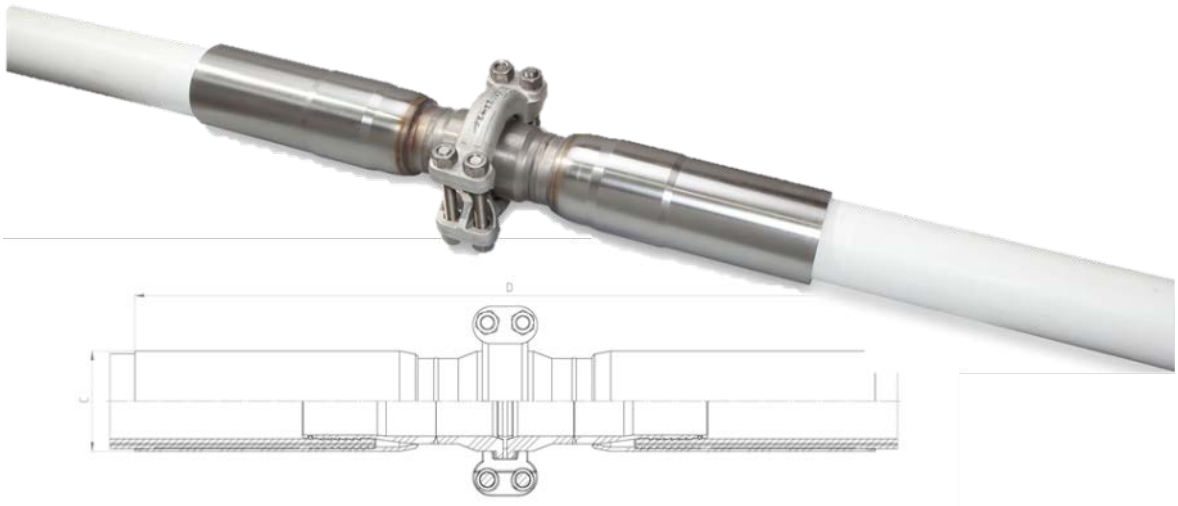
Table 16: Soluforce fitting system matrix

Soluforce® pipe type		**Soluforce fitting systems**		
		Double swage	**Electro fusion[1]**	**Single Swage[2]**
Soluforce Light (L450; L540)	ST & GT	-	√	-
Soluforce Classic (M480;M570)	ST & GT	-	√	-
Soluforce Heavy (H415; H515)	ST & GT	√	√	√
Soluforce Heavy (H415; H515)	PA	√	-	To be tested
Soluforce Heavy (H415; H515)	HT	√	-	To be tested
1	For electro fusion the maximum pressure rating is 125 bar / 1812 psi, end-fittings only ;			
2	Single swage system presently maximum pressure rating 150 bar / 2250 psi.			

6.2 Soluforce double swage fitting system

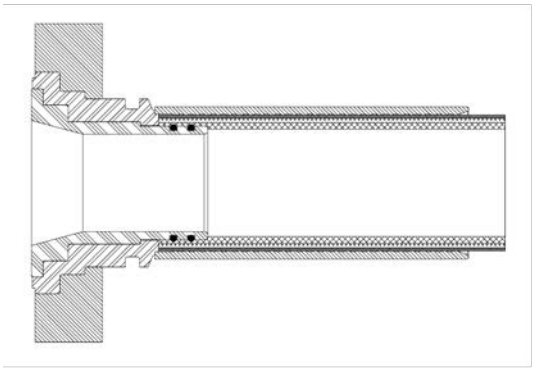
Schematically overview double swage fitting with weld stub and grayloc

Schematically overview double swage fitting grayloc connection

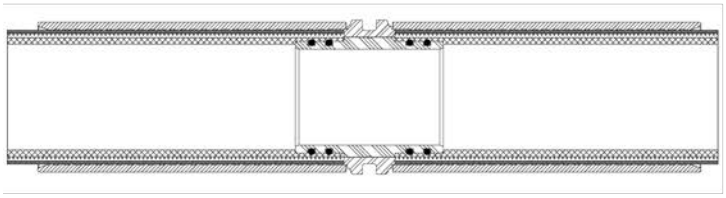


6.3 Soluforce single swage fitting system

Schematically overview single swage flanged end-fitting

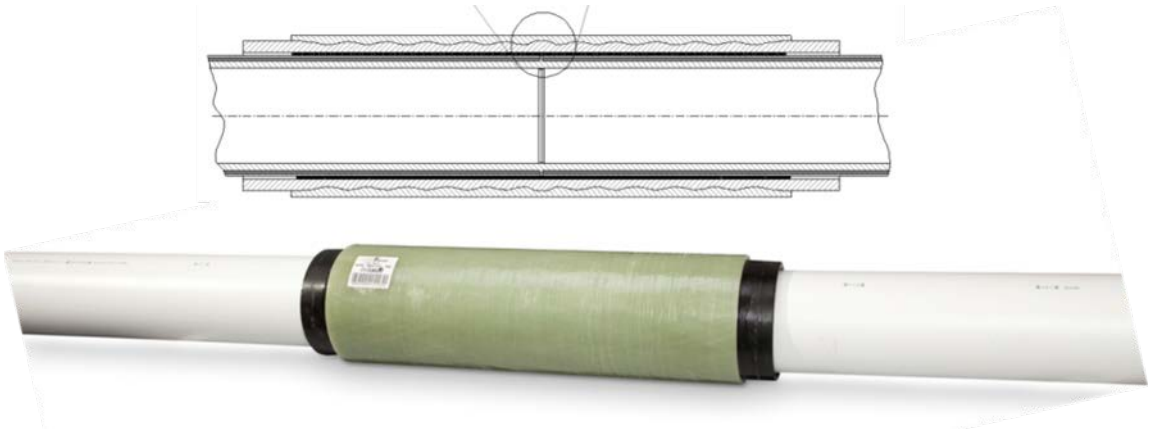


Schematically overview single swage mid line coupler

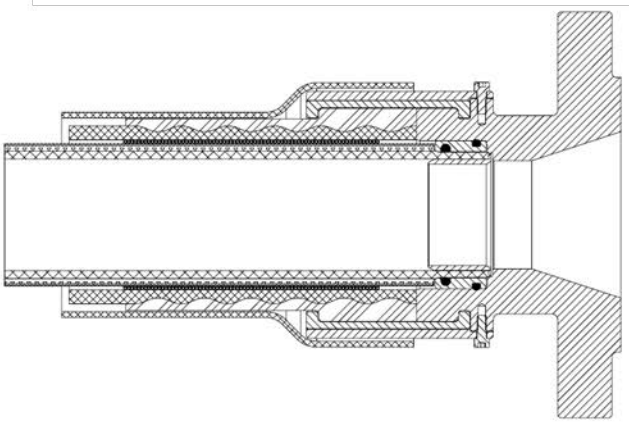


6.4 Soluforce electro fusion fitting system

Schematically overview electro fusion coupler



Schematically overview electro fusion flanged end-fitting for hook-up



DATE 09-01-2017

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