Industry
Design & Installation

Plan, Build, Operate

Planning Fundamentals

Industrial Piping Systems

Part 1

Disclaimer

The technical data are not binding. They neither constitute expressly warranted characteri

T U J D T O P S H V B S B O U F F E Q S P Q F S U J F T O P S B H V B S B O U F F E E V S B C J M J U Z 5 I F Z B S F

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Planning Fundamentals

Industrial Piping Systems

Part 1

+GF+

Planning Fundamentals

Industrial Piping Systems – Part 1

Part 1

How to use

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II Piping Solutions of GF Piping Systems

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Preface

('{1JQJOH 4ZTUFNT JT B NBKPS HMPCBM QSPWJEFS PG DPNQMFUF QJQJOH TPMVU
ding applications in various market segments. Founded in 1802, Georg Fischer started the
ÌSTU QSPEVDUJPO PG NBMMFBCMF JSPO ÌUUJOHT JO BOE UPEBZ JT SFDPHOJ[
development of corrosion-free plastic piping systems for the safe and reliable conveyance of
MJRVJET BOE HBTFT 5IJT UFDIOJDBM IBOECPPL SFÍFDUT NPSF UIBO ZFBST PG
know-how in the designing and manufacturing of plastic piping systems. Today, our product portfolio consists of more than 60'000 products and we are supporting our customers with products and services day to day around the globe.

5IF TDPQF PG UIFTF QMBOOJOH GVOEBNFOUBMT JT UP PËFS B WBMVBCMF TVQQP
of the proper materials and the most suitable product range for all main industrial applica
tions. In addition, the handbook provides extensive information about all jointing technologies
GPS QMBTUJD NBUFSJBMT BOE HJWFT UFDIOJDBM BEWJTFT JO UIF JOTUBMMBUJP
measurements and control, as well as actuation.

We strongly believe that the professional planning and the proper use of our comprehensive product range are the base for reliability, safety and high quality of plastic piping systems.

8F IPQF UIBU JO UIJT IBOECPPL ZPV XJMM ÌOE UIF RVBMJÌFE TVQQPSU UIBU ZPV
work.

In case of special applications our worldwide technical engineers will be glad to assist you.

8F XPVME MJLF UP UIBOL FWFSZPOF XIP DPOUJOVFT UP TVQQPSU ('{1JQJOH 4ZTU
to delivering more value to customers, through superior piping systems.

4DIBËIBVTFO

How to Use

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1 How to use

This handbook describes and explains the basic fundamentals for planning, product selection, processing and installation of pressure pipe in industrial applications.

It is suitable as a reference book as well as documents for training and education or to TVQQPSU UIF DPOTVMUBUJPO "MM TQFDJÌDBUJPOT BSF CBTFE PO UIF SFMFWBOU TUBOEBSET PO WBSJPVT OBUJPOBM TUBOEBSET %74 HVJEFMJOFT BOE BEEJUJPO SBX NBUFSJBM TVQQMJFST *O BEEJUJPO UIF SFTVMUT PG FYUFOTJWF JOUFSOBI JODPSQPSBUFE 5IVT UIF EFTJHOFS FOHJOFFS BOE JOTUBMMFS TIPVME CF HJWF assistance to properly plan and install their plastic piping system.

4FMFDUJPO BOE XFJHIUJOH PG UIF UPQJDT BSF GPDVTFE PO UIF FYQMBOBUJPO P BSFBT %FUBJMFE JOTUSVDUJPOT PG UIF QSPEVDUT BSF UP CF UBLFO GSPN UIF installation and operating instructions.

1MBOOJOH GVOEBNFOUBMT GPS VUJMJUZ BOE CVJMEJOH UFDIOPMPHZ TZTUFNT B IBOECPPLT 'PS GVSUIFS JOGPSNBUJPO QMFBTF DPOUBDU ZPVS MPDBM DPVOUSZ to: www.gfps.com

Overview of symbols

General symbols			
	General information		/ P U F
	& Y B N Q M F		0 O M J O F D B M D V M B U J P O U P P M T B O E mobile applications

Symbols of materials			
	Abrasion resistance		Application limits
	$ P N C V T U J P O C F I B W J P S		Mechanical characteristics
	Chemical resistance		Physiological properties
	High-purity properties		6 7 B O E X F B U I F S S F T J T U B O D F
	Application limits		

2 List of abbreviations

Abbrevia-tions	Description
BGA	German health authority
#H77	'FEFSBM *OTUJUVUF GPS $POTVNFS IFBMUI QSPUFDUJPO BOE WFUFSJOBS
%*#U	German Institute for construction technology
%7(8	(FSNBO BTTPDJBUJPO PG HBT BOE XBUFS F 7
%74	German association of welding technology
&1%.	&UIZMFOF QSPQZMFOF EJFOF SVCCFS
FAR	'FEFSBM "WJBUJPO 3FHVMBUJPOT
'%"	'PPE BOE %SVH "ENJOJTUSBUJPO
FKM	Fluororubber
GFK	Fiberglass reinforced plastics
,58	1MBTUJD ESJOLJOH XBUFS SFDPNNFOEBUJPO CZ UIF 'FEFSBM)FBMUI 0ÎD
MFR	Melt Flow Rate
MRS	Minimum Required Strength
/#3	/JUSJMF SVCCFS #VOB /
/3	/BUVSBM SVCCFS
PB	Polybutene
1&	Polyethylene
1& 9	Polyethylene
PP	Polypropylene
15'&	1PMZUFUSBÍVPSFUIZMFOF
17$	1PMZWJOZM DIMPSJEF
17$ $	1PMZWJOZM DIMPSJEF DIMPSJOBUFE
17$ 6	1PMZWJOZM DIMPSJEF VOQMBTUJDJ[FE
17%'	1PMZWJOZMJEFOF ÍVPSJEF
4%3	4UBOEBSE %JNFOTJPO 3BUJP
TG	Malleable iron
UP-GF	6OTBUVSBUFE QPMZFTUFS SFTJO HMBTT ÌCFS SFJOGPSDFE

Introduction

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1 GF Piping Systems

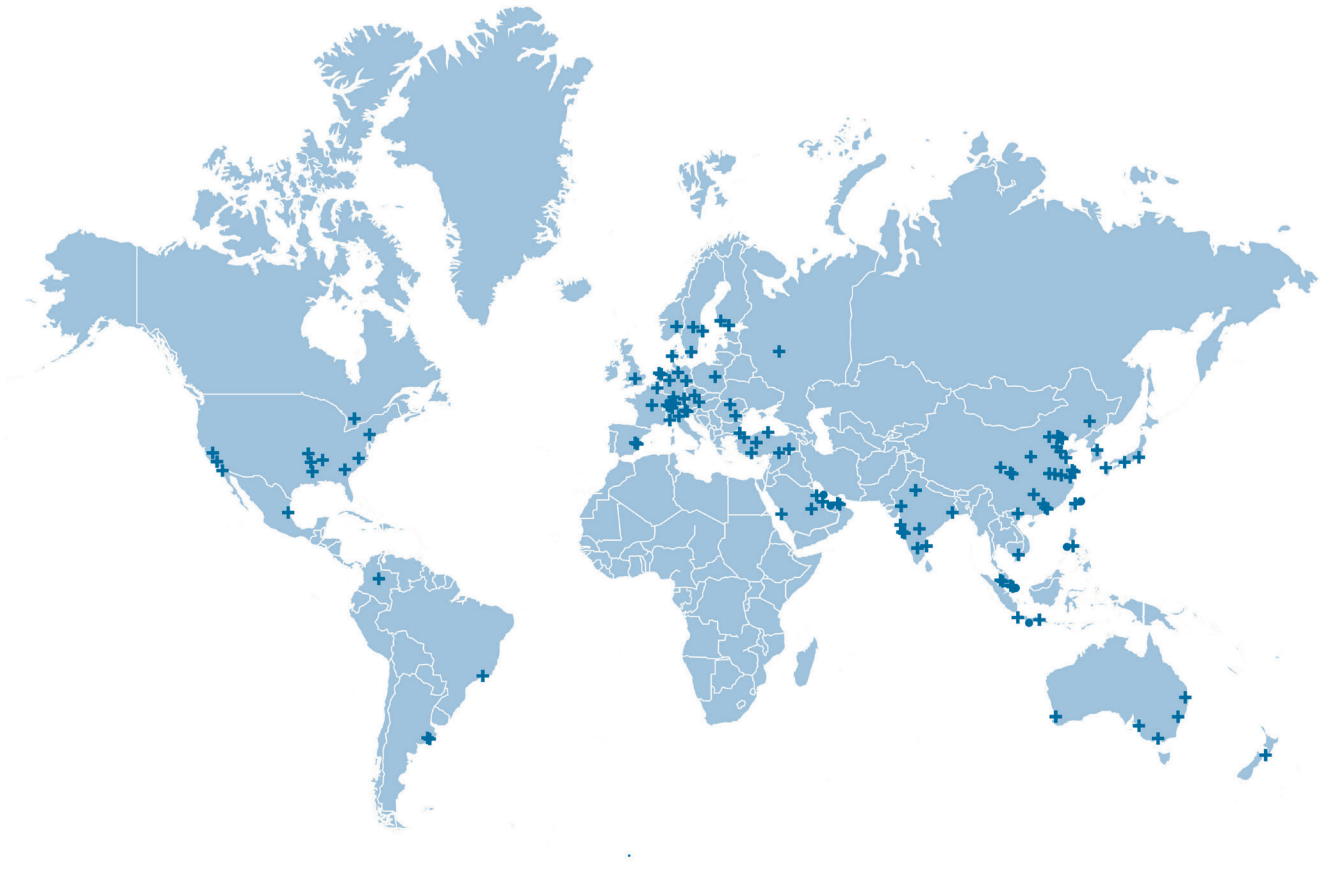
Global presence

Our global presence ensures customer proximity worldwide. Sales companies in over {DPVOUSJFT BOE SFQSFTFOUBUJWFT JO BOPUIFS DPVOUSJFT QSPWJEF DVTUP UIF DMPDL 8JUI QSPEVDUJPO TJUFT JO &VSPQF "TJB BOE UIF 64" XF BSF DMP BOE DPNQMZ XJUI MPDBM TUBOEBSET " NPEFSO MPHJTUJDT DPODFQU XJUI MPDB FOTVSFT IJHIFTU QSPEVDU BWBJMBCJMJUZ BOE TIPSU EFMJWFSZ UJNFT ('{1JQJC are always close by.

Complete solutions provider

8JUI PWFS QSPEVDUT XF PËFS JOEJWJEVBM BOE DPNQSFIFOTJWF TZTUFN T WBSJFUZ PG JOEVTUSJBM BQQMJDBUJPOT)BWJOH UIF QSPÌUBCJMJUZ PG UIF QS QSPDFTTFT BOE BQQMJDBUJPOT UIBU BSF JOUFHSBUFE JOUP UIF DPNQMFUF TZTU TUBOEBSET JO UIF NBSLFU XF EJSFDUMZ QSPWJEF PVS DVTUPNFST XJUI UFDIOP %VF UP PVS XPSMEXJEF OFUXPSL PG RVBMJÌFE DPOUBDU QBSUOFST DVTUPNFST our 50 years+ experience in plastics.

'SPN TUBSU UP ÌOJTI XF TVQQPSU PVS DVTUPNFST BT B DPNQFUFOU SFMJBCMF QBSUOFS BDUJWFMZ DPOUSJCVUJOH UIF LOPX IPX PG BO JOEVTUSJBM DPNQBOZ TVDDFTTGVM JO UIF NBSLFU GPS PWFS ZFBST



2 Quality

2.1 Quality assurance at all levels

2VBMJUZ DSFBUFT TBGFUZ BOE JT UIF CBTJT GPS USVTU *O DVTUPNFS SFMBUJP
QSPKFDU XPSL EFWFMPQNFOU QSPEVDUJPO BOE JO UIF TQFDJÌD BQQMJDBUJPO
BXBSFOFTT BOE TUBOEBSET EFDJEF PO TVTUBJOBCMF TVDDFTT 5IF GVOEBNFOU
RVBMJUZ EFUFSNJOFT PVS BDUJPOT TIBQFT PVS VOEFSTUBOEJOH PG RVBMJUZ
PXO DMBJN UP RVBMJUZ

5IF TZTUFNBUJD JOUFHSBUJPO PG QBSUOFST BOE TVQQMJFST JT QBSU PG PVS D
VOEFSTUBOEJOH PG RVBMJUZ BOE HVBSBOUFFT UIF CJOEJOH BTTVSBODF PG UIF
UIF FOUJSF WBMVF BEEFE DIBJO

('{1JQJOH 4ZTUFNT JT CPVOE UP UIF IJHI RVBMJUZ TUBOEBSET PG JUT DVTUPNFS
BDUJWFMZ SFTQPOTJCMF GPS NFFUJOH UIF DVTUPNFS SFRVJSFNFOUT BT XFMM B
TUBOEBSET 5IF SJHPSPVT JNQMFNFOUBUJPO PG PVS RVBMJUZ QPMJDZ SFQSFTF
FWFSZ TJOHMF QFSTPO $POTFRVFOUMZ UIF PSJFOUBUJPO UPXBSET RVBMJUZ XI
HPFT XJUIPVU TBZJOH GPS BMM FNQMPZFFT XPSLJOH JO UIF DPNQBOZ

2.2 Management systems

2VBMJUZ FOWJSPONFOU PDDVQBUJPOBM TBGFUZ BOE I PUFDUJPO IBWF
JNQPSUBOU SPMF JO UIF (FPSH 'JTDIFS HSPVQ *O MJOF U BMM QSPEVD
BT NBOZ TBMFT DPNQBOJFT PG ('{1JQJOH 4ZTUFNT BSF I JO BDDPSEBODF
RVBMJUZ NBOBHFNFOU TZTUFN 'VSUIFSNPSF BMM PG PVS QSPEVDUJPO TJUFT B
BDDPSEBODF XJUI *40 5IF TUBOEBSE EFÌOFT DSJUFSJB UIBU BSF BQQMJDBC
XPSME GPS FÎDJFOU FOWJSPONFOUBM NBOBHFNFOU TZTUFNT BOE BT B SFTVMU
UIF CBTJT GPS PQUJNJ[JOH FOWJSPONFOUBMMZ SFMFWBOU QSPDFTTFT

"T QBSU PG PVS TVTUBJOBCJMJUZ BDUJWJUJFT BMM QSPEVDUJPO TJUFT IBWF B
BDDPSEBODF XJUI 0)4"4 UIF JOUFSOBUJPOBM TUBOEBSE JO UIF BSFB PG PD
BOE TBGFUZ /FXMZ BDRVJSFE PS OFXMZ GPVOEFE QSPEVDUJPO DPNQBOJFT BSF
RVBMJUZ FOWJSPONFOUBM BOE PDDVQBUJPOBM TBGFUZ NBOBHFNFOU SFHJNF X
years.

2.3 Accredited test center

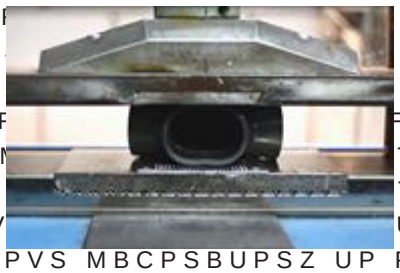
5IF UFTU DFOUFS PG ('{1JQJOH 4ZTUFNT JT B UFTU DFOU SFE BDDF
*40 *&${ GPS DPNQPOFOUT PG QJQJOH TZTUFNT *U J T E FT PG
DPOOFDUJPOT DPOOFDUJOH FMFNFOUT ÌUUJOHT NBOV BVS NBOD WBM
meters according to relevant standards and its own external as well as internal
TQFDJÌDBUJPOT

$VTUPNFST GPS UFTU MBCPSBUPSZ QSPHSBNT BSF UIF 3 % EFQBSUNFOUT NBOV
XFMM BT FOE VTFST PG ('{1JQJOH 4ZTUFNT DPNQPOFOUT BOE PUIFS FYUFSOBM D

%FWFMPQNFOU BOE QSPEVDU SFMFBTF UFTUT BSF DPNQMFUFE GPS 3 % EFQBSUN
*55 JOJUJBM UZQF UFTUJOH CBUDI SFMFBTF UFTUT #35 BOE QSPDFTT WFSJÌDE
PXO QSPEVDUJPO VOJUT BT XFMM BT PUIFS UFTUT GPS FYUFSOBM DVTUPNFST

5IF DPOUJOVPVT USBJOJOH BOE TQFDJÌD FYQFSJFODF PG PVS FNQMPZFFT UIF U
UFTUJOH TZTUFNT BT XFMM BT QSPQFSMZ EPDVNFOUFE UFTU TFRVFODFT BSF CE
BDDSFEJUJOH UIF UFTU DFOUFS JO BDDPSEBODF XJUI *40 *&$ 5IF BDDSFEJU
4XJTT{"DDSFEJUBUJPO 0ÎDF JT DPOÌSNFE JO UIF GPSN PG B DFSUJÌDBUF " WFS
BOOVBMMZ BT XFMM BT B SFOFXBM PG UIF BDDSFEJUBUJPO FWFSZ ZFBST

5IF 4"4 XIJDI JT SFTQPOTJCM
JTTVFE PVS BDDSFEJUBUJPO
*OUFSOBUJPOBM -BCPSBUPSZ FSB
UJPO *-"$ "MM MBCPSBUPSJF
*-"$ BSF PCMJHFE UP GPSNBM TU
SFQPSU JTTVFE CZ B GFMMPX T
VT BOE PVS DVTUPNFST UP V UFTU
SFQPSUT PSJHJOBUJOH GSPN PVS MBCPSBUPSZ UP PCUBJO
QSPEVDU BQQSPWBMT BOE RVBMJUZ DFSUJÌDBUFT FUD
5IFSFGPSF QPUFOUJBM FYQFOEJUVSF BOE UJNF
consumption is considerably reduced.



5IF BDDSFEJUFE UFTU QSPHS
- -POH UFSN JOUFSOBM QSFT
  &/ *40 &/ *40
- #VSTU UFTUT PO ÌUUJOHT B
- $SVTI UFTUT *40
- Impact resistance tests (ISO 13957)
- %FDPIFTJPO UFTU PG QPMZ
  GVTJPO KPJOUT *40
- %FDPIFTJPO UFTU *40
- 1FFMJOH UFTU *40
- 5FOTJMF TUSFOHUI BOE GBJ
  GVTFE UFTU TQFDJNFOT *4
- 1SFTTVSF ESPQ UFTU &/ *4
- %FUFSNJOBUJPO PG EFOTJU
- .FMU ÍPX SBUF &/ *40
- 0YJEBUJPO JOEVDUJPO UJN

" DPNQMFUF MJTUJOH PG BDD F
TFFO JO B UBCMF 5IJT UBCM Z
VQEBUFE DBO CF SFGFSSFE UP CZ DPOTVMUJOH UIF
GPMMPXJOH JOUFSOFU TJUF
XXX TBT DI

Accredited bodies

4FBSDI
454

3 Sustainability

As an internationally operating industrial group, GF is in the midst of society. It is, therefore, important to harmonize economy, ecology and social aspects. In accordance with this responsibility, our industrial and social activities carry a long-term and long-range orientation. It is our endeavor to anchor sustainability in all of our sales companies. Our sustainability goals, whose attainment we communicate regularly and transparently, drive our actions.

3.1 Environment

'PS ('{1JQJOH 4ZTUFNT PVS PXO FOWJSPONFOUBM SFTQPOTJCJMJUZ JT BO JOUFH
CVTJOFTT BDUJWJUJFT #FDBVTF XF SFHBSE FOWJSPONFOUBM BXBSFOFTT BT PO
JNQPSUBOU WBMVFT PG PVS DPNQBOZ BMM JOUFSOBM TUSVDUVSFT BOE QSPDFT
TVTUBJOBCJMJUZ 8F TUSJWF UP TBWF OBUVSBM SFTPVSDFT BOE XPSL SFMFOUM
FDP GSJFOEMJOFTT PG PVS QSPEVDUT BOE UIFJS BQQMJDBUJPOT 0VUUBOEJOH
JOOPWBUJWF UFDIOPMPHJFT GPSN UIF CBTJT PG PVS FOWJSPONFOUBMMZ GSJFO
TPMVUJPOT #Z TVQQMZJOH PVS DVTUPNFST XJUI DPNQMFUF QJQJOH TZTUFNT X
QSPNPUF FDPMPHJDBM BOE DPTU FÎDJFOU PQFSBUJOH QSPDFTTFT JO NBOZ JOEV
SPVUJOF 5P PCUBJO EFUBJMFE JOGPSNBUJPO BCPVU UIF FOWJSPONFOUBM DPNQ
XF NPOJUPS BMM QIBTFT PG UIF QSPEVDU MJGF DZDMF JO EFUBJM XIJDI BMTP B
JNQSPWF UIF MJGF DZDMF BTTFTTNFOU PG PVS QSPEVDUT

3.2 Social aspects

"UUSBDUJWF XPSLQMBDFT JOUFSFTUJOH UBTLT B HPBM PSJFOUFE USBJOJOH BC
EFWFMPQNFOU BT XFMM BT B GBJS TBMBSZ BOE HPPE TPDJBM CFOFÌUT DPOUSJC
GVUVSF PG UIF DPNQBOZ ('{1JQJOH 4ZTUFNT PQFSBUFT XJUI UIJT SFTQPOTJCJM
8JUI MPDBUJPOT JO PWFS DPVOUSJFT ('{1JQJOH 4ZTUFNT WJFXT UIF NVMUJUV
SFMJHJPOT OBUJPOBMJUJFT HFOEFST BOE BHF HSPVQT BT B WBMVBCMF TPVSDF
FYQFSJFODF 5IJT NBLFT QPTTJCMF UIF FYUSBPSEJOBSZ TFSWJDFT QFSGPSNFE C
TUBË NFNCFST FNQMPZFE CZ ('{1JQJOH 4ZTUFNT UISPVHIPVU UIF XPSME

Additional information about sustainability can be found at www.gfps.com/sustainability.

4 Services

From planning support to implementation – our specialists are always close by

"T B MFBEJOH QSPWJEFS PG QJQJOH TZTUFNT JO QMBTUJD XF PËFS PVS DVTUPN
QSPEVDUT CVU BMTP B DPNQSFIFOTJWF QBDLBHF PG TFSWJDFT 0VS TVQQPSU S
DPNQSFIFOTJWF UFDIOJDBM NBOVBM PS UIF FYUFOTJWF $"% MJCSBSZ UP BO JOU
FYQFSUT XIP XPSL DMPTFMZ UPHFUIFS XJUI MPDBM TBMFT DPNQBOJFT "OE XIFO
JNQMFNFOUJOH B QSPKFDU PVS DVTUPNFST BEEJUJPOBMMZ CFOFÌU GSPN B XJEI
DPVSTFT FJUIFS PO TJUF PS JO PVS NPEFSO USBJOJOH DFOUFST XPSMEXJEF

Chemical resistance

0VS TQFDJBMJTU UFBNT IBWF EFDBEFT PG FYQFSJFODF JO UIF BSFB PG DIFNJDBM
PËFS JOEJWJEVBM TVQQPSU BOE BEWJDF JO TFMFDUJOH UIF SJHIU NBUFSJBM GP
QMBTUJDT TZTUFN TPMVUJPO 0O SFRVFTU B UFBN XJMM FYBNJOF BOE TFMFDU U
GPS TQFDJBM BQQMJDBUJPOT

CAD library

5IF FYUFOTJWF $"% MJCSBSZ JT UIF NPTU GSFRVFOUMZ VTFE QMBOOJOH UPPM BU
5IF{EBUBCBTF DPNQSJTFT PWFS ESBXJOHT BOE UFDIOJDBM EBUB SFHBSEJO
NFBTVSFNFOU BOE DPOUSPM UFDIOPMPHZ BT XFMM BT NBOVBM BOE BDUVBUFE W
BEWBOUBHF PG UIF $"% MJCSBSZ JT UIBU UIF EBUB DBO CF JOUFHSBUFE EJSFDU

Technical support

5FDIOJDBM TVQQPSU BOE NBUFSJBM TFMFDUJPO BSF LFZ GBDUPST GPS B TVDDFT
PG TQFDJBMJTUT IFBERVBSUFSFE JO 4XJU[FSMBOE JT BWBJMBCMF UP TVQQPSU U
TBMFT DPNQBOJFT BSPVOE UIF XPSME 'PS UFDIOJDBM BEWJDF PS GPS HFOFSBM
DVTUPNFST BSF TVQQPSUFE JOEJWJEVBMMZ CZ UIF TQFDJBMJTU UFBN JO UIF DP
company.

Online and mobile calculation tools

0VS OVNFSPVT NVMUJMJOHVBM POMJOF DBMDVMBUJPO UPPMT BSF WFSZ VTFGVM
DBMDVMBUJOH #Z NFBOT PG QSFTTVSF UFNQFSBUVSF EJBHSBNT UIF QSFTTVSF
SFDPNNFOEFE GPS QJQF BOE ÌUUJOHT BU WBSJPVT UFNQFSBUVSFT DBO CF FBTJM
"QQ UIF NPCJMF BQQMJDBUJPO PG ('{1JQJOH 4ZTUFNT JT BO PO TJUF QMBOOJOI
BOE ÍPX WFMPDJUZ DBMDVMBUJPO UP TFMFDU UIF SJHIU EJNFOTJPO PG QJQJOH

On-site training

Our experts are available to support our customers locally and conduct training in diverse
GVTJPO BOE KPJOUJOH UFDIOJRVFT PO MPDBUJPO 5IF EVSBUJPO BOE TUSVDUVS
PO UIF QSPKFDU BOE UIF TZTUFN CFJOH JOTUBMMFE

Customizing

5IF DVTUPNJ[JOH UFBNT BU ('{1JQJOH 4ZTUFNT XPSL DMPTFMZ UPHFUIFS BSPVOE
GPDVT PG UIFTF UFBNT JT UP NBOVGBDUVSF DVTUPN QBSUT GPS TQFDJBM TZTUF
B{WBSJFUZ PG TQFDJBM TPMVUJPOT DBO CF QSPEVDFE JO TNBMM TFSJFT 4UBOE
XBSSBOU UIF IJHIFTU MFWFM PG RVBMJUZ GPS UIF JOEJWJEVBM TPMVUJPOT PG F

Planning Fundamentals

'PS PVS DVTUPNFST XF IBWF EPDVNFOUFE UIF FYUFOTJWF LOPX IPX PG ('{1JQJO
QMBOOJOH BOE JOTUBMMJOH QMBTUJD QJQJOH TZTUFNT JO PVS UFDIOJDBM NBOV
EPDVNFOUBUJPO JT BWBJMBCMF JO CPUI QSJOUFE BOE EJHJUBM WFSTJPOT 5IF S
JO QMBOOJOH MBSHF BOE TNBMM QSPKFDUT

Training courses

('{1JQJOH 4ZTUFNT PËFST B XJEF SBOHF PG USBJOJOH DPVSTFT UIBU BMMPX QBS
DPOÌEFODF JO XPSLJOH XJUI PVS QSPEVDUT BOE QSPWFO KPJOUJOH UFDIOPMPH.
USBJOJOH JT DMFBSMZ EFÌOFE TUSVDUVSFE BOE BEBQUFE UP UIF WBSJPVT MFW
participants.

5 Training

2VBMJÌFE QFSTPOOFM JT POF PG UIF LFZ GBDUPST GPS UIF TVDDFTT PG B DPNQB NPUJWBUFE BOE XFMM USBJOFE FNQMPZFFT XJUI UIF BQQSPQSJBUF LOPX IPX BO are reliable partners.

('{1JQJOH 4ZTUFNT
QSPGFTTJPOBM TZTU
QSPWJEFS PËFST ZP
DPVSTFT XJUI B GPD
BQQMJDBUJPOT TBM
EJËFSFOU DVSTUPNFS

5IF KPJOUJOH UFDIO
as measurement and control
UFDIOPMPHZ BSF JO
JOOPWBUJWF 5P TU
need continuing education.
('{1JQJOH 4ZTUFNT N
essential contribution to your
LOPX IPX /P NBUUFS
ÌFME PG FYQFSUJTF
VUJMJUJFT CVJMEJ
industrial applications – you can
CFOFÌU GSPN UIF USBJOJOH DPVSTFT
XIJDI BSF BEBQUFE UP UIF EJËFSFOU
NBSLFU TFHNFOUT BOE
applications.

8F PËFS B DVTUPNJ[
GPS TBMFT QFSTPOO
PDDVQBUJPOBM HSP
JOTUBMMFST QMBO
CVJMEFST #FTJEFT
BUUBDI HSFBU JNQP
IBOET PO QSBDUJDF
FTQFDJBMMZ FRVJQ
USBJOJOH 5IFZ BSF
TJNVMUBOFPVT USBJ
{QFSTPOT VOEFS JEFBM
DPOEJUJPOT 8F XPSL UPHFUIFS
DMPTFMZ XJUI PVS TBMFT QFSTPOOFM
XIFO TFMFDUJOH USBJOFST 5IFSF BSF
CBTJD BEWBODFE BOE NBTUFS
DPVSTFT XIJDI BSF BMM TUSVDUVSFE
JO B DPPSEJOBUFE GBTIJPO

For additional information about the current training program, visit www.gfps.com.

Piping Solutions

of GF Piping Systems

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1 Market Segments 24

1.1 Water Treatment

$IFNJDBM 1SPDFTT *OEVTUSZ

.JDSPFMFDUSPOJDT

$PPMJOH

1.5 Energy

.BSJOF

1.7 Water Utilities

(B6TU JM JUJFT

#VJMEJOH 5FDIOPMPHZ

"QQMJDBUJPOT4XJNQPPMT

2 System and Product Solutions 43

"EWBOUBHFT PG *OEVTUSJBM 1MBTUJD 1JQJOH 4ZTUFNT

.PTU *NQPSUBOU .BSLFU 4FHNFOUT

17$ 6 1JQJOH 4ZTUFN

17$ $ 1JQJOH 4ZTUFN

"#4 1JQJOH 4ZTUFN

4:(&' 1JQJOH 4ZTUFNT 4UBOEBSE 1MVT

130(&' 1JQJOH 4ZTUFNT 4UBOEBSE 1MVT BOE /BUVSBM

FDP'*5 1JQJOH 4ZTUFN 57

$0/5"*/ *5 1MVT 1JQJOH 4ZTUFN 59

$00- '*5 1JQJOH 4ZTUFNT

"VUPNBUJPO

II

1 Market Segments

1.1 Water Treatment

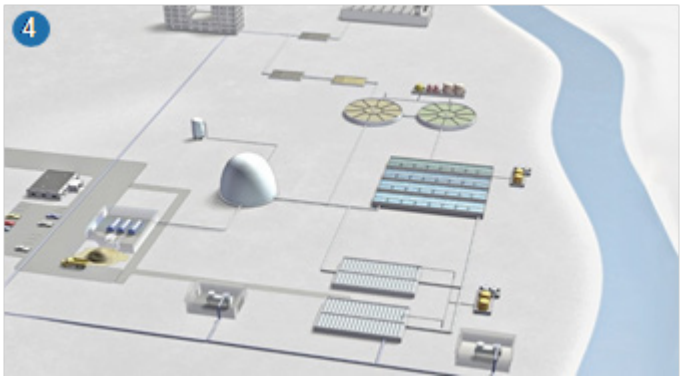
1.1.1 Overview

4JODF UIF MBUF nT UIF XBUFS USFBUNFOU CVTJOFTT IBT CFFO DPOUJOVPVTMZ TDBSDF DPVOUSJFT JU JT FWFO SFHBSEFE UP CF UIF NPTU JOWFTUNFOU JOUFOT JOEVTUSZ TFDUPS GPS UIF OFYU EFDBEFT %FQFOEJOH PO UIF BQQMJDBUJPO BS UP GBDF EJËFSFOU DIBMMFOHFT JO XBUFS USFBUNFOU QSPDFTTFT SBOHJOH GSP RVBMJUZ VQ UP QSPWJEJOH SFMJBCMF NFBTVSFNFOUT UP NFFU TUSJOHFOU SFHV 4ZTUFNT TUFQT VQ UIFTF DIBMMFOHFT XJUI B DPNQSFIFOTJWF TZTUFN PËFSJOH WBMWFT BOE UIF JEFBM KPJOUJOH UFDIOPMPHZ BT XFMM BT BO PQUJNBMMZ BEB DPNQPOFOUT GPS BVUPNBUJPO UFDIOPMPHZ

Drinking water

Industrial process water

Industrial waste water



Municipal waste water

Drinking water

1SPEVDJOH ESJOLJOH XBUFS JT B EFNBOEJOH DIBMMFOHF XIJDI SFRVJSFT UIF SJ
UIF TDFOFT %FQFOEJOH PO UIF BQQMJDBUJPO BSFB UIF DIPJDF PG QMBTUJD NE
BOE ÌUUJOHT JT FTTFOUJBM GPS B MPOH MBTUJOH TZTUFN 8JUI UIF IJHI RVBMJU
('{1JQJOH 4ZTUFNT UIF PQUJNBM DPNQBUJCJMJUZ PG BMM DPNQPOFOUT JT XBSSI

Industrial process water

)JHI XBUFS RVBMJUZ JO UFSNT PG QVSJUZ GPS TUFBN CPJMFST DPPMJOH TZTUF
QSPDFTTFT JT UIF LFZ SFRVJSFNFOU GPS JOEVTUSZ UPEBZ "WPJEJOH BOZ GPSN
TDBMJOH BOE DPSSPTJPO JT BDIJFWFE UISPVHI UFDIOPMPHJFT BT JPO FYDIBOHJ
SFWFSTF PTNPTJT BOE FMFDUSP EFJPOJ[BUJPO

Industrial waste water

8BTUF XBUFS USFBUNFOU QMBOUT GPS JOPSHBOJD DBVTUJDT BOE BDJET BSF TNI
UIFNTFMWFT $PSSPTJPO SFTJTUBODF BOE TUBË TBGFUZ BSF UIF UPQ QSJPSJUZ
XBTUF DPOUBJOJOH MJOFT ('{1JQJOH 4ZTUFNTn QIJMPTPQIZ GPS TBGF USBOTQP
NFFUT UIFTF BEWBODFE QSPDFTT OFFET

Municipal waste water

4USJOHFOU SFHVMBUJPOT BOE CJOEJOH MBXT EFNBOE TUBUF PG UIF BSU UFDIOI
QMBOUT UPEBZ .FNCSBOF UFDIOPMPHJFT DIFNJDBM EPTJOH TZTUFNT BOE QPMZ
VOJUT BSF POMZ TPNF PG UIF FYBNQMFT UIBU SFRVJSF FÎDJFOU BOE TBGF QJQJO

1.1.2 Leading Systems (Samples)

ecoFIT and ELGEF	PVC-U	PROGEF Standard	CONTAIN-IT Plus
E r E NN 1/ r 1/	E r E NN 1/ r 1/	E r E NN 1/ r 1/	E r E NN
‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$
Automation Measurement – Control – Actuation			
BDD UP QSJNBSZ QJQF NBUFSJBM			

1.2 Chemical Process Industry

1.2.1 Overview

$IFNJDBM BOE 1SPDFTT *OEVTUSZ FODPNQBTTFT BMM UIF JOEVTUSJBM BDUJWJUJ
FYUSBDUJPO PG OBUVSBM SFTPVSDFT BOE UIFJS USBOTGPSNBUJPO JOUP CBTJD
TQFDJBMUJFT &BDI DIFNJDBM IBT B EJTUJODUJWF WBMVF DIBJO XIFSF DBSFGVM
DPNQPOFOUT TFMFDUJPO JT B NBOEBUPSZ SFRVJTJUF GPS QMBOOFST EFTJHOFS
5IF{IBSTI FOWJSPONFOU JO NPTU PG UIF JOEVTUSJBM QMBOUT UIF TUSJWF GPS
SFTQPOTJCMF DBSF QPMJDJFT GPS DIFNJDBM IBOEMJOH ESJWF IJHI EFNBOET PC
SFHBSE UP IFBMUI BOE TBGFUZ FOWJSPONFOUBM TUBOEBSET DPNQMJBODF SFM
NBJOUFOBODF

Chemicals extraction from natural resources

Mining and minerals processing

.JOJOH BOE NJOFSBM QSPDFTTJOH JOEVTUSZ BSF BNPOH UIF NPTU JOUFOTJWF V
DIFNJDBMT JO IBSTI FOWJSPONFOU BOE XJUI EFNBOEJOH UBTLT GPS JOTUBMMBU
SFTJTUBODF UP DPSSPTJPO ('{1JQJOH 4ZTUFNT QSPEVDUT BSF VTFE JO UIF NJO
TFWFSBM QSPDFTT TUFQT GSPN PSF CFOFÌDJBUJPO UP IZESPNFUBMMVSHZ

Oil and gas industry

8BUFS DZDMF JO PJM BOE HBT JOEVTUSZ JT DPNQMFY BOE EFNBOEJOH B NVMUJU
BEEJUJWFT BSF VTFE UP FOIBODF QSPDFTT QFSGPSNBODF BOE JODSFBTF UIF FÎD
USFBUNFOU PQFSBUJPOT &WPMWJOH GSPOUJFST JO PËTIPSF BOE IZESBVMJD GS
VODPOWFOUJPOBM SFTPVSDFT BSF NPSF BOE NPSF XFMDPNJOH (' QMBTUJD QJQJ
MJHIUXFJHIU NPEVMBSJUZ PG JOTUBMMBUJPO BOE MPOH MBTUJOH MJGF JO BHH

Chemicals production and distribution

Petrochemicals

1FUSPDIFNJDBMT BSF UIF CVJMEJOH CMPDLT GPS NPTU PG UIF PCKFDUT TVSSPV
BOE UIFJS WBMVF DIBJO JT HSPXJOH XJUI OFX JOTUBMMBUJPOT BDDPSEJOH UP U
PG MJGF JO FNFSHJOH FDPOPNJFT BOE VSCBOJ[BUJPO NFHBUSFOE 0MFÌO BSPNI
HBT QSPDFTTJOH JOEVTUSJBM QMBOUT IBWF IJHI DPNQMFYJUZ ÍPX TDIFNFT GPS
VTFE BT QSPDFTT BEEJUJWFT PS DBUBMZTUT BOE JO TFWFSBM DIFNJDBM JOKFDU

Fertilizers

-JLF QFUSPDIFNJDBMT GFSUJMJ[FS QMBOUT QMBZ B LFZ SPMF JO UIF HMPCBM DI
UIF BHSP JOEVTUSJBM OFFE GPS JOUFOTJWF GPPE QSPEVDUJPO BOE CFJOH BO F
BNNPOJB HBT NPOFUJ[BUJPO JOUP OJUSPHFO CBTFE GFSUJMJ[FST 'FSUJMJ[FS Q
JO UIF WBMVF DIBJO PG UIF NPTU VTFE NJOFSBM BDJET XPSMEXJEF JO UIF JOEV
BDJE BOE QIPTQIPSJD BDJE

Chlor-alkali

$IMPS BMLBMJ QMBOUT BSF UIF CBDLCPOF PG UIF CBTJD JOEVTUSJBM JOPSHBOJ
QJQJOH TPMVUJPOT ÌOE UIFJS JEFBM BSFB PG BQQMJDBUJPO JO UIF EVBM MBNJC
FMFDUSPMZTJT XIJMF EPXOTUSFBN UIF DIMPSJOF USFF BOE UIF JOÌOJUF DBVTU
VTBHFT PËFS UIF QFSGFDU FOWJSPONFOU GPS UIFSNPQMBTUJD JOTUBMMBUJPOT
&MFDUSP DIMPSJOBUJPO BOE XBUFS EJTJOGFDUJPO BSF JODSFBTJOH QSBDUJDFT
4ZTUFNT PËFS LFZ DPNQPOFOUT GPS UIF TLJE MPX XFJHIU BOE UPQ RVBMJUZ JO

Basic inorganic chemicals, specialty chemicals, bio-chemicals

8IFUIFS UIFSF BSF CBTJD TVCTUBODFT MJLF UJUBOJVN EJPYJEF PS CSPNJOF QJ
GPS QIBSNBDFVUJDBMT BEIFTJWFT PS DIFNJDBMT GPS XBUFS USFBUNFOU PS FM
('{1JQJOH 4ZTUFNT QSPEVDUT BSF FNQMPZFE OFBSMZ BU BMM QSPDFTT TUBHFT
BT JO UIF USBEJUJPOBM DIFNJDBM QSPDFTTJOH JT JODSFBTJOHMZ CFJOH SFQM
PG UIF CJP DIFNJDBMT XIFSF JOPSHBOJD DIFNJDBMT QMBZ B EJTUJODUJWF SPM
PS DBUBMZTUT

Chemicals used in manufacturing and process industries

Steel mills and metal industry

.FUBMMJD NBUFSJBMT BSF UIF CBDLCPOF PG JOGSBTUSVDUVSF DPOTUSVDUJPO B
NBKPSJUZ PG UIF FOHJOFFSFE QSPEVDUT PG JOEVTUSZ BOE FWFSZEBZ MJGF 4U
NFUBM QSPDFTTJOH QMBOUT GPS PQFSBUJPOT PG TNFMUJOH SFÌOJOH SFDZDMJ
BHHSFTTJWF BDJET BOE BMLBMJT FTQFDJBMMZ JO UIF QJDLMJOH QSPDFTT *O U
QJQJOH TZTUFNT QMBZ B LFZ SPMF GPS FYBNQMF JO UIF FYIBVTU HBTFT TDSVC

Surface treatment, galvanization, batteries, painting and printing, glass industry

%SJWFO QSJNBSJMZ CZ USBOTQPSUBUJPO JOEVTUSZ BOE IPVTFIPME BQQMJBODF
UIF NFUBMT JT B XJEFTQSFBE JOEVTUSJBM QSBDUJDF JODMVEJOH EFNBOEJOH ÌC
FMFDUSPDIFNJDBM BQQMJDBUJPOT TVDI JO DBTF PG HBMWBOJ[BUJPO PG GBTIJPC
XBUDIFT USFBUNFOU PG TUFFM UZSF DPSE FUDIJOH PG TVSGBDFT GPS FMFDUS
DPNQPOFOUT 1SFQBSBUJPO PG NFUBM TVSGBDFT GPS QBJOUJOH JOWPMWFT IJH
EJQQJOH USFBUNFOU TUBHFT XIFSF UIF FYDFMMFOU NBUFSJBM QVSJUZ BOE MFE
('{1JQJOH 4ZTUFNT DPNQPOFOUT BSF QSPWFO CFOFÌUT

Pulp and paper, starch, yeast and sugar, cosmetic and detergents, textile industry

(MPCBMJ[BUJPO BOE VSCBOJ[BUJPO ESJWFO JODSFBTJOH TUBOEBSET PG MJGF Q
NBOVGBDUVSJOH JOEVTUSJFT GPS TFWFSBM QSPEVDUT XJUI DIBMMFOHJOH RVBM
SFRVJSFNFOUT BOE XJUIJO TUSJDU SFHVMBUJPOT GPS FOWJSPONFOUBM DPNQMJ
TBGFUZ)JHI RVBMJUZ DPNQPOFOUT EVSBCMF NBUFSJBMT QSFDJTF QSPDFTT D
('{1JQJOH 4ZTUFNT JO B NVMUJUVEF PG BQQMJDBUJPOT JOWPMWJOH DIFNJDBMT

1.2.2 Leading Systems (Samples)

PROGEF (Standard)	CONTAIN-IT Plus	SYGEF	PVC-U	PVC-C	ecoFIT and ELGEF
E rE NN E rE NN E rE NN E rE NN E rE NN E rE NN 1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/					
‹$ UP ‹$ ‹$ UP ‹$ ‹$ UP ‹$‹$ UP ‹$ ‹$ UP ‹$ ‹$ UP ‹$					
Automation Measurement – Control – Actuation					

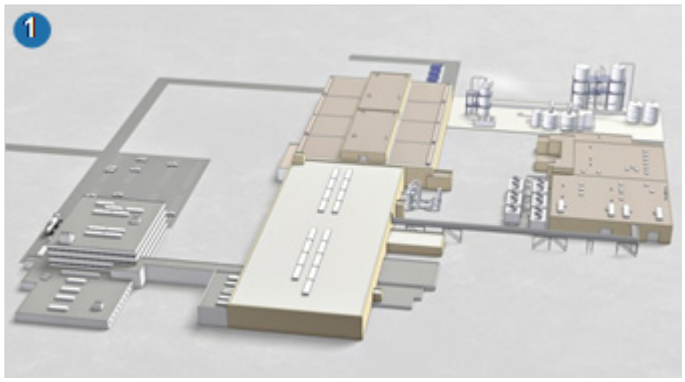
BDD UP QSJNBSZ QJQF NBUFSJBM

1.3 Microelectronics

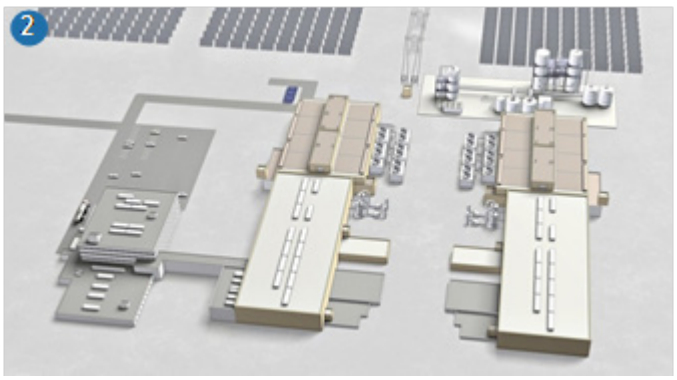
1.3.1 Overview

"U ('{1JQJOH 4ZTUFNT XF SFBMJ[F UIBU ZPVS IJHI UFDI QSPEVDUJPO QMBOUT SVC
EFQFOEBCMF TBGF QJQJOH TZTUFNT UIBU DBO DPOTJTUFOUMZ EFMJWFS DSJUJD
must.

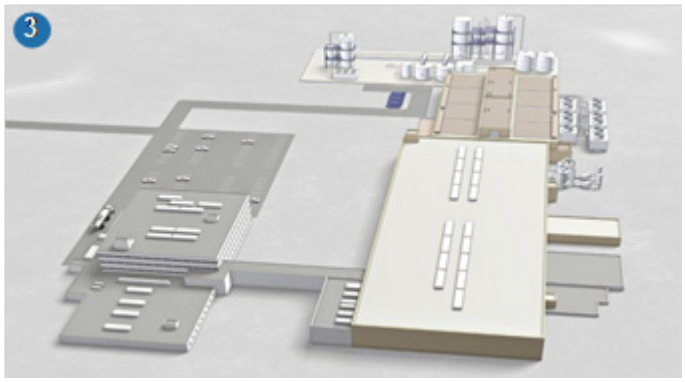
"WPJEJOH VOOFDFTTBSZ TIVUEPXOT JT B DPNNPO HPBM UIBU XF TIBSF 0VS TVQC
QMBTUJD QJQJOH TZTUFN QSPEVDUT BOE KPJOUJOH UFDIOPMPHJFT DPVQMFE XJU
LOPXMFEHFBCMF FOHJOFFSJOH TUBË IBT LFQU GBDUPSJFT MJLF ZPVS PXO SVOO
UXP EFDBEFT %VSJOH UIJT UJNF FOE VTFST MJLF ZPVSTFMG IBWF TFFO UIF BEE
QJQJOH TZTUFNT BOE SFQMBDFE PUIFS NBUFSJBMT UP BDIJFWF TBGFUZ RVBMJU



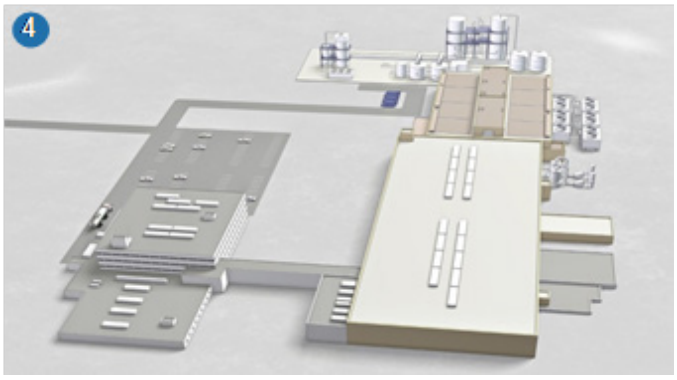
Semiconductor



Photovoltaic



TFT/HB-LED



Storage media

Semiconductor

)JHIMZ TQFDJBMJ[FE GBDJMJUJFT IBOEMF UIF DPNQMFYJUZ BOE TFOTJUJWFOFTT
QSPEVDUT JO UIF TFNJDPOEVDUPS XBGFS QSPEVDUJPO JOEVTUSZ CZ PQFSBUJOH
DMFBO SPPN FOWJSPONFOUT ('{1JQJOH 4ZTUFNT PËFST B QPSUGPMJP PG IJHI QV
GPS UIF TBGF BOE SFMJBCMF DPOWFZBODF PG DSJUJDBM QSPDFTTJOH ÍVJET UP
QSPDFTTJOH FRVJQNFOU JOTUBMMFE PO QSPEVDUJPO ÍPPS

Photovoltaic

)JHI EFNBOET SFHBSEJOH QVSJUZ TBGFUZ BOE RVBMJUZ DIBSBDUFSJ[F QSPEVDU
QIPUPWPMUBJD TZTUFNT 3FMJBCMF DPOWFZBODF PG NFEJB VOEFS DMFBO DPOE
BOE BQQSPQSJBUFMZ DPOUSPMMFE 8IFUIFS JU JT QSPDFTT UFDIOPMPHZ PS UIF
('{1JQJOH 4ZTUFNT QSPEVDU QPSUGPMJP DPWFST BMM IJHI FOE XBUFS BQQMJDB
industry.

TFT/HB-LED

5IF NBOVGBDUVSJOH PG 5'5 -&% UFDIOPMPHJFT JT TUSVDUVSFE JO XBGFS DMFBO TUFQT QBUUFSOJOH BOE FUDIJOH NBQQFE JO UZQJDBM BQQMJDBUJPOT TVDI BT DIFNJDBM EJTUSJCVUJPO BT XFMM QSPDFTT DPPMJOH XBUFS GPS UPPMT ('{1JQJ SJHIU TPMVUJPO BDDPSEJOH UP QSPDFTT SFRVJSFNFOUT UFNQFSBUVSF DPOEJU DPODFOUSBUJPOT

Storage media

4JODF NFNPSZ DBQBDJUZ QFS GPPUQSJOU JT DPOUJOVPVTMZ JODSFBTJOH QSPE NFNPSZ EFWJDFT TIPXJOH BMTP BO JODSFBTFE EFNBOET GPS QVSF BOE IJHI QVS DPOTUSVDUJPOT GPS UIFJS GBDJMJUJFT JO WBSJPVT BQQMJDBUJPOT

Applications

- 1SPDFTT 7BDVVN 4PM
- $.1 4MVSSZ QSPDFTT
- 618)PU 618
- $IFNJDBM EJTUSJCVUJP $POWFZBODF
- 1SPDFTT DPPMJOH XBU
- 4QFDJBMUZ XBTUF
- *OEVTUSJBM HSBEF XBU
- %* XBUFS 4QFDJÌFE X
- 8FU CFODI QSPDFTT UP 0&.

1.3.2 Leading Systems (Samples)

PROGEF	CONTAIN-IT Plus	SYGEF	PVC-U	PVC-C	ecoFIT and ELGEF

E rE NN E rE NN E rE NN E rE NN E rE NN E rE NN
1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/
‹$ UP ‹$ ‹$ UP ‹$ ‹$ UP ‹$‹$ UP ‹$ ‹$ UP ‹$ ‹$ UP ‹$

"VUPNBUJPO
.FBTVSFNFOU r $POUSPM r "DUVBUJPO

BDD UP QSJNBSZ QJQF NBUFSJBM

1.4 Cooling

1.4.1 Overview

(' 1JQJOH 4ZTUFNT PËFST BQQMJDBUJPO PSJFOUBUFE WBMVF BEEJOH TZTUFN TF
USBOTQPSU PG DIJMMFE XBUFS BU ‹$ JO BJS DPOEJUJPOJOH QMBOUT JOEVT
‹$ BOE IFBU QVNQ DPNCJOFE DPPMJOH r IFBUJOH JOTUBMMBUJPOT BT XFMM
TBWJOH USBOTQPSU PG TFDPOEBSZ SFGSJHFSBOUT JO SFGSJHFSBUJPO QMBOUT
4VQFSNBSLFUT $PME 4UPSFT 'PPE BOE #FWFSBHF QSPEVDUJPO GBDUPSJFT

&OWJSPONFOUBM SFHVMBUJPOT XPSMEXJEF BSF SFTUSJDUJOH UIF VTF PG IJHI (
1PUFOUJBM SFGSJHFSBOU HBTFT UIJT JT ESJWJOH UIF $PPMJOH NBSLFU UPXBS
JOEJSFDU PS TFDPOEBSZ TZTUFNT UP SFEVDF UIF BNPVOU BOE MFBLBHFT PG NB
HBTFT &ÎDJFOU FDPOPNJDBM USBOTGFS PG UIF IFBU MPBE JO UIF TFDPOEBSZ Q
JNQPSUBODF UP UIF FÎDJFODZ PG UIF DPNQMFUF QMBOU

(' 1JQJOH 4ZTUFNT PËFST B SBOHF PG SFBM WBMVF BEEJOH TZTUFNT GPS BMM U
BMM PËFSJOH DPSSPTJPO SFTJTUBODF PQUJNVN FÎDJFODZ UIBOLT UP GBDU
JOTVMBUJPO BOE TJNQMF UJNF TBWJOH JOTUBMMBUJPO PO TJUF 'SFPO GSFF BO
FYQFDUFE MJGF TQBO

Cold stores

Commercial refrigeration

A/C Cooling: commercial - residential

F & B production

Cooling media > 0 °C / 32 °F

Air Conditioning

$IJMMFE XBUFS ‹$ BJS DPOEJUJPOJOH QMBOUT BSF DPNNPO GPS MBSHFS DPI
JOTUBMMBUJPOT DFOUSBMJ[FE DPME XBUFS MPPQT PËFS FÎDJFODZ BOE ÍFYJCMF
FOE VTFS BMJLF ('{1JQJOH 4ZTUFNT PËFST XJUIJO JUT TZTUFNT BMTP UIF OFDFT
BOE ÌSF XBMM QFOFUSBUJPO TPMVUJPOT OFDFTTBSZ GPS TVDI JOTUBMMBUJPOT

Industrial Cooling Water

"MM JOEVTUSJBM QMBOUT SFRVJSF DPPMJOH XBUFS CPUI XJUIJO UIF GBDUPSZ JU
NBDIJOFSZ BOE BMTP GPS FYUFSOBM ESZ DPPMFS SFTQFDUJWFMZ DPPMJOH UPX
4ZTUFNT PËFS BMM EFDJTJPO NBLFST SFBM BEEFE WBMVF GPS TVDI JOTUBMMBU
FÎDJFODZ BOE SFBM UJNF TBWJOHT DPNQBSFE XJUI USBEJUJPOBM TPMVUJPOT

Data Centers

"MM TFDUPST GSPN CBOLT UP VOJWFSTJUJFT JOTVSBODF DPNQBOJFT UP DPNNVC SFRVJSF DFOUSBMJ[FE TFSWFS TUPSBHF PG DSJUJDBM JOGPSNBUJPO "O FËFDUJ JT B XBUFS MPPQ BTTPDJBUFE XJUI B OPO DPSSPEJOH OPO TDBMJOH QSFTTVSF piping system.

Cooling media < 0 °C / 32 °F

Commercial refrigeration

4VQFSNBSLFUT BOE HSPDFSJFT TUPSFT NFEJVN UFNQFSBUVSF GPS GSFTI GPPET BOE EBJSZ QSPEVDUT BOE MPX UFNQFSBUVSF GPS GSP[FO HPPET 4FDPOEBSZ S VTJOH HMZDPM BOE TBMU TPMVUJPOT SFRVJSF TNPPUI OPO DPSSPEJOH OPO ES GPS BO FÎDJFOU USBOTQPSU PG DPPMJOH DBQBDJUZ LFFQJOH B MPX DBSCPO GP

Cold stores

1SFTFSWJOH GSVJUT PS WFHFUBCMFT BGUFS IBSWFTU PS TUPSJOH EBJSZ NFBU JOTUBMMBUJPOT SFRVJSF FÎDJFOU MPOH MBTUJOH BOE NBJOUFOBODF GSFF DPP MPPQT VTJOH QSF JOTVMBUFE QMBTUJD QJQJOH TZTUFNT QSPWJEF UIF SFRVJSF BOE IVNJEJUZ DPOUSPM XJUI ZFBST DPSSPTJPO SFTJTUBOU MJGF TQBO

Food and Beverage Production

'SPN SFBEZ NBEF NFBM QSPEVDUJPO GBDUPSJFT UP EBJSJFT TMBVHIUFS IPVTF QSPEVDUJPO UP DBSCPOBUFE ESJOLT BMM GPSNT PG GPPE BOE CFWFSBHF QSP B SFMJBCMF FÎDJFOU DPPMJOH QMBOU 5IF TBGFUZ PG UIF XPSLFST IZHJFOF SF FÎDJFODZ BSF UIF NBJO ESJWFST XIFO EFTJHOJOH UIF DPPMJOH QMBOU -PX QSF TPMVUJPO TFDPOEBSZ DJSDVJUT XJUI QSF JOTVMBUFE QMBTUJD QJQF PËFS B TJ TUBUF PG UIF BSU TPMVUJPO GPS JOEJSFDU SFGSJHFSBUJPO JOTUBMMBUJPOT

Applications

Air Conditioning +6/+12°C	Industrial Cooling Water	Data Centers	Commercial Refrigeration	Cold Stores	Industrial Refrigeration

1.4.2 Leading Systems (Samples)

COOL-FIT ABS	COOL-FIT ABS Plus (pre-insulated)	COOL-FIT 2.0 (pre-insulated)	COOL-FIT 4.0 (pre-insulated)	iFIT	ecoFIT and ELGEF
E r E NN 1/ E r E NN 1/	E r E NN 1/ E r E NN 1/	E r E NN 1/	E r E NN 1/	E E NN 1/	E r E NN 1/ r 1/
‹$ UP	‹$ ‹$ UP	‹$‹$ UP	‹$ ‹$ UP	‹$‹$ UP	‹$ ‹$ UP ‹$
Automation Measurement – Control – Actuation					

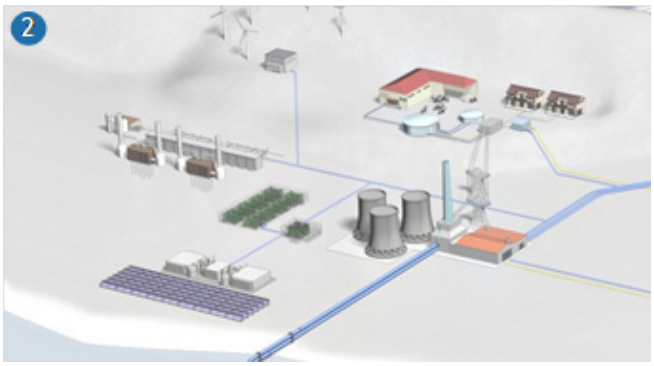
1.5 Energy

1.5.1 Overview

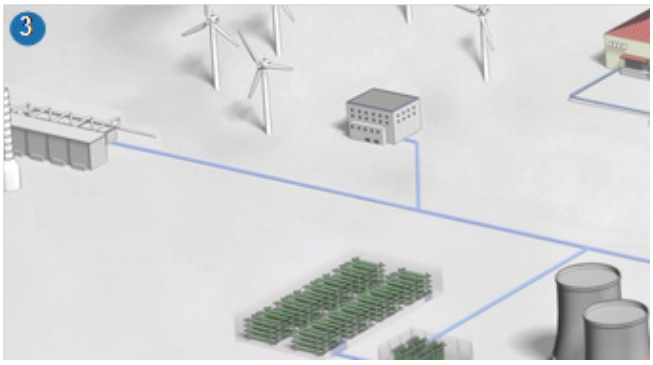
*O UIF HSPXJOH TFOTF PG TVTUBJOBCJMJUZ QSPGPVOE DIBOHFT BSF CFHJOOJOH FOFSHZ JT QSPEVDFE EFMJWFSFE BOE VTFE ('{1JQJOH 4ZTUFNT QSPWJEFT JOUSFTJTUBOU QMBTUJD TPMVUJPOT GPS TVDDFTTGVMMZ NBOBHJOH IJHIMZ TQFDJBMBQQMJDBUJPOT JO UPEBZmT BOE UPNPSSPXmT FOFSHZ QPXFS HFOFSBUJPO

$PSSPTJPO JT UIF CJHHFTU DPOUSJCVUPS UP QJQJOH TZTUFN GBJMVSFT JO B QPNJOE UIF HPBM JT UP SFQMBDF NFUBM QJQJOH XJUI UIFSNPQMBTUJD TPMVUJPOTSFTJTUBODF GPS VQ UP ZFBST EFQFOEJOH PO UIF BQQMJDBUJPO

Conventional power plants



Renewable energies



Pioneering green solutions

&OFSHZ QSPEVDUJPO JODMVEF DPBM HBT XBTUF UP FOFSHZ CJPHBT CJPNBTT BMHBDBSCPO DBQUVSF UP OBNF TPNF FYBNQMFT

Conventional Power Plants

$POWFOUJPOBM QPXFS HFOFSBUJPO VTJOH GPTTJM GVFMT PS OVDMFBS TPVSDFIBT B MBSHF XPSMEXJEF NBSLFU TIBSF BOE JT FYUFOEFE CZ JOOPWBUJWF OFX ETPMVUJPOT GPS DPPMJOH XBTUF BOE DIFNJDBM MJOFT BSF NBYJNJ[JOH TBGFUZ

Renewable Energies

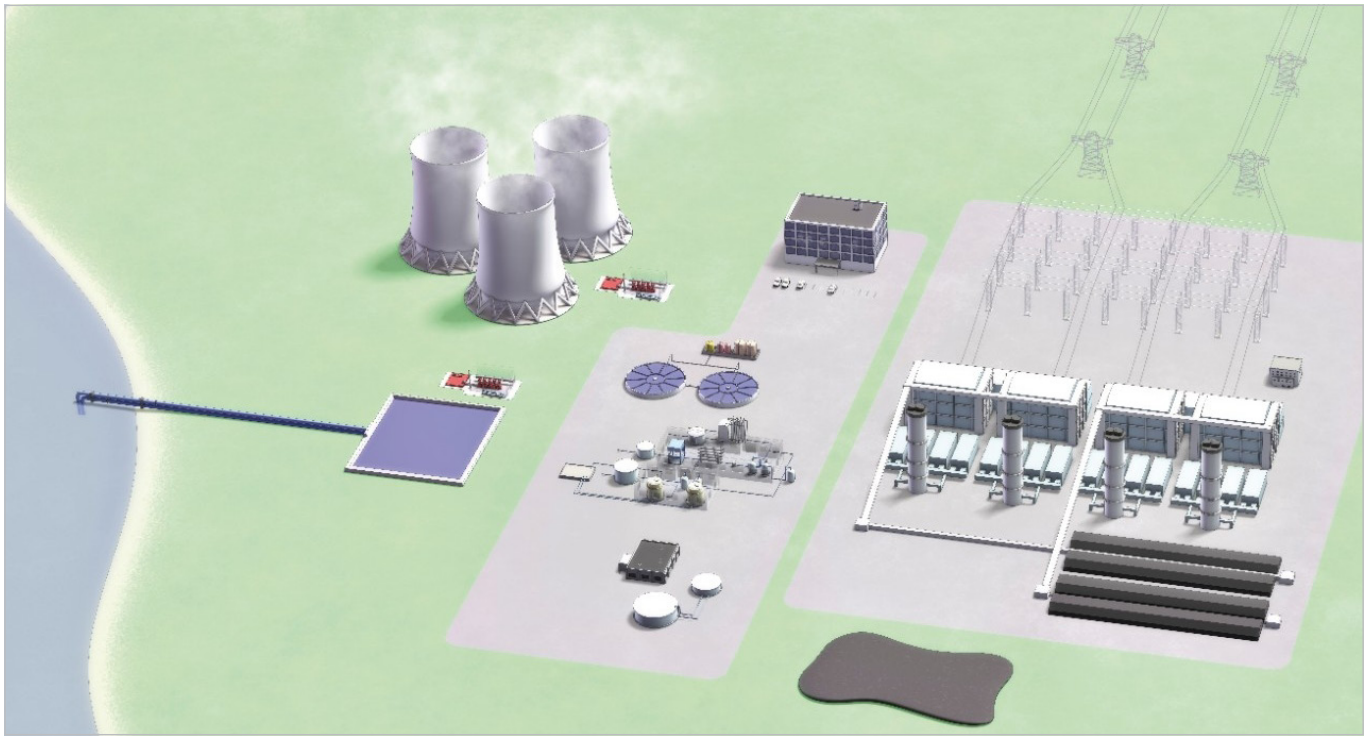
(FOFSBUJOH FOFSHZ CZ NFBOT PG SFOFXBCMF OBUVSBM SFTPVSDFT JT B EZOBNJHSPXUI SBUFT DPOUSJCVUJOH UP TVTUBJOBCMF FOFSHZ QSPEVDUJPO GPS UIF GDPPMJOH PS DPOUBJONFOU TZTUFN TPMVUJPOT GSPN ('{1JQJOH 4ZTUFNT JO XBUUSFBUNFOU SFEVDFT FOFSHZ DPTUT BOE QPUFOUJBM FOWJSPONFOUBM FËFDUT FTBGFUZ PO TJUF BU UIF TBNF UJNF

Pioneering Green Solutions

5IF EFWFMPQNFOU PG JOOPWBUJWF HSFFO UFDIOPMPHJFT GPS UIF JOUFMMJHFOUTPVSDFT PG FOFSHZ JT B IJHIMZ QSPNJTJOH NBSLFU PG UIF GVUVSF 1SPWJEJOHQSPEVDUT BOE UFDIOPMPHJFT JO XBUFS BOE DIFNJDBM NFEJB DPOWFZBODF ('{1PËFST DPTU FÎDJFOU TPMVUJPOT UIBU NFFU IJHIFTU IFBMUI TBGFUZ BOE FOWJSments.

Corrosion free piping systems for water and chemical applications in power generation

Industrial Cooling Water	Chemical Conveyance	Water Intake Lines	Flue Gas Desulfurization	Water Distribution	Gas Distribution	Fire Fighting



Safety Showers	Slurry Transfer	Water Treatment	Desalination	Makeup Water	Compressed Air	Hot & Cold Water in Buildings

1.5.2 Leading Systems (Samples)

ecoFIT and ELGEF	PVC-U	PVC-C	PROGEF	CONTAIN-IT Plus

E r E NNE r E NNE r E NNE r E NNE r E NN
1/ r 1/ 1/ r 1/ 1/ r 1/ 1/ r 1/

‹$ UP ‹$ UP ‹$‹$ UP ‹$‹$ UP ‹$ ‹$ UP ‹$

Automation
Measurement – Control – Actuation

BDD UP QSJNBSZ QJQF NBUFSJBM
"45.WFSTBVOUJMBCMF

1.6 Marine

1.6.1 Overview

4IJQT BOE QMBUGPSNT BSF FYQPTFE UP UIF GPSDFT PG OBUVSF 8JOE SBJO BOE IBSTI PO TUSVDUVSF IVMMT IPVTJOH BOE TVQQMZ MJOFT 1SFWFOUJOH DPSSPTJPO IFSF UIBO BOZXIFSF FMTF 8JUI ('{1JQJOH 4ZTUFNT QSPEVDUT DPSSPTJPO JT OP 5IF QMBTUJD QJQJOH TZTUFNT SFEVDF NBJOUFOBODF UJNF BOE JODSFBTF QSPEV

1MBTUJD QJQJOH TZTUFNT XFJHIU BQQSPY UJNF MFTT UIBO NFUBM 6TJOH QMB DPOUSJCVUF UP B MPXFS DBSCPO GPPUQSJOU PG UIF UPUBM JOTUBMMBUJPO

('{1JQJOH 4ZTUFNT PËFST *.0 DPNQMJBOU BOE GVMMZ BQQSPWFE QJQJOH TZTUFN BQQMJDBUJPOT QFSGFDUMZ TVJUBCMF GPS OFX CVJME BOE SFUSPÌU

Cruisers

Ferries

O shore

Commercial vessels

Cruise / ferries

$SVJTFT BOE GFSSJFT BSF ÍPBUJOH DJUJFT XIJDI OFFE TBGF DPOWFZBODF PG ES CMBDL XBUFS UPHFUIFS XJUI IJHI RVBMJUZ XBUFS USFBUNFOU (BMMFZ BOE MBV SFRVJSJOH DPSSPTJPO SFTJTUBOU BOE SFMJBCMF NBUFSJBM "JS DPOEJUJPOJOI POCPBSE DPNGPSU 1SF JOTVMBUFE QJQJOH DBO BMTP FOTVSF IJHIFS UIFSNBM F

O shore

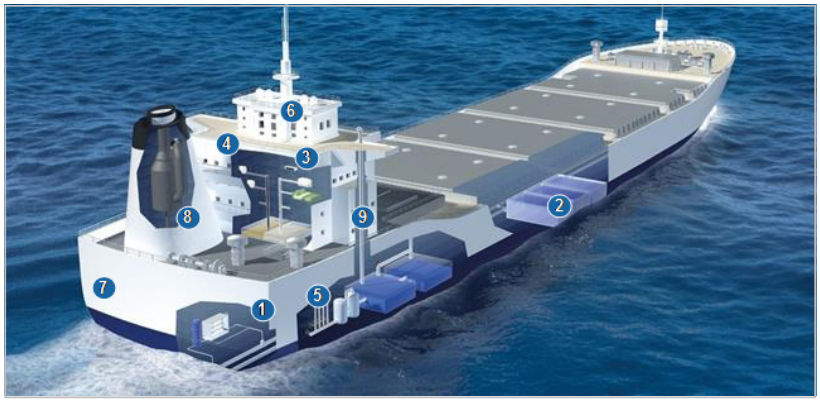
'MPUFMT BDDPNNPEBUJPOT BOE MJWJOH CBSHFT OFFE IJHIFS MJGF TUBOEBSE P BOE EP MB UE ST US J SV VD BR UD IN BF CE UF N JE JB TM US JE SV QB SP UJ DB ËM FB SM FE JOUFSOBMMZ BOE FYUFSOBMMZ CZ DPSSPTJPO BOE JODSVTUBUJPO

Commercial vessels

$PNNFSDJBM WFTTFM ÍFFUT PG MBSHF EJNFOTJPOT EPNJOBUF UPEBZmT XPSMEXJ
5IJT USFOE JT BDDPNQBOJFE CZ SJTJOH FOWJSPONFOUBM SFRVJSFNFOUT BOE TU
QPMMVUJPO SFTVMUJOH GSPN UIF FYQBOEFE USBEF BOE USBWFM $PNNFSDJBM
MJHIUFS BOE DPSSPTJPO SFTJTUBOU TPMVUJPOT PO CBMMBTU QJQJOH TZTUFN X
BOE HBT TDSVCCFS FÏVFOUT

('{1JQJOH 4ZTUFNT TVQQPSUT UIF JOEVTUSZ UP GBDF UIFTF UFDIOJDBM PQFSBU
FOWJSPONFOUBM DIBMMFOHFT 5IF DPSSPTJPO BCSBTJPO BOE DIFNJDBM SFTJTU
JEFBMMZ BEBQUFE UP UIF FYUSFNF DPOEJUJPOT PO UIF IJHI TFB PËFSJOH PVUT
BOE B MPOH TZTUFN MJGF DZDMF

Applications



Description
- Ballast Water Treatment
- Ballast System
  -)PU $8PBMUFS
  - (SFZ BOE8#BMMBTU L4IJQT
- Water Treatment
  - A$ $PPMJOH
  - $PNQSFTTFE "JS
  - AJS $MFBOJOH (BT 4DS
  - WBUFS 5SFBUJOH

1.6.2 Leading Systems (Samples)

INSTAFLEX	JRG SANIPEX MT	SeaDrain	PVC-U	PVC-C	ecoFIT and ELGEF
E r E NN 1/	E r E NN 1/	~ r o 4DIFEVEMFr E NN 1/ r 1/	E r E NN 1/ r 1/	E r E NN 1/ r 1/	‹$ UP ‹$
‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	
Automation Measurement – Control – Actuation					

1.7 Water Utilities

1.7.1 Overview

)ZHJFOJD ESJOLJOH XBUFS QVSF JO UBTUF TNFMM BOE BQQFBSBODF JT POF PG SFRVJSFNFOUT 5IF EFNBOE GPS B TFDVSF TVQQMZ PG DMFBO XBUFS JT JODSFBT UIF GVMM TQFDUSVN PG XBUFS TVQQMZ ('{1JQJOH 4ZTUFNT IBT B WBSJFUZ PG JO BOE TQFDJBMJ[FE QSPEVDUT EFTJHOFE TQFDJÌDBMMZ GPS UIF XBUFS EJTUSJCVU LOPX IPX BOE FYQFSUJTF GPS BMM XBUFS EJTUSJCVUJPO BQQMJDBUJPOT IFMQT GPS ZPVS BQQMJDBUJPO

Water transportation lines

8IFO USBOTQPSUJOH XBUFS B TBGF BOE SFMJBCMF DPOOFDUJPO JT UIF LFZ TVD TBNF UJNF JU DBO CF B DIBMMFOHJOH UBTL FTQFDJBMMZ BU MBSHF EJNFOTJPOT VOEFSTUBOET UIF OFFE GPS QSPQFS UPPMJOH IJHI QFSGPSNBODF KPJOUJOH UF DPOOFDUJPO QBSUT BT XFMM BT FYQFSU TVQQPSU PO TJUF

Water distribution lines

'PS UIF SFMJBCMF FDPOPNJDBM BOE TVTUBJOBCMF XBUFS EJTUSJCVUJPO JU JT DPNQPOFOUT MJLF QJQF ÌUUJOHT BOE WBMWFT BSF DPOOFDUFE TBGF BOE SFMJ PËFST B DPNQSFIFOTJWF SBOHF PG KPJOUJOH UFDIOPMPHJFT 5IF FMFDUSP GVT FOTVSFT B NBUFSJBM IPNPHFOFPVT DPOOFDUJPO PG QJQF BOE ÌUUJOH UIBU DPO OFUXPSL 8JUI UIF .6-5* +0*/5 TZTUFN BMM LJOET PG NBUFSJBMT DBO CF DPOOFD TBGF BOE TJNQMF XBZ

Water service lines and house connections

*O UIF MBTU TUBHF PG UIF XBUFS HSJE TFSWJDF MJOFT CSJOH XBUFS UP UIF NF BOE NBUFSJBM IPNPHFOFPVT KPJOUJOH UFDIOPMPHJFT BNPOHTU NBOZ PUIFS QF DIBSBDUFSJTUJDT 1& JT UPEBZnT NBJO VTFE NBUFSJBM GPS OFX JOTUBMMBUJPO &-(&' 1MVT FMFDUSP GVTJPO TZTUFN BO BQQSPQSJBUF TPMVUJPO DBO CF GPVOE &BDI JOEJWJEVBM &-(&' ÌUUJOH BOE TBEEMF JT NBEF UP NBUDI BOE XIFO QVU UP SFMJBCMF MFBL QSPPG DPOOFDUJPOT .BOZ EJËFSFOU DPNCJOBUJPOT DBO CF E QSPEVDUT "MTP 1& WBMWFT XJMM DPOUSJCVUF UP B SFMJBCMF BOE TBGF OFUX &-(&'{1MVT TZTUFN

Pressure sewage lines

3BUIFS UIBO HSBWJUZ UIF QSFTTVSF TFXBHF TZTUFN JT VTJOH QVNQT UP NPWF BMPOH UP UIF XBTUF XBUFS USFBUNFOU QMBOU 1SFTTVSF TFXBHF TZTUFNT BSF TNBMMFS EJBNFUFS QJQF UIBU BSF MFTT FYQFOTJWF BOE FBTJFS UP JOTUBMM $ ('{1&{TZTUFN B SFMJBCMF OFUXPSL GPS ZFBST DBO CF CVJMU

Irrigation

" HSPXJOH XPSME QPQVMBUJPO BOE UIF DIBOHJOH DMJNBUF FOIBODF UIF GPPE B
.PSF BOE NPSF GPPE QSPEVDUJPO XJMM CF TFQBSBUFE GSPN UIF MPDBM XFBUIF
HMBTT IPVTFT PS EPJOH FYUFOEFE JSSJHBUJPO TZTUFNT JO DSFBTJOH UIF PVUQVU PG GPP
TJNQMF UP JOTUBMM BOE FOTVSJOH B TFDVSF XBUFS EJTUSJCVUJPO PWFS UIF U
CFDPNF BO JNQPSUBOU BUUSJCVUF ('{1JQJOH 4ZTUFNT QSPWJEFT B DPNQSFIFO
GPS JSSJHBUJPO BT XFMM BT PO UIF MPDBM USBJOJOH BOE GBTU EFMJWFSJFT

1.7.2 Leading Systems (Samples)

ELGEF	MULTI/JOINT	iJOINT	Machines	Tools
E r E NN 1%/ r %/ NN E r E NN E r E NN		E r E NN	Butt fusion E NN r E NN Electrofusion 5SBOTGPSNFS .4" Electrofusion *OWFSUFS UFDIOPMPHZ .4"	E r E NN
&MFDUSP GVTJPOEÌUUJOHT TQJHPU ÌUUJOHT CFOET BOE TFHNFOUFE ÌUUJOHT		DPVQMJOHT UFFXJTCFGEFUFDIOPMPHZ VQEUEMFT NN USBOTÌUUJOHT VOJWFSBM		EJËFSFOU JOTUBMMB UPPMT FOBCMF FBTZ JOTUBMMBUJPO BOE IJHI RVBMJUZ KPJOU

1.8 Gas Utilities

1.8.1 Overview

'PS EFDBEFT HBT IBT CFFO EFMJWFSFE UISPVHI B OFUXPSL PG CVSJFE USBOTNJ
EJTUSJCVUJPO QJQF UP IPNFT BOE JOEVTUSJFT UISPVHIPVU UIF XPSME *U IBT H
NPTU EFQFOEBCMF GPSN PG FOFSHZ BOE CFJOH POF PG UIF DMFBOFTU TBGFTU
FOFSTHPZVSDFT

%VSJOH SFDFOU ZFBST UIF HBT TVQQMZ JOEVTUSZ IBT JOWFTUFE HSFBUMZ UP F
DPOTJTUFOU RVBMJUZ JO UIF PQFSBUJPO BOE NBJOUFOBODF PG HBT TVQQMZ OF
('{1JQJOH{4ZTUFNT DPOUJOVFT UP QSPWJEF IJHI RVBMJUZ TZTUFNT BOE TFSWJDI
NBJOUBJOJOH UIFTF OFUXPSLT UIVT DPOUSJCVUJOH UP UIF USBOTQPSUBUJPO PG
TFDVSF BOE SFMJBCMF XBZ

Gas transportation lines

8IFO USBOTQPSUJOH HBT B TBGF BOE SFMJBCMF DPOOFDUJPO JT UIF LFZ TVDDF
TBNF UJNF JU DBO CF B DIBMMFOHJOH UBTL FTQFDJBMMZ BU MBSHFS EJNFOTJPO
VOEFSTUBOET UIF OFFE GPS QSPQFS UPPMJOH IJHI QFSGPSNBODF KPJOUJOH UF
DPOOFDUJPO QBSUT BT XFMM BT FYQFSU TVQQPSU PO TJUF

Gas distribution lines

'PS UIF SFMJBCMF FDPOPNJDBM BOE TVTUBJOBCMF HBT EJTUSJCVUJPO JU JT FT
DPNQPOFOUT MJLF QJQF ÌUUJOHT BOE WBMWFT BSF DPOOFDUFE TBGF BOE SFMJ
PËFST B DPNQSFIFOTJWF SBOHF PG KPJOUJOH UFDIOPMPHJFT 5IF FMFDUSP GVT
FOTVSFT B NBUFSJBM IPNPHFOFPVT DPOOFDUJPO PG QJQF BOE ÌUUJOH UIBU DPO
OFUXPSL 8JUI UIF .6-5* +0*/5 TZTUFN BMM LJOET PG NBUFSJBMT DBO CF DPOOFD
TBGF BOE TJNQMF XBZ

Gas service lines and house connections

*O UIF MBTU TUBHF PG UIF HBT HSJE TFSWJDF MJOFT CSJOH HBT UP UIF NFUFS
NBUFSJBM IPNPHFOFPVT KPJOUJOH UFDIOPMPHJFT BNPOHTU NBOZ PUIFS QPTJU
1&{JT UPEBZnT NBJO VTFE NBUFSJBM GPS OFX JOTUBMMBUJPOT 5IBOLT UP UIF N
FMFDUSP GVTJPO TZTUFN BO BQQSPQSJBUF TPMVUJPO DBO CF GPVOE GPS FWFS
JOEJWJEVBM &-(&' ÌUUJOH BOE TBEEMF JT NBEF UP NBUDI BOE XIFO QVU UPHFUI
SFMJBCMF MFBL QSPPG DPOOFDUJPOT .BOZ EJËFSFOU DPNCJOBUJPOT DBO CF E
QSPEVDUT "MTP 1& WBMWFT XJMM DPOUSJCVUF UP B SFMJBCMF BOE TBGF OFUX
&-(&'{1MVT TZTUFN

1.8.2 Leading Systems (Samples)

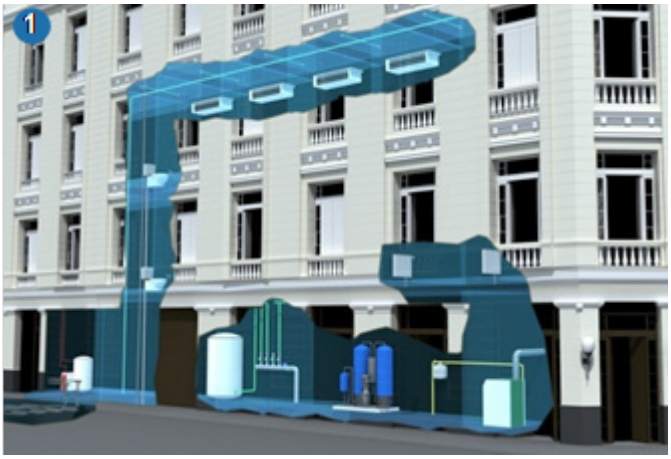
ELGEF	Ventile	MULTI/JOINT	Machines	Tools
E r E NN 1 1/& CBMM WBMW%T VrQ%U/P NN E r E NN 1/E NN			Butt fusion E NN r E NN	E r E NN
&MFDUSP GVTJPO Pressure Tapping T TQJHPU ÌUUJOHT 7TBMWF BOE TFHNFOU ÌUUJOHT		8JEF SBOHF PG	XJUI $/$ UFDIOPMPHZ UP E NN Electrofusion 5SBOTGPSNFS .4" Electrofusion *OWFSUFS UFDIOPMPHZ .4"	XJEF SBOHF PG EJËFSFOU JOTUBMMB UPPMT FOBCMF FBTZ JOTUBMMBUJPO BOE IJHI RVBMJUZ KPJOU

1.9 Building Technology

1.9.1 Overview

4VTUBJOBCJMJUZ DPNGPSU BOE IZHJFOF BSF BU UIF UPQ PG UIF XJTI MJTU GPS SFOPWBUJPO QSPKFDUT &OWJSPONFOU GSJFOEMZ BOE DPTU FÎDJFOU QJQJOH T EJËFSFODF JO UFSNT PG [FSP EFBE MFH OPJTF SFEVDUJPO DPSSPTJPO SFTJTU

1SFGBCSJDBUJPO JT CJH USFOE FWFO JODMVEJOH QSFGBCSJDBUFE CBUISPPN VC UIF PWFSBMM DPOTUSVDUJPO UJNF EVF UP GBDUPSZ QSPDFFEJOHT JO QBSBMMF CBUISPPN TVQQMZ UP UIF TJUF *ODPSQPSBUJOH EFTJHO BOE UIF TVQQMZ PG B Î QMVNCJOH BOE TBOJUBSZ QJQJOH TZTUFN NBLFT BMM UIF EJËFSFODF



Hotel

Hospital

Industrial buildings

Residential buildings

Hotels

)PUFMT BSF BO PBTJT PG DPNGPSU BOE DBMN (VFTUT FYQFDU ÌSTU DMBTT TFSW QFSGFDUMZ GVODUJPOJOH IZHJFOJD BOE FOWJSPONFOU GSJFOEMZ QJQJOH TZTU XBUFS IZHJFOF XJUI B GVMM IZHJFOJD DPODFQU QJQJOH TZTUFNT JO B IPUFM Q BDPVTUJD TPMVUJPOT GPS ESBJOBHF BOE XBUFS TVQQMZ TZTUFNT &OFSHZ TBW GVSUIFS DPOUSJCVUFT UP B NPSF TVTUBJOBCMF CVJMEJOH DIBOHFPWFS

Hospitals

)PTQJUBMT BOE IFBMUIDBSF GBDJMJUJFT BSF B QMBDF PG IFBMJOH BOE DPOWBM FOWJSPONFOU XBUFS IZHJFOF JT PG VUNPTU JNQPSUBODF XIFSF OP DPNQSPNJT 5IVT ESJOLJOH XBUFS JOTUBMMBUJPOT JO IPTQJUBMT NVTU CF DBSFGVMMZ QMB

Commercial and industrial buildings

$PNNFSDJBM BOE JOEVTUSJBM CVJMEJOHT BT XFMM BT SFTFBSDI GBDJMJUJFT IE UIFZ BMM OFFE BO FOWJSPONFOU GSJFOEMZ IFBUJOH BOE DPPMJOH TZTUFN BT X MFBL GSFF TVQQMZ PG ESJOLJOH XBUFS TQSJOLMFS XBUFS HBT BOE DPNQSFTT

Residential buildings / Green buildings

$PNGPSU IZHJFOF BOE TVTUBJOBCJMJUZ BSF UIF DVSSFOU LFZ USFOET JO NPEF SFOPWBUJPO PS FYUFOTJPO QSPKFDUT POF SFMJFT PO FOWJSPONFOU GSJFOEMZ TZTUFNT EVSBCMF FBTZ IBOEMJOH ESJOLJOH XBUFS JOTUBMMBUJPOT BOE MFBL systems.

1.9.2 Leading Systems (Samples)

iFIT	INSTAFLEX	JRG SANIPEX	JRG SANIPEX MT
E r E NN 1	E r E NN 1	E/ r E NN 1	E r E NN 1/
‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$

AQUASYSTEM (PP-R)	Silenta Premium	iLITE	GF Malleable Iron Fittings
E r E NN 1	E/ r E NN	E r NN 1/	UP JODI 1/
‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$	‹$ UP ‹$

1.10 Application-System Overview

	ABS	AQUASYSTEM	CONTAIN-IT Plus	COOL-FIT	ecoFIT	ELGEF Plus	iFIT	iJOINT	INSTAFLEX	JRG Sanipex	JRG Sanipex MT	Malleable Fittings	PROGEF	PRIMOFIT	PVC-C	PVC-U	SeaCor	SeaDrain	Silenta Premium	SYGEF	WAGA
"$ $PPMJOH	9	9		9	9	9	9		9		9										
"EWBODFE 8BUFS 1SPDFTTJOH PO 4IJQT					9	9															
Ballast Water					9	9															
#BMMBTU 8BUFS 5SFBUNFOU PO 4IJQT													9		9	9	9				
#JPMPHJDBM																				9	
$IFNJDBM %JTUSJCVUJPO $PO8WFZBODF													9		9	9				9	
$PNQSFTTJTSFE					9	9			9		9	9									
$PNNPO 5PXFST				9	9								9			9					
%JTUSJDU DPNNPO IFBUJOH				9		9			9												
%PTJOHHMVUJPO			9		9								9		9	9				9	
%SBJOBHFWFMJOFT																			9		
%SBX PË 4UBUJPO					9								9		9	9				9	
'JSFHIUJOH					9	9															
'JSF 1SPUFDUJPO 4QSJOLMFS 4ZTUFNT									9	9		9		9							
'JTI 'BSNT	9				9											9					
(BT %JTUSJCVUJPO MJOFT						9															9
(BT)PVTF $POOFDUJPOT 4FSWJDF -JOFT														9							9
(BT*OTUBMMBUJPO												9		9							
(BT .BJOUFOBODF BOE 3FQBJS						9								9							9
(BT 4DSVCCFS			9		9	9							9		9	9	9			9	
(BT 5SBOTQPSU MJOFT						9															9
(FPUIFSNBM					9	9			9				9		9	9					
(SFZ BOE #MBDL 8BUFS JO 4IJQT					9	9										9	9	9	9		
Heating							9			9	9	9		9			9				
)PU $PME 8BUFS		9					9		9	9	9				9		9				
*OEVTUSJBM $PPMJOH 8BUFS				9	9								9		9	9	9			9	
*SSJHBUJPO $POUSPM						9		9													
*PO &YDIBOHFS					9										9	9					
.FEJB 'JMUSBUJPO			9												9	9					
.JYJOH #BUDIJOH BOE 3BUJP $POUSPM					9								9		9	9				9	
/FVUSBMJ[BUJPO			9										9		9	9					
1SFTTVSF TFXBHF 8BTUF XBUFS						9															9
1SPDFTT $PPMJOH 8BUFS	9			9	9								9		9	9				9	
3FGSJHFSBUJPO	9			9	9	9	9				9										
4BGFUZXFST		9		9								9									
4FBN (BT -/(					9	9															9
4VSGBDFBUNFOU			9		9								9		9	9				9	
4XJNNJOHPPMT					9	9										9					
5BOLMMJOH			9		9								9		9	9				9	
6MUSBQVSF 8BUFS)PU 6MUSBQVSF 8BUFS																				9	
8BUFS .BJOUFOBODF BOE 3FQBJS						9		9						9							9
8BUFS %JTUSJCVUJPO MJOFT					9	9										9		9			9
8BUFS)PVTF $POOFDUJPOT 4FSWJDF -JOFT						9							9			9		9			9
8BUFS JOUBLF MJOFT					9	9															
8BUFS TUPSBHF						9															9
8BUFS 5SBOTQPSU -JOFT					9	9															9

4VJUBCJMJUZ PG TZTUFN TPMVUJPOT NBZ EJËFS BDD UP SFTQFDUJWF MPDBM OF

2 System and Product Solutions

('{1JQJOH 4ZTUFNT EFWFMPQT QSPEVDFT BOE NBSLFUT B DPNQSFIFOTJWF SBOH
TZTUFNT BOE DPNQPOFOUT JO B WBSJFUZ PG NBUFSJBMT VTFE XPSMEXJEF UP US
BOE BHHSFTTJWF NFEJB 0VS HPBM JT UP QSPWJEF DPNQSFIFOTJWF TZTUFN TPM
QJQF ÌUUJOHT WBMWFT UPPMT KPJOUJOH UFDIOPMPHZ BOE BVUPNBUJPO GPS
UIVT GVMÌMMJOH UIF FYQFDUBUJPO PG PVS DVTUPNFST

0VS JOEVTUSJBM TZTUFN TPMVUJPOT BSF BMM CBTFE PO DFSUJÌFE SBX NBUFSJB
SFRVJSFNFOUT PG UIF NPTU TJHOJÌDBOU JOUFSOBUJPOBM TUBOEBSET BOE PËFS
TPMVUJPOT UP PVS DVTUPNFST

2.1 Advantages of Industrial Plastic Piping Systems

Excellent Problem Solver

- $PSSPTJPO GSFF
- (PPE DIFNJDBM BOE UFNQFSBUVSF SFTJTUBODF
- /P FMFDUSJDBM DPOEVDUJWJUZ BOE MPX UIFSNBM DPOEVDUJWJUZ
- 4NPPUI JOOFS TVSGBDF
- -PX XFJHIU BOE IJHI ÍFYJCJMJUZ

Economic e ciency

- &YDFMMFOU QSJDF QFSGPSNBODF SBUJP JO JOTUBMMBUJPO BOE PQFSBUJOO
- -PX JOTUBMMBUJPO BOE NBJOUFOBODF DPTUT
- 4ZTUFN MJGFUJNF EF TJHO PWFS ZFBST

[1] 'PS EFUBJMFE XBSSBO
UFSNT BOE DPOEJUJPO
XXX HFQT DPN

Complete solutions

-)JHI RVBMJUZ TZTUFN DPNQPOFOUT
- #SPBE TFMFDUJPO PG WBMWFT XJUI NBOZ DPOOFDUJPO PQUJPOT
- 1SPWFO KPJOUJOH UFDIOPMPHJFT
- 8PSMEXJEF TFSWJDF $VTUPNJ[JOH FOHJOFFSJOH TFSWJDFT NBDIJOF SFOUBM
  TBMFT TVQQPS
- 4ZTUFN MJGF U JNF XBSSBOUZ

High quality

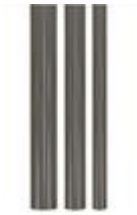
- $FSUJÌFE SBX NBUFSJBMT XJUI NBOZ BQQSPWBMT
- USBDFBCJMJUZ
- -PX $0 GPPUQSJOU PG QMBTUJD NBUFSJBM

2.2 Most Important Market Segments

Industrial Systems	Water treatment	Chemical process industry	Micro-electronics	Energy	Marine	Cooling
17$ 6	9	9	9	9	9	
17$ $		9	9	9	9	
ABS						9
4:(&' 17%'		9	9	9		
130(&' 11	9	9	9	9		
FDP'*5 1&	9	9	9	9	9	9
$00- '*5					9	9
$0/5"*/ *5 1MVT	9	9	9	9		

2.3 PVC-U Piping System

5IF QJQJOH TZTUFN NBEF PG 17$ 6 NBUFSJBM DBO CF VTFE GPS PQFSBUJOH UFNQ
SBOHF PG ‹$ UP ‹$ 5IBOLT UP PVUTUBOEJOH DIFNJDBM SFTJTUBODF 17$ 6 Q
XJUITUBOE EFNBOEJOH DPOEJUJPOT QBSUJDVMBSMZ EVSJOH UIF USBOTQPSU PG
BT BDJET CBTFT BOE TBMUT 5IF 17$ 6 TZTUFN JT XJEFMZ VTFE JO UIF DIFNJDBM
JOEVTUSZ JO XBUFS USFBUNFOU QSPDFTTFT GPS ESJOLJOH XBUFS BQQMJDBUJP


Pipes

Fittings

Jointing technology

Automation

Valves

Essential system properties

- 'PPE BOE ESJOLJOH XBUFS BQQSPWBMT QSPWFO QIZTJPMPHJDBM IBSNMFTTOFT
- 'JSTU DMBTT TPMVUJPO GPS BHHSFTTJWF NFEJB TVDI BT BDJET CBTFT BOE TE
- 4QBDF TBWJOH JOTUBMMBUJPO XJUI 130 '*5 TQJHPU TPDLFU ÌUUJOHT
- 4BGF BOE TJNQMF KPJOJOH UFDIOPMPHJFT XJUI MPX DPTUT GPS UPPMT BOE NB

Most important market segments

- Water treatment
- $IFNJDBM QSPDFTT JOEVTUSZ
- .BSJOF
- .JDSPFMFDUSPOJDT
- Energy

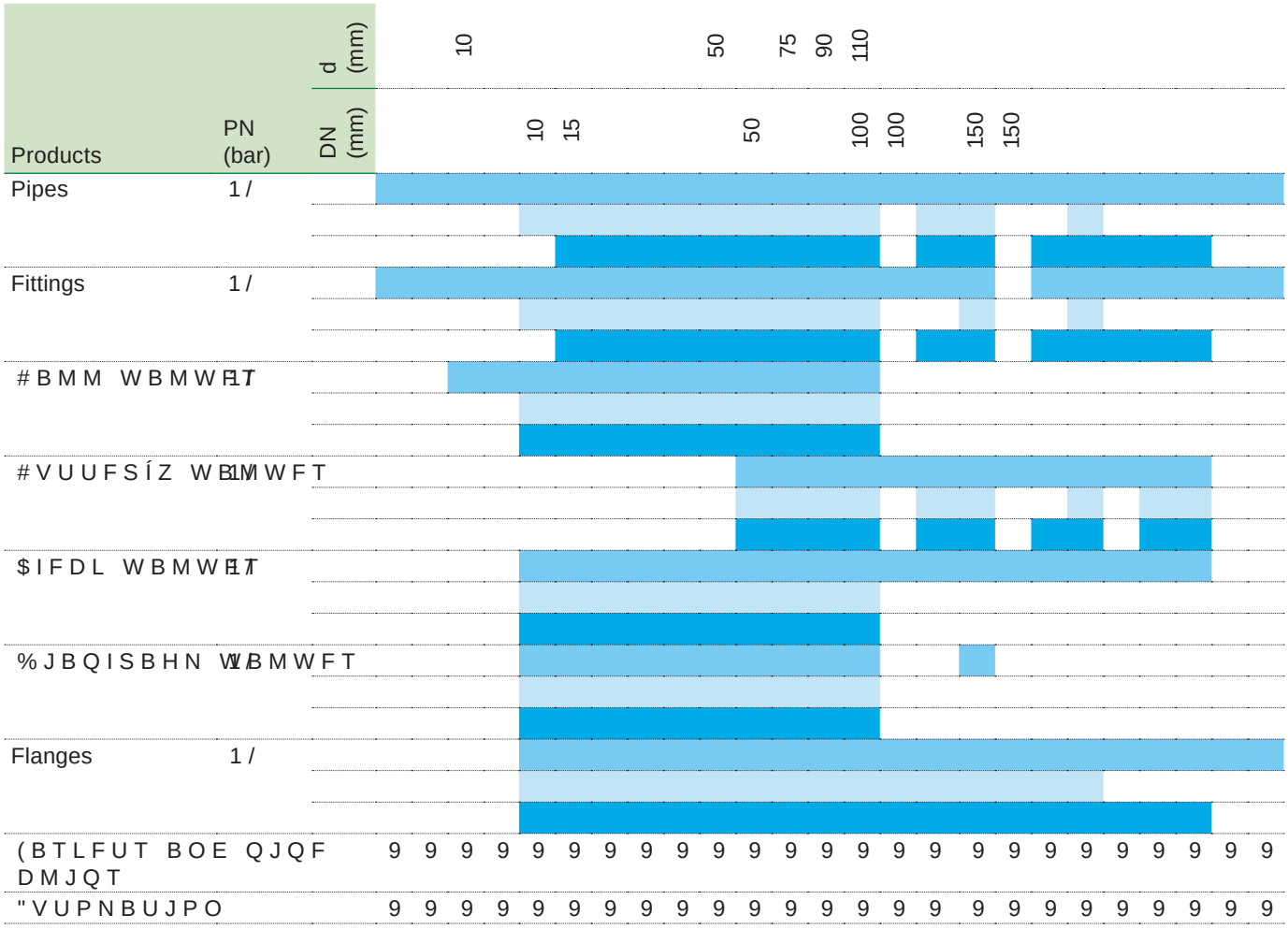
Technical data

/PNJOBM QSFTTVSF	6Q UP CBS
Temperature range	‹$ UP ‹$
+PJOUJOH IOPMPHZ	4PMWFOU DFNFOUJOH
Standards and guidelines[1)]	*40 &/ "45. #4 +*4 $& 3P)4 %*/ %74
"QQSPWBMT	%*#5 %7(8 (045 3 %(4 "$4 83"4 ,*8" $45# **1 "#4 #7 $$4 %/7 (- -3 3*/" 3.304

1) 'PS BEEJUJPOBM JOGP BCPVU BOE BSF FFMJOFT BOE BQQSPWBMT TFF XXX HGQT DPN

PVC-U product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF



'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG 17$ 6 WJTJU XXX H

5IF GPMMPXJOH UBCMF VTFT VOJUT PG NFBTVSF CBTFE PO UIF #4 JODI TZTUFN

Products	PN (bar)	d (mm)	10	12	16	20	25	32	40	50	63	75	90	110	125	140
Pipes	1/															
Fittings	1/															
#BMM WBMWF	1/															
#VUUFSÍZ WBMWFT	1/															
$IFDL WBMWF	1/															
%JBQISBHN WBMWFT	1/															
Flanges	1/															
(BTLFUT BOE QJQF DMJQT			9	9	9	9	9	9	9	9	9	9	9	9	9	
"VUPNBUJPO			9	9	9	9	9	9	9	9	9	9	9	9	9	

17$ 6ZTUFN

"#4 4ZTUFN

'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG 17$ 6 WJTJU XXX H

2.4 PVC-C Piping System

17$ $ QJQJOH TZTUFNT IBWJOH BO PQFSBUJPOBM UFNQFSBUVSF SBOHF GSPN ‹
TVJUBCMF GPS IJHI UFNQFSBUVSF FOWJSPONFOUT 5IF FYDFMMFOU NFDIBOJDBM
IJHI UFOTJMF TUSFOHUI TUJËOFTT BOE JNQBDU TUSFOHUI BSF FWJEFOU FWFO B
UFNQFSBUVSFT 17$ $ TZTUFNT BSF VTFE XIFSFWFS BHHSFTTJWF NFEJB TVDI BT
PS BDJET BU B IJHI UFNQFSBUVSF BSF USBOTQPSUFE GPS FYBNQMF JO UIF DIFN
JOEVTUSZ PS JO NFUBM USFBUNFOU BOE NJDSPFMFDUSPOJD QSPEVDUJPO

Pipes

Fittings

Jointing technology

Automation

Valves

Essential system properties

- 7FSZ HPPE NFDIBOJDBM QSPQFSUJFT FWFO BU IJHIFS UFNQFSBUVSFT
- 'MBNF SFUBSEBOU FYUJOHVJTIJOH
- 4BGF BOE TJNQMF KPJOUJOH UFDIOPMPHZ XJUI MPX DPTUT GPS UPPMT BOE NBU

Most important market segments

- $IFNJDBM QSPDFTT JOEVTUSZ
- .BSJOF
- .JDSPFMFDUSPOJDT
- Energy

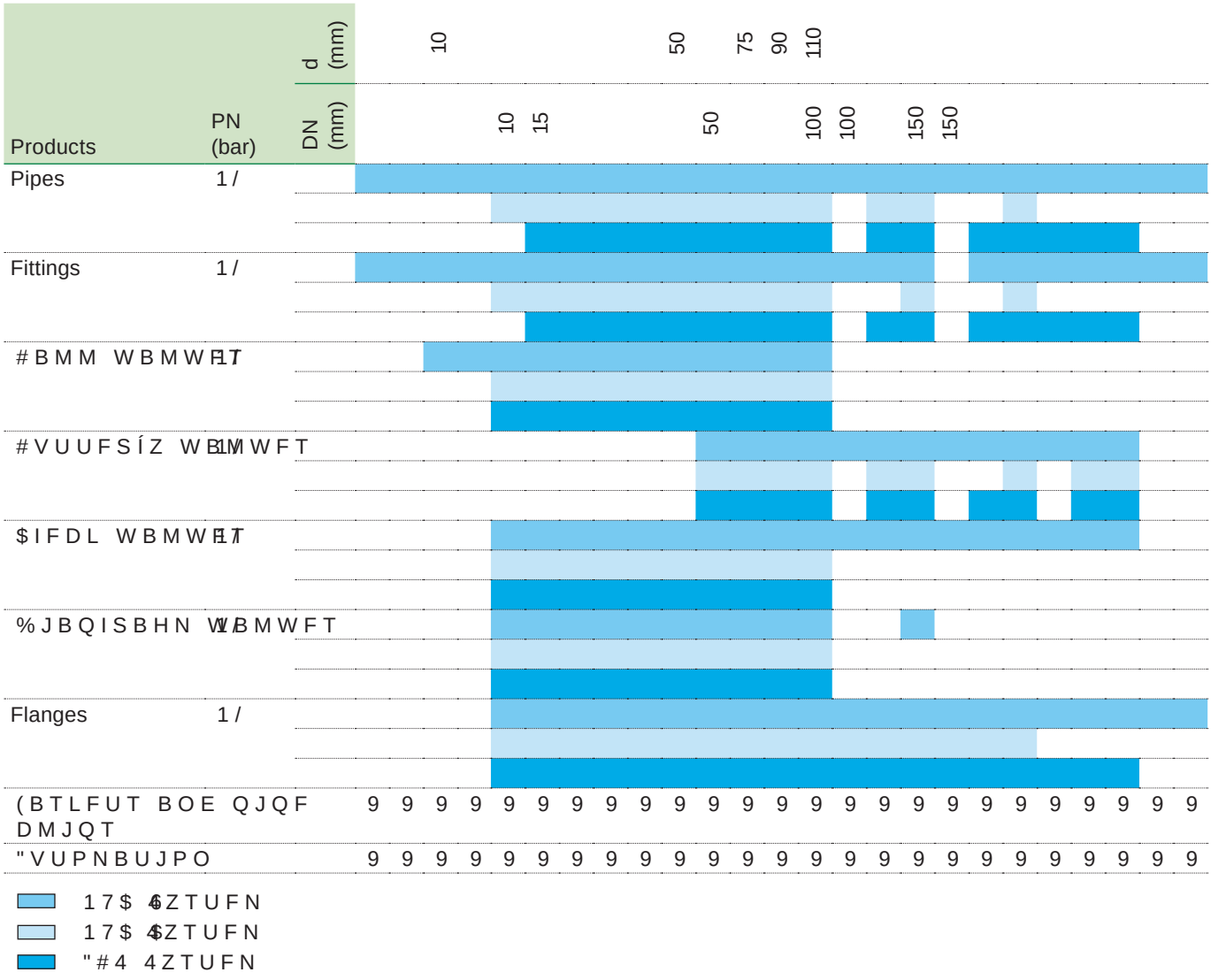
Technical data

/PNJOBM QSFTTVSF	6P UP CBS
Temperature range	‹$ UP ‹$
+PJOUFOHOPMPHZ	4PMWFOUDFNFOUJOH
Standards and guidelines[1)]	*40 &/ "45. #4 +*4 $& 3P)4 %*/ %74
"QQSPWBMT	%(4 "$4 83"4 (045 3 "#4 #7 $$4 %/7 (- -3 3*/" 3.304

1) 'PS BEEJUJPOBM JOGP BCPVU BOE BSFFFMJOFT BOE BQQSPWBMT TFF XXX HFQT DPN

PVC-C product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF



'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG 17$ $ WJTJU XXX

2.5 ABS Piping System

5IF PVUTUBOEJOH DIBSBDUFSJTUJDT PG "#4 BMMPX JUT BQQMJDBUJPO JO B XJEF
CFUXFFO ”$ UP ”$ 5IF FYDFQUJPOBMMZ IJHI OPUDIFE JNQBDU TUSFOHUI WB
UFNQFSBUVSFT JOEJDBUF UIF NBUFSJBMmT IJHI SPCVTUOFTT BOE UPMFSBODF U
"#4{TZTUFNT PËFS BO FOFSHZ FÎDJFOU TPMVUJPO GPS JOEVTUSJBM MPX UFNQFS
SFGSJHFSBUJPO BOE DPPMJOH TZTUFNT

Pipes	Fittings	Jointing technology	Automation	Valves

Essential system properties

- 0VUTUBOEJOH DIBSBDUFSJTUJDT PG "#4 BMMPX JUT BQQMJDBUJPO JO B XJEF
- -PX UIFSNBM DPOEVDUJWJUZ
-)JHI JNQBDU TUSFOHUI FWFO BU MPX UFNQFSBUVSFT
-)BMPHFO GSFF
- 4BGF BOE TJNQMF KPJOUJOH UFDIOPMPHZ XJUI MPX DPTUT GPS UPPMT BOE NBU

Most important market segments

- $PPMJOH
- Water Treatment

Technical data

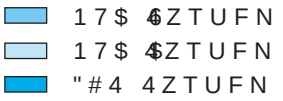
/PNJOBM QSFTTVSF	6P UP CBS
Temperature range	‹$ UP ‹$
+PJOUJOH UFDIOPMPHZ	4PMWFOU DFNFOUJOH
Standards and guidelines[1)]	*40 &/ "45. #4 +*4 $& 3P)4 %*/ %74
"QQSPWBMT	(045 3 "#4 #7 $$4 %/7 (- -3 3*/" 3.304

1) 'PS BEEJUJPOBM JOGPSNBUJPO BCPVU TUBOEBSET BQQSPWBMT BOE HVJEFMJOFT TFF XXX HGQT DPN

ABS product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Products	PN (bar)	d (mm) / DN (mm)	10 / 10	15 / 15	50 / 50	75 / 100	90 / 100	110 / 100	150 / 150	150 / 150
Pipes	1 /									
Fittings	1 /									
#BMM WBMWF	1									
#VUUFSGÍZ WBMWF	1									
$IFDL WBMWF	1									
%JBQISBHN WBMWF	1									
Flanges	1 /									
(BTLFUT BOE QJQF DMJQT			9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
"VUPNBUJPO			9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9



'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG "#4 WJTJU XXX HG

5IF GPMMPXJOH UBCMF VTFT VOJUT PG NFBTVSF CBTFE PO UIF #4 JODI TZTUFN

Produkte	PN (bar)	d (mm)	10	16	20	25	32	40	50	63	75	90	110	125	140	160
Pipes	10															
	16															
Fittings	10															
	16															
#BMM WBMWFT	10															
	16															
#VUUFSGÍZ WBMWFT	10															
	16															
$IFDL WBMWFT	10															
	16															
%JBQISBHN WBMWFT	10															
	16															
Flanges	10															
	16															
(BTLFUT BOE QJQF DMJQT			9	9	9	9	9	9	9	9	9	9	9	9	9	
"VUPNBUJPO			9	9	9	9	9	9	9	9	9	9	9	9	9	

17$ 4ZTUFN
"#4 4ZTUFN

'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG "#4 WJTJU XXX HG

2.6 SYGEF Piping Systems: Standard & Plus

5IF PVUTUBOEJOH QIZTJDBM BOE NFDIBOJDBM QSPQFSUJFT PG UIF 4:(&' QJQJOH QPMZWJOZMJEFOF ÍVPSJEF 17%' BTTVSF B TVQFSJPS QFSGPSNBODF GPS IJHIM BQQMJDBUJPOT JO UIF JOEVTUSJBM TFDUPS 4:(&' 4UBOEBSE DPNCJOFT UIF TBGF BOE BHHSFTTJWF DIFNJDBMT XJUI B WFSZ CSPBE UFNQFSBUVSF SBOHF ‹$ UP BEEJUJPO 4:(&' 1MVT XJUI JUT FYDFMMFOU TVSGBDF SPVHIOFTT BOE QVSJUZ P TPMVUJPO GPS UIF TVQQMZ PG IJHI QVSJUZ XBUFS JO UIF NJDSPFMFDUSPOJDT J

Pipes

Fittings

Jointing technology

Automation

Valves

Essential system properties

- 7FSZ IJHI UFNQFSBUVSF SBOHF BOE DIFNJDBM SFTJTUBODF
- &YUSFNFMZ TNPPUI TVSGBDF
- &YDFMMFOU QVSJUZ UIBOLT UP DPNQMFUFMZ DPOUSPMMFE DMFBOSPPN NBOVG

Most important market segments

- $IFNJDBM QSPDFTT JOEVTUSZ
- .JDSPFMFDUSPOJDT
- Energy

Technical data

/PNJOBM QSFTTVSF	6Q UP CBS
Temperature range	‹$ UP ‹$
+PJOUJOH IOMPHZ	4PDLFU GVTJPO
	#VUU GVTJPO
	*OGSBSFE *3 GVTJPO
	#FBE BOE DSFWJDF GSFF #$' GVTJPO
Standards and guidelines[1)]	*40 &/ "45. #4 +*4 $& 3P)4 %*/ %74
"QQSPWBMT	%*#U "4.& #1& '%" 641 DMBTT 7* '.

1) 'PS BEEJUJPOBM JOGP BCPVU BOE BSF FFMJOFT BOE BQQSPWBMT XXX HEQT DPN

SYGEF Standard, SYGEF Plus product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Products	PN (bar)	SDR)	DN (mm)	d (mm)
Pipes			10 15 50 100	50 75 90 110
	10			
4PDLFU GVTJPO ÌUUJOHT				
#VUU GVTJPO ÌUUJOHT *3 BOE #$' DPNQBUJCMF				
	10			
#BMM WBMWFT				
	10			
%JBQISBHN WBMWFT				On request
	10			
#VUUFSÍZ WBMWFT	10			
$IFDL WBMWFT				
	10			
Pressure regulating WBMWFT	10			
7FOUJMBUJOH BOE CMFFE WBMWFT				
Flanges				
(BTLFUT				
1JQF $MJQT				
"VUPNBUJPO				
*3 XFMEJOH				
#$' XFMEJOH				
#VUU GVTJPO[1] NBDIJOF				
4PDLFU GVTJPO NBDIJOF				

4:(&'4UBOEBSE

4:(&' 1MVT

1) #VUU GVTJPO GPS 4:(&' 4UBOEBSE JT UFDIOJDBMMZ QPTTJCMF CVU OPU SFDP GPS 4:(&' 1MVT JU JT OPU BMMPXFE

2.7 PROGEF Piping Systems: Standard, Plus, and Natural

130(&' TZTUFNT PVU PG QPMZQSPQZMFOF TIPX FYDFMMFOU QIZTJDBM QSPQFSUJF DIBSBDUFSJTUJDT 5IF IJHI RVBMJUZ NBUFSJBM BMMPXT BQQMJDBUJPOT JO B WF SBOHF ‹$ UP ‹$ 5IBOLT UP JUT IJHI DIFNJDBM SFTJTUBODF HPPE BCSBTJPO IJHI JNQBDU TUSFOHUI 130(&' 4UBOEBSE NFFUT BMM SFRVJSFNFOUT PG EFNBOEJ FOWJSPONFOUT $MFBOFE BOE QBDLFE JO TQFDJÌFE QSPDFTTFT UIF TJMJDPOF O 130(&' 1MVT TZTUFN IBT B IJHI QVSFOFTT GBDUPS 5IF TZTUFN JT XJEFMZ VTFE J BQQMJDBUJPOT JO NJDSPFMFDUSPOJDT BT XFMM BT JO DPBUJOH BOE TVSGBDF U JT B USBOTMVDFOU VOQJHNFOUFE QPMZQSPQZMFOF UIBU JT XIFSFWFS QVSF TPM CFOFÌDJBM QSPQFSUJFT TVDI BT FYDFMMFOU DMFBO TNPPUI TVSGBDF UPHFUIF DSFWJDF GSFF XFMEJOH FOTVSF UIF TZTUFN RVBMJUZ

Pipes

Fittings

Jointing technology

Automation

Valves

Essential system properties

-)JHI JNQBDU TUSFOHUI
-)JHI PQFSBUJOH UFNQFSBUVSF SBOHF
-)JHI TVSGBDF RVBMJUZ GPS 130(&' 1MVT
-)JHIFTU DMFBOMJOFTT BOE QSPUFDUJPO BHBJOTU DPOUBNJOBUJPO GPS 130(&'
- #FBE BOE DSFWJDF GSFF KPJOUJOH UFDIOPMPHZ GPS 130(&' /BUVSBM

Most important market segments

- Water treatment
- $IFNJDBM QSPDFTT JOEVTUSZ
- .JDSPFMFDUSPOJDT
- Energy

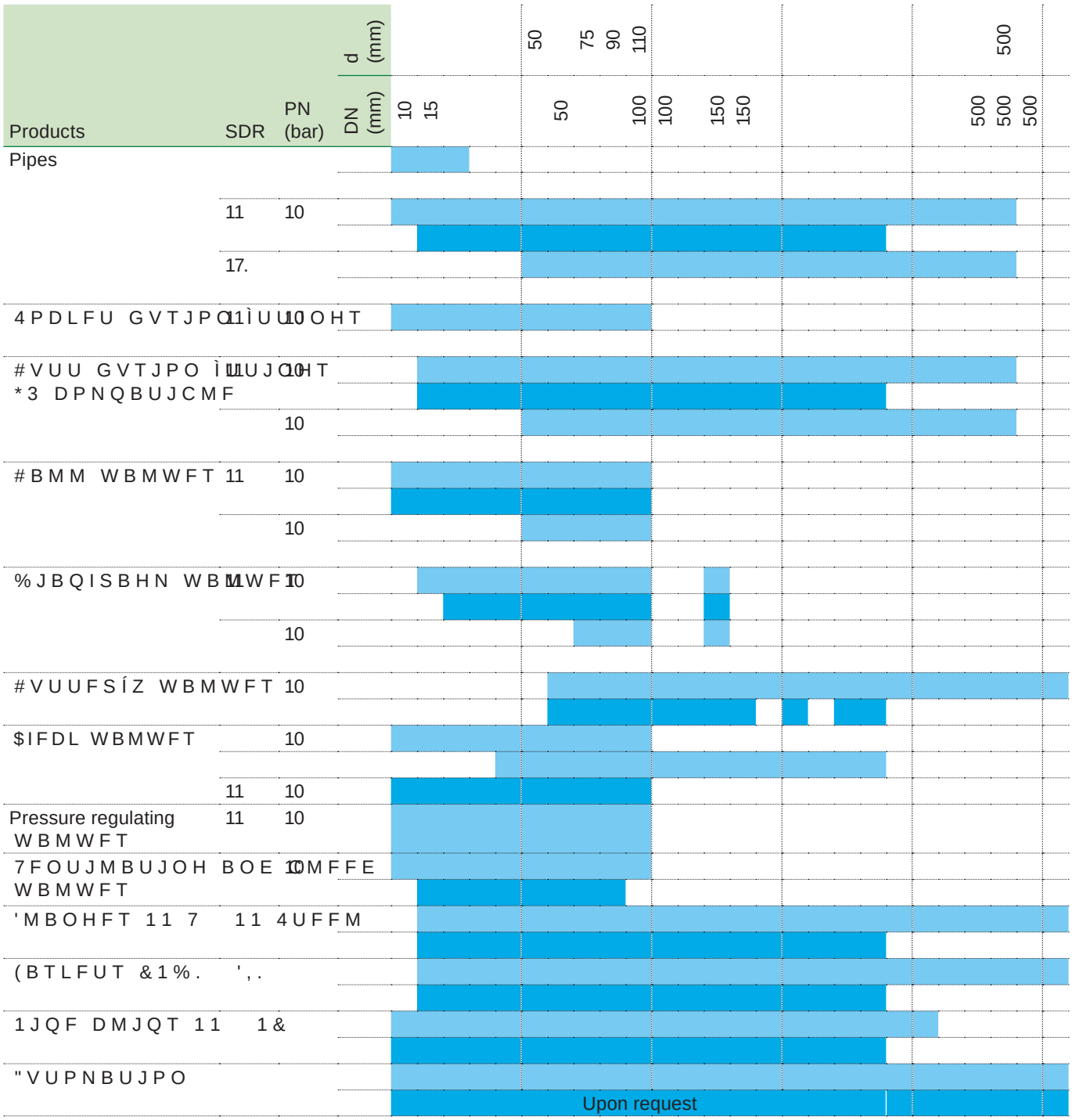
Technical data

/PNJOBM QSFTTVSF	6Q UP CBS
Temperature range	‹$ UP ‹$
+PJOUJOH UFDIOPMPHZ	4PDLFU GVTJPO
	#VUU GVTJPO
	*OGSBSFE *3 GVTJPO
	#FBE BOE DSFWJDF GSFF GVTJPO #$' GPS 130(&' /BUVSBM
Standards and guidelines[1]	*40 &/ %*/ %74
"QQSPWBMT	'%" 641 DMBTT 7* %M#U %/7 -MPZEnT 3FHJTUFS

1) 'PS BEEJUJPOBM JOGP BCPVU BOE BQQSPWBMT TFF XXX HDQT DPN

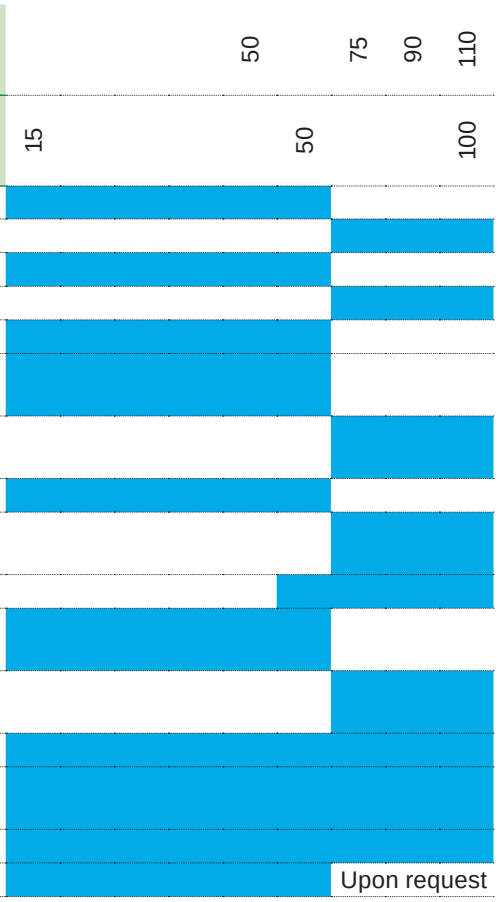
PROGEF Standard, PROGEF Plus product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF



Product overview PROGEF Natural

Products	SDR	PN (bar)	DN (mm)	d (mm)
Pipes	11	10		
#VUU GVTJPO ÌUUJOH	11	10		
*3 BOE #$' DPNQBUJCMF				
Sanitary adapter	11	10		
#BMM WBMWFT 11) CPEZ 11 3	11	10		
#BMM WBMWFT 11) 'MBOHFOOFDUPS		10		
%JBQISBHN WBMWFT 11 3	11	10		
%JBQISBHN WBMWFT 11) 'MBOHFOOFDUPS		10		
#VUUFSÍZ WBMWFT 11)		10		
$POF DIFDL WBMWFT 11) CPEZ 11 3	11	10		
$POF DIFDL WBMWFT 11) 'MBOHFOOFDUPS		10		
'MBOHF 11 7 11 4UFFM				
'MBOHF HBTLFUT &1%. ',.				
1JQF DMJQT 11 1&				
"VUPNBUJPO				



'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG 130(&' 4UBOEBSE
XXX HGQT DPN

2.8 ecoFIT Piping System

5IF FDP'*5 QJQJOH TZTUFN JT CBTFE PO UIF NBUFSJBM QPMZFUIZMFOF XIJDI NFF SFRVJSFNFOUT JO UIF JOEVTUSJBM FOWJSPONFOU *U BMMPXT BQQMJDBUJPOT J SBOHF ‹$ UP ‹$ BOE GFBUVSFT IJHI 67 SFTJTUBODF HPPE BCSBTJPO SFTJ JNQBDU TUSFOHUI 7BMWF CPEJFT NBEF PG 17$ 6 PS 11) XJUI 1& FOE DPOOFDUJ JOUFHSBUJPO JO UIF FDP'*5 TZTUFN 5P QSPWJEF B NBYJNVN PG ÍFYJCJMJUZ UII TPDLFU XFMEJOH CVUU XFMEJOH TQJHPUT PS ÍBOHFT

Pipes

Fittings

Jointing technology

Automation

Valves

Essential system properties

- 67 BOE XFBUIFS SFTJTUBOU
- 0VUTUBOEJOH TUBCJMJUZ
-)JHI JNQBDU TUSFOHUI QBSUJDVMBSMZ BU MPX UFNQFSBUVSFT
-)JHI ÍFYJCJMJUZ

Most important market segments

- Water treatment
- $IFNJDBM QSPDFTT JOEVTUSZ
- Energy
- .BSJOF
- $PPMJOH
- .JDSPFMFDUSPOJDT

Technical data

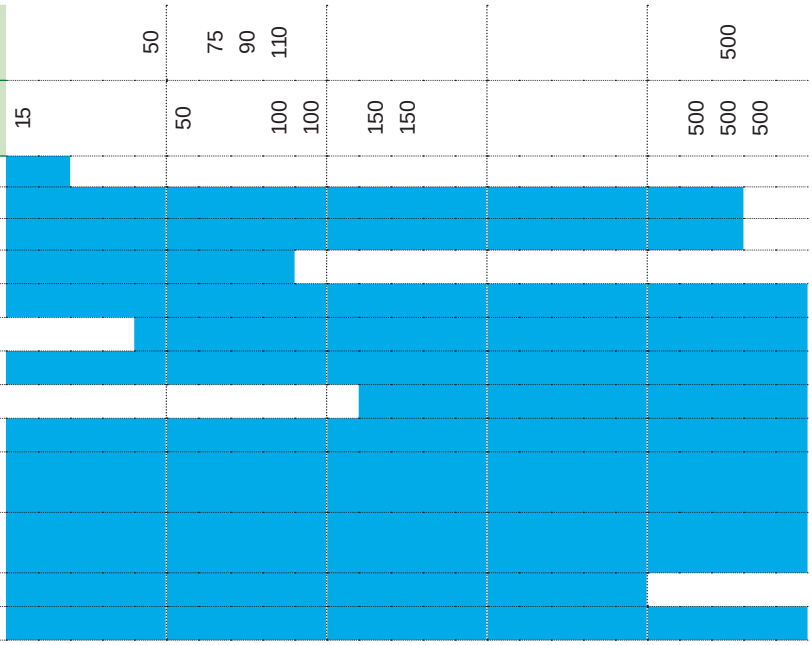
/PNJOBM QSFTTVSF	6P UP CBS
Temperature range	‹$ UP ‹$
+PJOUJOH UFDIOPMPHZ	4PDLFU GVTJPO
	#VUU GVTJPO
	*OGSBSFE *3 GVTJPO
	&MFDUSPGVTJPO
Standards and guidelines[1]	*40 &/ %74
"QQSPWBMT	%*#U '. **1 "#4 %/7 (- 3*/" 3.304 $$4 /L BQQSPWFE

1) 'PS BEEJUJPOBM JOGP BCPVU BOE BQQSPWBMT TFF XXX HDQT DPN

ecoFIT product overview

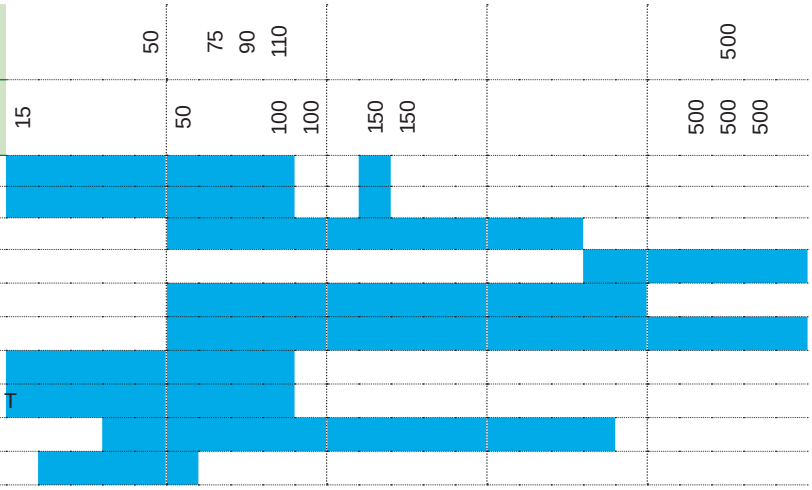
5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Products	Material	SDR	PN (bar)	DN (mm) / d (mm)
Pipes	PE100			
		11		
			10	
4PDLFU GVTJPO 1È&UJC11HT		11	10	
#VUU GVTJPO ÌUPE100HT	PE100	11		
*3 DPNQBUJCMF			10	
&MFDUSPGVTJPOHT	PE100	11		
&-(&'			10	
7BMWFT				
Flanges	11 7			
	11 45			
(BTLFUT	&1'.			
	', .			
1JQF DMJQT	11 1&			
"VUPNBUJPO				



Valve product range

Products	Ventilkörper	DN (mm) / d (mm)
#BMM WBMWFT	11) 17$ 6	
%JBQISBHNWBMWFT	11) 17$ 6	
#VUUFSÍZ WBMWFT	11)	
	11 3	
	17$ 6	
	.FUBM	
$POF DIFDL WBMWFT	11) 17$ 6	
7FOUJMBUJOH BOE 1C1M)F F1E7 $WB MWFT		
$IFDL WBMWFT	11) 17$ 6	
1SFTTVSF DPOUSPM 1W)B M1W7F 6		



'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG FDP'*5 WJTJU XXX

2.9 CONTAIN-IT Plus Piping System

5IF $0/5"*/ *5 1MVT QJQJOH TZTUFN JT VTFE UP NJOJNJ[F SJTLT UP IVNBOT UIF F
UIF QMBOU &YJTUJOH MFHBM SFHVMBUJPOT PS PSEJOBODFT DPVME TQFDJGZ EP
TZTUFNT ('{1JQJOH 4ZTUFNT FOTVSFT FYDFMMFOU QFSGPSNBODF JO USBOTQPSU
PS IB[BSEPVT NFEJB JO BMM UZQFT PG EJËFSFOU BQQMJDBUJPOT 5IF $0/5"*/ *5
GPS NFEJB MJOFT JT BWBJMBCMF JO B WBSJFUZ PG QMBTUJDT 11 1& 17%' 17$
QSPUFDUJWF MJOF JT NBEF PG 1& SFTVMUJOH JO IJHI 67 BOE XFBUIFS SFTJTUBC
('{1JQJOH 4ZTUFNT PËFST BT XFMM o17$ 6p PS oUSBOTQBSFOU 17$ 6p BT PVUTJE

Pipes

Fittings

Jointing technology

Leak monitoring

Valves

Essential system properties

- 4VJUBCMF GPS WJTVBM JOTQFDUJPO BOE JEFOUJÌDBUJPO
- 1SPUFDUJPO PG QFSTPOOFM BOE UIF FOWJSPONFOU
- "EBQUBCMF MFBL NPOJUPSJOH TZTUFN
- $PNQMJBODF XJUI MFHBM SFHVMBUJPOT

Most important market segments

- Water treatment
- $IFNJDBM QSPDFTT JOEVTUSZ
- .JDSPFMFDUSPOJDT
- Energy

Technical data

/PNJOBM QSFTTVSF	6Q UP CBS	[1] 'PS BEEJUJPOBM JOGP BCPVU WBDVVN BOE TFF BOE BQQSPWBMT TFF XXX HFQT DPN
Temperature range	‹$ UP ‹$ BDD UP QSJNBSZ QJQF NBUFSJBM	
+PJOUJOH IOPMPHZ	Inside pipe 4PDLFU GVTJPO	
	#VUU GVTJPO	
	*OGSBSFE *3 GVTJPO	
	4PMWFOU TPDLFU JOH	
	&YUFSJPS &MFDUSPGVTJPO .FDIBOJDBM KPJOU XJUI &1%. TMFFWF	
Standards and guidelines[2]	*40 &/ *40 "45. %*/ %74	
"QQSPWBMT[3]	1MFBTF SFGFS UP UIF 130(&' FDP'*5 4:(&' 17$ 6 BOE 17$ $	

Produktübersicht CONTAIN-IT Plus

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Material (inner/outer)	Products	PN_{inner} (bar)	PN_{outer} (bar)	d_i [1] (mm)	d_o [1] (mm)
11) 1&	4PDLFU GVTJPO ÌUUJOHT	10			
		10	10		
	#VUU GVTJPO ÌUUJOHT JOGSBSFE DPN	10			
	QBUJCMF	10	10		
	#BMM WBMWFT	10			
	%JBQISBHN WBMWFT	10			
	.FDIBOJDBMMZ KPJOFE TUFFM	10			
1& 1&	#VUU GVTJPO *3 GVTJPO ÌUUJOHT				
			10		
	#BMM WBMWFT IPVTJOH 17$ 6	10			
	#BMM WBMWFT IPVTJOH 11)	10			
	.FDIBOJDBMMZ KPJOFE TUFFM	10			
1& 1&	4PDLFU GVTJPO ÌUUJOHT	10			
		10	10		
	#BMM WBMWFT IPVTJOH 17$ 6 11)	10			
	.FDIBOJDBMMZ KPJOFE TUFFM	10			
17%' 1&	4PDLFU GVTJPO ÌUUJOHT				
			10		
	#VUU GVTJPO *3 GVTJPO ÌUUJOHT				
			10		
		10	10		
	#BMM WBMWFT				
	%JBQISBHN WBMWFT	10			
	.FDIBOJDBMMZ KPJOFE TUFFM				
17$ 6 1&	$FNFOUFE TPDLFUT ÌUUJOHT				
			10		
		10	10		
	#BMM WBMWFT				
	%JBQISBHN WBMWFT	10			
	.FDIBOJDBMMZ KPJOFE TUFFM				
17$ $ 1&	"EIFTJWF GJOJTI				
			10		
	#BMM WBMWFT				
	%JBQISBHN WBMWFT	10			
	.FDIBOJDBMMZ KPJOFE TUFFM				
-FBLQPJOUPSJOH					

[1] d_P %JNFOTJPO PG UIF PVUFS QJQF
d_i %JNFOTJPO PG UIF JOOFS QJQF

'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG $0/5"*/ *5 1MVT W
BOE TFF UIF QMBOOJOH GVOEBNFOUBMT JO DIBQUFS c%PVCMF DPOUBJONFOU Q
$0/5"*/ *5 1MVTo

2.10 COOL-FIT Piping Systems

$PPMJOH JO HFOFSBM DBO CF EJWJEFE JOUP CBTJD BQQMJDBUJPO BSFBT POF J
‹' DBMMFE JOEVTUSJBM SFGSJHFSBUJPO BOE UIF PUIFS POF JT BCPWF ‹$ ‹'
TVDI BJS DPOEJUJPOJOH TZTUFNT PS QSPDFTT DPPMJOH

('{1JQJOH 4ZTUFNT PËFST TJODF NBOZ ZFBST UIF QSF JOTVMBUFE $00- '*5 "#4 1M
DIBQUFS UP DPWFS BMM DPPMJOH BQQMJDBUJPOT *O BEEJUJPO ('{1JQJOH
UIF OFX QSF JOTVMBUFE $00- '*5 SBOHF XIJDI JT CBTFE PO UIF 1& &MFDUSPGV
GPS UIF QSJNBSZ QJQF BOE UBSHFUT BCPWF ‹$ ‹' BQQMJDBUJPOT TFF DIBQU
$00- '*5 JT FYUFOEFE UP CFMPX ‹$ ‹' BQQMJDBUJPOT IBWJOH B UIJDLFS JO
$00- '*5

2.10.1 COOL-FIT ABS Plus / COOL-FIT 4.0

$00- '*5 TZTUFNT BSF DPNQMFUFMZ QSF JOTVMBUFE QMBTUJD QJQJOH TZTUFNT G
DJSDVJUT UIBU BSF PQFSBUFE XJUI XBUFS CSJOF PS HMZDPM TPMVUJPOT BT XF
BQQMJDBUJPO BSFBT BSF JOEVTUSJBM SFGSJHFSBUJPO TZTUFNT XJUI NFEJVN UP
{‹$ BOE BJS DPOEJUJPOJOH TZTUFNT GPS NFEJB BCPWF ‹$

('{1JQJOH 4ZTUFNT PËFS UXP QSPEVDU WBSJBOUT

- $00- '*5 "#4 1MVT
- $00- '*5

'PS UIF QJQF BOE ÌUUJOHT PG UIF $00- '*5 "#4 1MVT TZTUFN UIF JOTJEF NFEJB Q
MPX UFNQFSBUVSF JNQBDU SFTJTUBOU "#4 NBUFSJBM GPS $00- '*5 TZTUFN UI
NBEF PG 1& 'PS CPUI TZTUFNT UIF NFEJB QJQF JT DPWFSFE CZ IJHI RVBMJUZ ('
XFMM BT B SPCVTU BOE 67 SFTJTUBOU KBDLFU QJQF 5IF TNPPUI JOTJEF TVSGBD
FOTVSFT WFSZ MPX QSFTTVSF MPTTFT 5IF MPX UIFSNBM DPOEVDUJWJUZ PG UIF
JOTVMBUJPO BSF B HVBSBOUFF GPS MJGF MPOH MPX FOFSHZ BOE PQFSBUJOH DP
EFTJHO MJNJUT UIF JOTUBMMBUJPO UJNF UP B NJOJNVN

$00- '*5 "#4 1MVT BOE $00- '*5 TZTUFNT BSF XFMM TVJUFE GPS VTF JO DPME T
QSPEVDUJPO F H JO CSFXFSJFT EBJSJFT BOE TMBVHIUFSIPVTFT JO TVQFSNBS
JOEVTUSJBM DPPMJOH XBUFS TZTUFNT GPS QSPDFTT DPPMJOH BOE JO DPNQVUJ

COOL-FIT systems		Compatible components		
COOL-FIT ABS Plus	COOL-FIT 4.0	Jointing technology	Automation	Valves

Essential system properties

- JO TZTUFN NFEJB QJQF JOTVMBUJPO BOE QSPUFDUJWF PVUFS TIFBUI JO PO
- 2VJDPOOFDUJPO
  - $00- '*5 "#4 1MVT QBUFOUFE DPOOFDUJPO XJUI JOTJEF OJQQMF XJUIPVU SFN JOTVMBUJPO
  - $00- '*5 QSF JOTVMBUFE FMFDUSPGVTJPO ÌUUJOHT
- 6TFT BQQSPY MFTT FOFSHZ JO PQFSBUJPO DPNQBSFE UP QPTU JOTVMBUFE
- 67 BOE XFBUIFS SFTJTUBOU TUFBN KFU DPNQBUJCMF

Most important market segments

- $PPMJOH
- .BSJOF

Technical data

/PNJOBM QSFTTVSF	SQ UP CBS GPS $00- '*5 "#4 1MVT VQ[1] UP 'PS CBS GPS $00- J*5 BCPWF BOE BSF FFMJOFT BOE BQQSPWBMT TFF XXX HFQT DPN
Temperature range	‹$ UP ‹$ GPS $00- '*5 "#4 1MVT ‹$ UP ‹$ GPS $00- '*5
+PJOUJOH NFUIPE	4PMWFOU DFNFOUJOH GPS $00- '*5 "#4 1MVT
	&MFDUSPGVTJPO GPS $00- '*5 1& 1MVT
Standards and guidelines[1]	*40 &/ *40 "45. %*/ %74
"QQSPWBMT[2]	1MFBTF SFGFS "#4 BOE FDP'*5

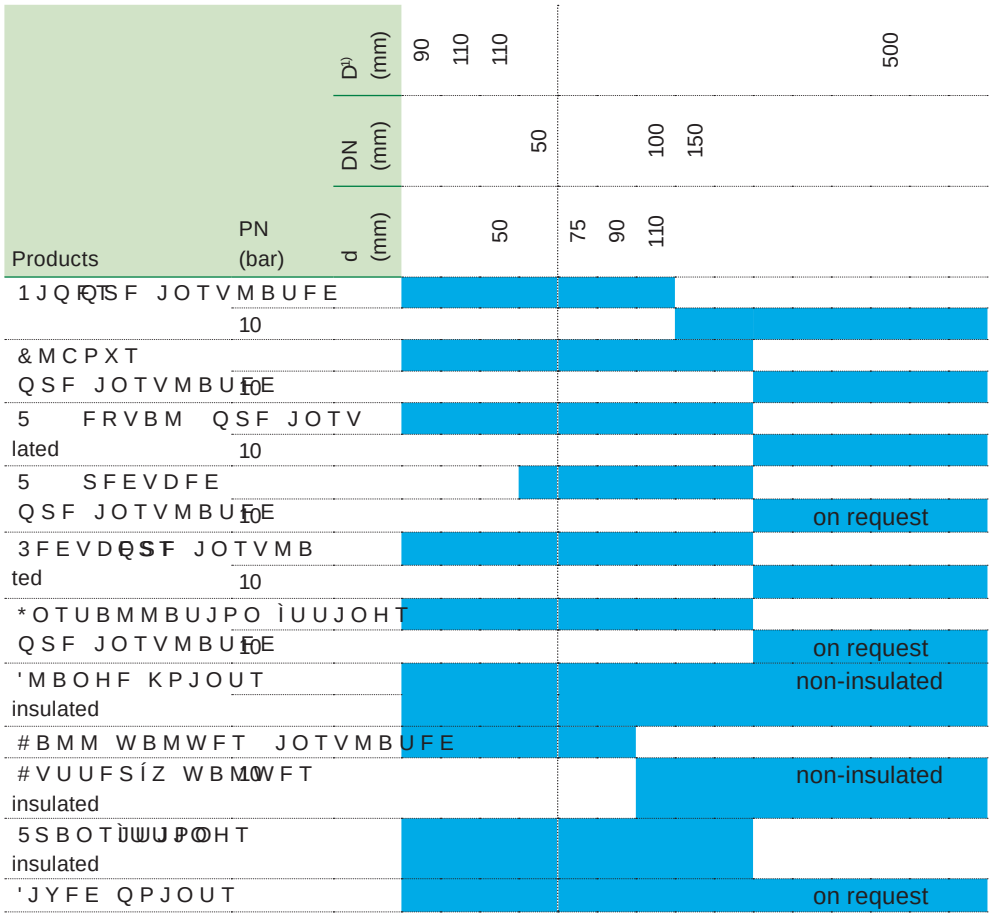
COOL-FIT ABS Plus product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Products	PN (bar)	d (mm)	DN (mm)	D[1] (mm)
1JQF FOET QSF JOTVMBUFE	10	50	50	90
				90
#FOET QSF JOTVMBUFE	10	50	50	110
5 FRVBM QSF JOTVlated	10	50	50	110
5 SFEVDFE QSF JOTVMBUFE				
*OTUBMMBUJPO ÌUUJOHT QSF JOTVMBUFE	10	50	50	110
#BMM WBMWFT	10	50	50	110
#VUUFSÍZ WBMWFT	10	50	50	110
%JBQISBHN WBMWFT	10	50	50	110
$IFDL WBMWFT	10	50	50	110
'MBOHFT	10	50	50	110
5SBOTJUJPOT QJQF NBUFS	10	50	50	110
(BTLFUT BOE QJQF DMJQT	10	50	50	110
"VUPNBUJPO	10	50	50	110
$FNFOUJOH	10	50	50	110
5SBOTJUJPOT QJQF NBUFS	10	50	50	110
		75	65	125
		90	80	140
		110	100	160
			125	180
			150	200
				225
				250
				280
				315
				355
				400
				450
				500
				560
				630

Upon request

COOL-FIT 4.0 product overview



[1] %VSDINFTTFS WPN 4D
mantel

'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG $00- '*5 WJTJU XX
TFF UIF QMBOOJOH GVOEBNFOUBMT DIBQUFS 4ZTUFN $00- '*5o

2.10.2 COOL-FIT 2.0 / COOL-FIT2.0 M

$00- '*5 JT B QSF JOTVMBUFE QJQJOH TZTUFN GPS UIF EFMJWFSZ PG SFGSJHF JOTVMBUJPO UIJDLOFTT PG NN UIF TZTUFN DBO CF VTFE JO BJS DPOEJUJPOJO DPPMBOUT UFNQFSBUVSFT BCPWF ‹$ $00- '*5 JT CBTFE PO FTUBCMJTIFE JN BOE DPSSPTJPO GSFF 1& QJQF BOE ÌUUJOHT 5IF TNPPUI JOOFS TVSGBDF PG UIF NJOJNBM MPTTFT PG QSFTTVSF 5IF MPX UIFSNBM DPOEVDUJWJUZ BOE IJHI RVBM HVBSBOUFF MPX PQFSBUJOH DPTU PWFS UIF FOUJSF MJGFTQBO PG UIF TZTUFN 5 EFTJHO r 'MVJE QJQF *OTVMBUJPO +BDLFU UVCF r JOTUBMMBUJPO UJNF JT LFC

5IF TZTUFN DPOTJTUT PG QJQF ÌUUJOHT WBMWFT ÍFYJCMF IPTFT BOE USBOTJU DPNQPOFOUT BSF QSF JOTVMBUFE PS TVQQMJFE XJUI NPVOUBCMF JOTVMBUJPO T UPPMT BMMPX GPS GBTU BOE TBGF JOTUBMMBUJPO PG UIF TZTUFN

$00- '*5 SZTUFNT	$PNQBUJCMF DPNQPOFOUT			
COOL-FIT 2.0	COOL-FIT 2.0M	COOL-FIT 4.0	ecoFIT PE	iFIT

Essential system properties

- JO TZTUFN NFEJB QJQF JOTVMBUJPO BOE QSPUFDUJWF PVUFS KBDLFU
- GBTUFS JOTUBMMBUJPO UIBO DPOWFOUJPOBM TZTUFNT
- CFUUFS JOTVMBUJPO QFSGPSNBODF UIBO QPTU JOTVMBUFE NFUBM TZTUFNT
- $PSSPG SIPO

Most important market segments

- $PPMJOH ‹$ ‹'
- .BSJOF

Technical data

/PNJOBM QSFTTVSF CBS	4%3
Temperature range .FEJVN &OWJSPONFOU	<$ UP <$ <$ UP <$
+PJOUJOH NFUIPE	&MFDUSPGVTJPO
Standards and guidelines[1)]	*40 &/ *40
"QQSPWBMT	'JSF DMBTTFT QMFBTF TFF DIBQUFS PS BU XXX HGQT DPN XJU VQ UP NBTUFJOHT

[1)] 'PS BEEJUJPOBM JOGP BCPVU UIF BQQSPWBMT TFF XXX HGQT DPN

COOL-FIT 2.0 product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

Products	d (mm)	50	75	90	110
1JQFT 1/					
$PVQMFST					
&MCPXT < <					
5 < FRVBM					
5 < SFEVDFS					
3FEVDFST					
'MFYJCMF IPTFT					
#BMM WBMWFT					
#VUUFSÍZ WBMWFT					
5SBOTÌUJPO QJFDFT					
'JYFE QPJOUT					

COOL-FIT 2.0M product overview

5IF GPMMPXJOH UBCMF VTFT NFUSJD VOJUT PG NFBTVSF

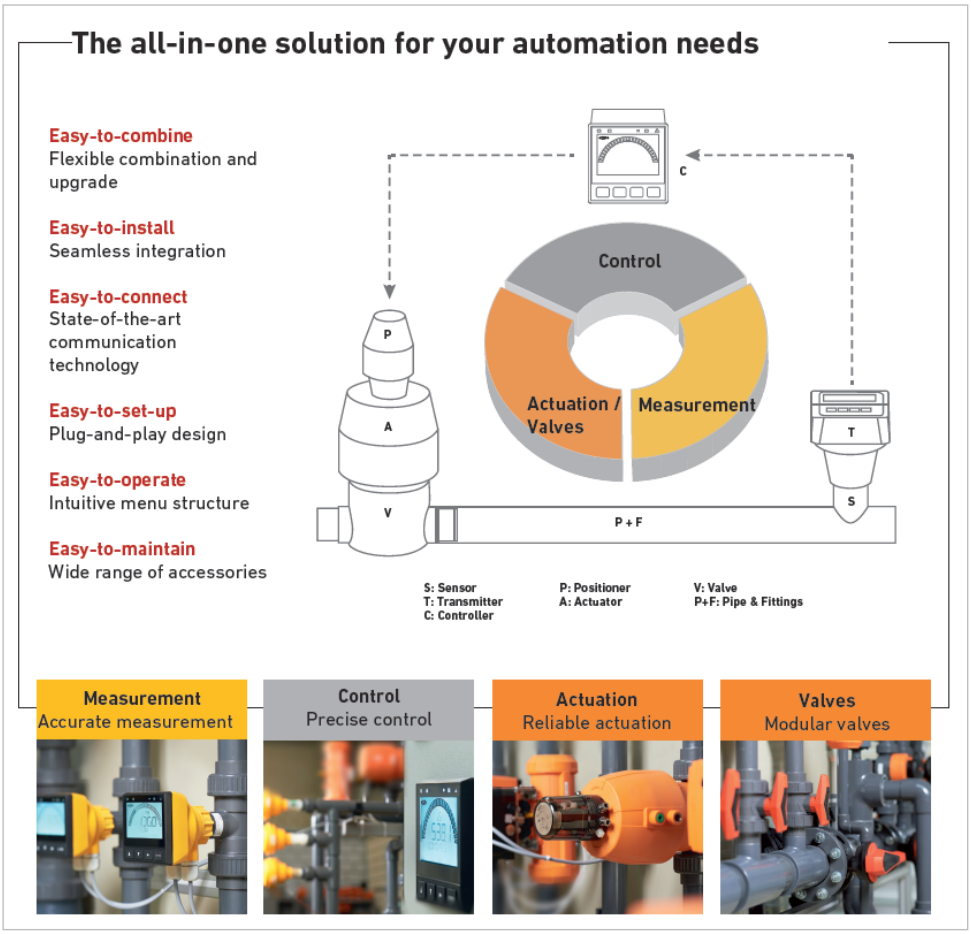
Products	d (mm)	50	75	90	110
Pipes					
$PVQMFST					
&MCPXT <					
5 < FRVBM					

'PS NPSF JOGPSNBUJPO BCPVU UIF TZTUFN TQFDJÌDBUJPO PG $00- '*5 WJTJU XX TFF UIF QMBOOJOH GVOEBNFOUBMT DIBQUFS 4ZTUFN $00- '*5o

2.11 Automation

2.11.1 Overview

5IF BVUPNBUJPO DMPTFE DPOUSPM MPPQ DPOTJTUT PG BO FF FMFNFOUT NFBTVS
BDUVBUJPO JOGPSNBUJPO BOE DPOUSPM FMFNFOU JODMVEFT B OVNCFS PG NFBTVSJOH UFDIO
DBQUVSJOH BMM UZQFT PG QSPDFTT JOGPSNBUJPO BOE BSF BWBJMBCMF JO QMBTUJD BOE BSF
UPHFUIFS XJUI UIF DPSSFTQPOEJOH TFÌBUQPTHFDU JOUFHSBUJPO JOUP UIF QJQJOH
TZTUFN DPOUSPM FMFNFOU DPOUBJOT WBSJPVT DPOUSPM GVODUJPOT r GSPN TJ
1*%DPOUSPMMFST r BOE DPNNPO DPNNVOJDBUJPO QSPUPDPMT UP FYDIBOHF
FMFDUSJDBM BOE NBHOFUJD EBUB BDDFTTPSZ QBSUT



2.11.2 Measurement

Product overview

Product categories
'MPXFBTVSFNFOU VMUSBTPVOE QBEEMFXIFFM FMFDUSPN
Q) 031
$POEVDUJWJUZ SFTJTUJWJUZ
1SFTTVSFWFMM
Temperature
$MPVEJOH
$IMPSJOF
%JTTPMWFE PYZHFO

2.11.3 Control

Product overview

Product categories
.VMUJ QBSBNFUFS
4QFDJBM USBOTNJUUFS F H CBUDI 1*%
.VMUJ DIBOOFM
.PEVMBS GVODUJPOBMJUJFT F H)BSU BEEJUJPOBM UP N" PVUQVUT

2.11.4 Actuation

Product overview

Product categories
&MFDUSJDBM BOE QOFVNBUJD BDUVBUPS
1PTJUJPOFST BOE BDUVBUPS BDDFTTPSJ
"4 JOUFSGBDF

2.11.5 Valves

Product overview

Product categories
.BOVBM WBMWFT
.BHOFUJD QJMPU WBMWFT
1SFTTVSF SFHVMBUJOH WBMWFT

Plastic Piping Materials

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III

1 Introduction to Plastics Materials

1.1 Plastics in general

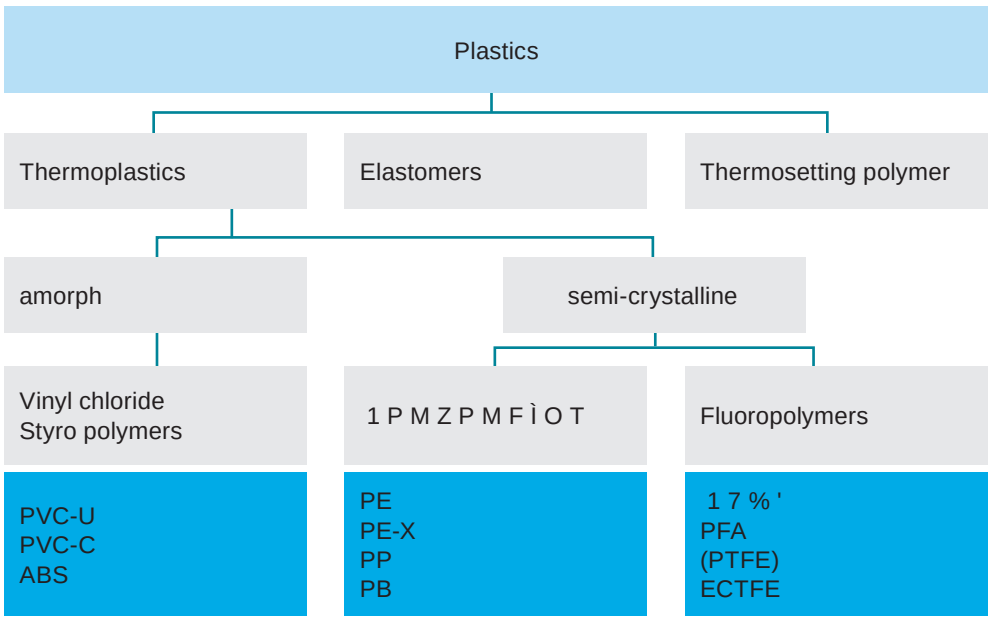
1.1.1 History

As early as 1838, Victor Regnault succeeded in manufacturing polyvinyl chloride in UIF{MBCPSBUPSZ CZ FYQPTJOH WJOZM DIMPSJEF UP TVOMJHIU *O 'SJU[,MBU fundamental principle for the technical manufacture of PVC. In their early years during the war from 1914 to 1918, the plastics had to replace other scarce materials and were thereby partly overwhelmed in terms of their applicability. Therefore, plastics had to be improved. 5P{EP UIJT JU XBT OFDFTTBSZ UP JOWFTUJHBUF UIF JOOFS TUSVDUVSF PG UIFTF detail. After the versatile application possibilities were recognised, in 1938 the large-scale production of plastics began.

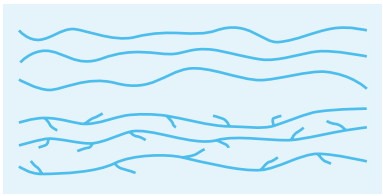
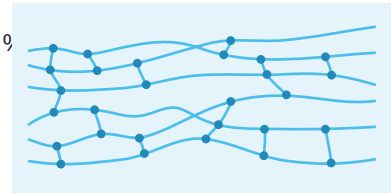
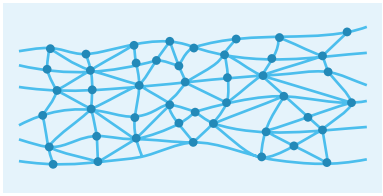
1.1.2 Structure and properties

Polymers are organic compounds that are obtained either by the conversion of natural products (e.g. natural rubber, cellulose), or by synthesis from petroleum derivatives. Polymer chains, together with additives such as stabilisers and processing aids, produce the actual material – SFGFSSFE UP BT QMBTUJD 5IFTF DIBJOT DPOTJTU NBJOMZ PG DBSCPO BOE IZESPH UZQF IBMPHFOT DIMPSJOF ÍVPSJOF PYZHFO OJUSPHFO BOE TVMQIVS DBO BMTF the polymer chain. Polymers are also referred to as macromolecules, that is to say, a single polymer chain consists of more than 1,000 basic building blocks, the monomers.

*O QMBTUJD QJQJOH EFTJHO NBJOMZ UIFSNPQMBTUJDT BSF VTFE XIJDI BSF QSPD WBMWFT{BOE QJQF XJUI B UFDIOJRVF NPSF DPNNPOMZ VTFE GFSSFE UP BT &MBTUPNFST BSF VTFE BT TFBMJOH NBUFSJBMT JOTVMBUJOH NBUFSJBMT ÍBOHFT BOE QVTI ÌU ÌUU UIFSNPTFUUJOH QPMZNFS BSF VTFE BT JOTVMBUJPO GPBNT PS JO HMBTT ÌCSF SFJ Injection moulding and extrusion.

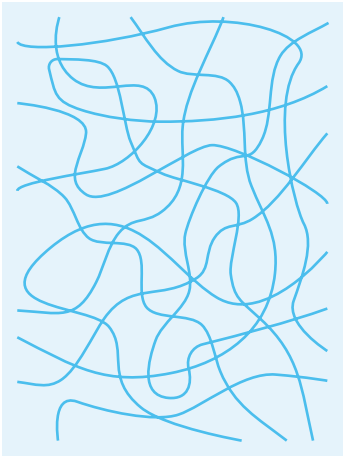
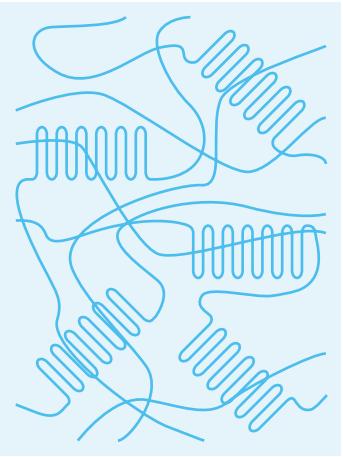


Materials for piping systems – Overview

Main group		Property
Thermoplastics e.g. PE, PVC		• Linear or branched • Meltable • Soluble, swellable • Plastic mouldable
Elastomer F H /#3 &1%		• Poorly linked • Not meltable • Not soluble, not swellable • Not plastically mouldable
Thermosetting plastics F H 163 &Q		• Strongly linked • Not meltable • Not soluble, not swellable • Not plastically malleable

Plastics – Main groups

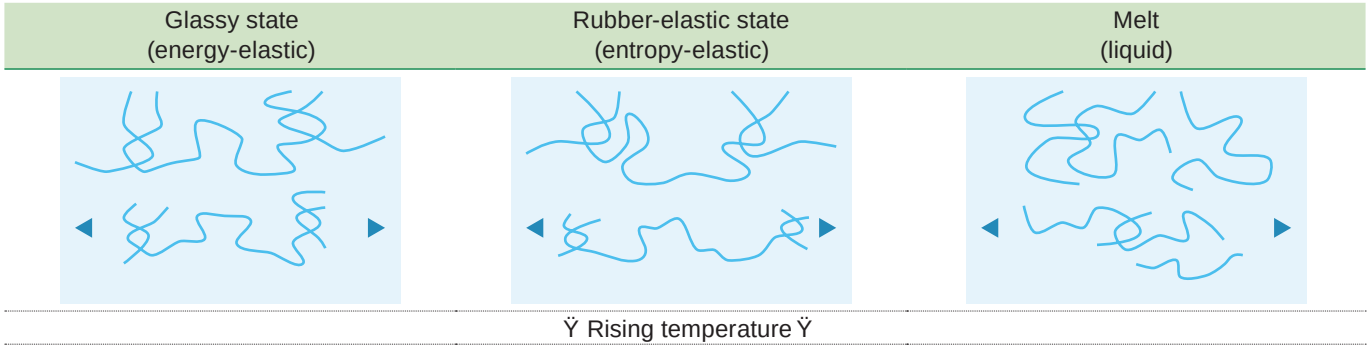
The thermoplastics, the fusible agents of plastics, are subdivided into two groups:

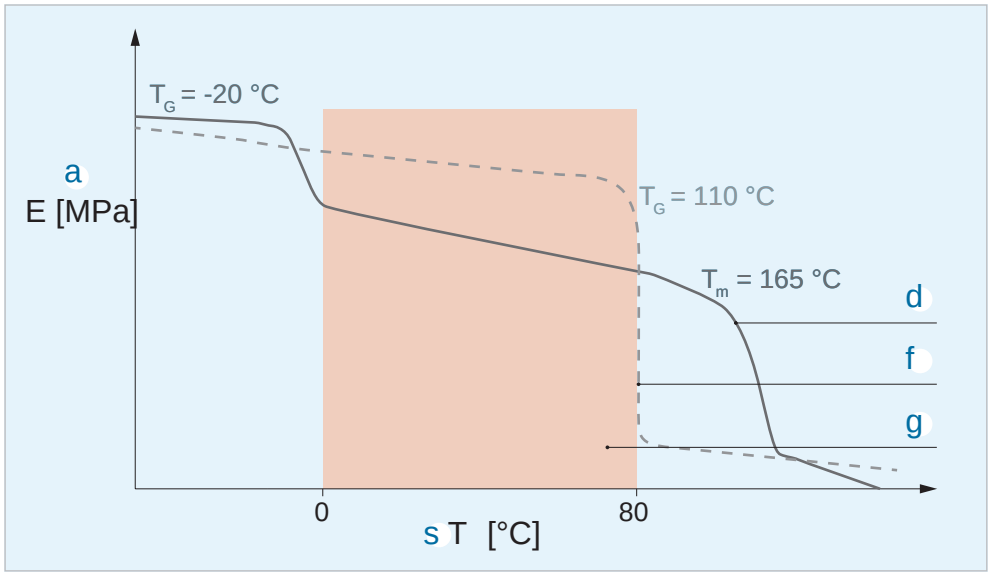
Amorphous thermoplastics	Semi-crystalline thermoplastics
In the case of the amorphous (Greek “without form”) thermoplastics, the polymer chains are present as disordered, intertwined bundles. Typical representatives of this H S P V Q B S F G P S F Y B N Q M F These plastics dissolve and swell easily C Z { B E E J O H T P M W F O U T 5 I F S F Q M B T U J D T B S F { T P M W F O U D F N F O U F E U P N F U I F S piping installations.	The semi-crystalline thermoplastics contain not only the disordered, amorphous but also highly ordered regions in which the chains are arranged into crystalline structures. Representatives of this group are for F Y B N Q M F { Q P M Z P M F Ì O T T V D I B T Q P M Z F U I Z M F O F (PE), polypropylene (PP) and polybutene (PB). these plastics do not swell and are not soluble in solvents. Piping systems made P G { T F N J D S Z T U B M M J O F N B U F S J B M T B S F U I F S F G P S F { V T V B M M Z D P O O F D U F E C Z X F M E J O H
	

Subdivision of the Thermoplastics

1.1.3 Mechanical properties

The mechanical properties of plastics, especially thermoplastics, are temperature-dependent. At low temperatures below the glass-transition temperature T_g the chains CFDPNF{JNNPCJMF BOE CSJUUMF XIJDI MFBET UP JODSFBTFE GSBHJMJUZ "U IJH ($T_g < T < T_m$), the chains become more mobile, causing semi-crystalline materials to gain UPVHIOFTT CVU{MPTF TUSFOHUI BOE SJHJEJUZ "U UIJT TUBHF BNPSQIPVT QMB TPGUFOJOH #PUI{UIF{FNCSJUUMFNFOU BOE TPGUFOJOH UFNQFSBUVSFT BSF DIBS JOEJWJEVBM UZQFT{PG QMBTUJD BOE EFQFOEFOU PO UIFJS NPMFDVMBS TUSVDU DPOUJOVFT U$_m$P{ SJJ-F{FTF5NJ 5DSZTUBMMJOF UIFSNPQMBTUJD JT BMTP QSFTFOU BT B





Application temperature
Modulus of elasticity (rigidity)
Temperature
Semi-crystalline, here PP-H
Amorph, here PVC-C
Application temperature

The application temperatures for semi-crystalline and amorphous thermoplastics vary due UP{UIFJS EJËFSFOU QSPQFSUJFT 4FNJ DSZTUBMMJOF NBUFSJBMT BSF QSFGFSBC above their glass transition temperature. However, amorphous thermoplastics are used below the glass transition point.

Plastics also tend to creep to progressive deformation under load. Their mechanical properties are not only temperature-dependent but also time-dependent. For use in piping system construction, the materials are therefore tested for their creep internal compressive strength in accordance with *40{ and *40{ JO PSEFS UP EFUFSNJOF UIF NBYJNVN operating temperatures and pressure for a service life of 50 years.

The characteristic values for mechanical properties of GF pipe materials can be found in the relevant raw materials chapter.

1.1.4 Advantages

Compared to metallic materials, the following general advantages for plastics result:

Properties and advantages of plastics

Property	Advantage
Low density 1 M B T U J D U P	Very light-weight {H D N Ž
Chemical resistance	No corrosion as with metals
Low thermal conductivity	• Minimum heat loss • Low condensation • Plastics are poor heat conductors, but good insulators Thermal conductivity: • 1 # {8˝, N • 1 & {8˝, N • 1 7 $ {8, N
Tight connections due U P { B { W B S J F U Z P G technologies	Plastics can be welded, glued and clamped D P O O F D U J P O
Smooth surface	The smooth surface causes low pressure losses

1.2 Plastic in the environment

The world is facing big challenges in the energy sector. These challenges include increasing
F O F S H Z D P O T V N Q U J P O U I F ÌO J U F O B U V S F P G G P T T J M S F T P V S D F T S J T J O H F O F S H
change. In order to satisfy the needs not only of today but also of future generations,
sustainable development is essential. Plastics help to meet these challenges.

5 I F Q S P E V D U T P G (' { 1 J Q J O H { 4 Z T U F N T B S F V T F D C Z D V S T U P N F S T G P S Z F B S T T P N F U
& W F O U I F T N B M M F T U J O D S F B T F T J O F Î D J F O D Z r T V D I B T B T U J U B C M F E F T J H O r D B
U I F F O W J S P O N F O U B M Q F S G P S N B O D F (' { 1 J Q J O H { 4 Z T U F N T U I F S F G P S F Q V S T V F T B I
J O { U I F E F W F M P Q N F O U P G Q J Q J O H T Z T U F N T 4 V T U B J O B C M F T P M V U J O T B S F P M Z
M J G F { D Z D M F P G U I F B Q Q M J D B U J O T B O E Q S P E V D U S J D O T J E E F S E

Plastics save energy

In addition to the well-known technical advantages such as corrosion resistance, plastics also
characterised by their ecological advantages. Its light weight and insulating properties make
J U T U V J U B C M F G O S B W B S J F U Z P G F O F S H Z F Î D J F O U B Q Q M J D B U J O T J O W F I J D M F T
piping systems. Plastics are mainly made from crude oils. About four percent of the world's
P J M J S Q S P D F T T E J O U O Q M B T U J D 5 I F F Ë P S U S U O S E V D F U I F D O T V N Q U J O P G
fuels, however, do not mean a renouncement of plastic – on the contrary: The use of plastics
saves energy!

* O B T U V E Z 1 M B T U J D T & V S P Q F I B T R V B O U J Ì F E I P X F O F S H Z D O T V N Q U J O B O E H S
H B T { F N J T T J O S B Ë F D U Q M B T U J D Q S P E V D U S C Y S F Q M B D J O H U I F N X J U I P U I F S N B U

Results

- 1MBTUJD QSPEVDUT FOBCMF TJHOJÌDBOU TBWJOHT JO FOFSHZ BOE SFEVDF HSFF
- Replacing plastic products with other materials will in most cases increase energy consumption and greenhouse gas emissions.

Replacing as many plastic products as possible with other materials would require over 50% more energy than is consumed today throughout the life cycle of all plastic products.
*O{PUIFS XPSET 5IF QMBTUJD QSPEVDUT PO UIF NBSLFU UPEBZ IBWF FOBCMFE PG{ NJMMJPO (+ QFS ZFBS 5IJT JT FRVBM UP BO BNPVOU PG NJMMJPO UP 200 very large oil tankers.

i "EEJUJPOBM JOGPSNBUJPO PO TVTUBJOBCJMJUZ BOE MJGF DZDMF BTTFTTNFO HGQT TVTUBJOBCJMJUZ NBUFSJBMT

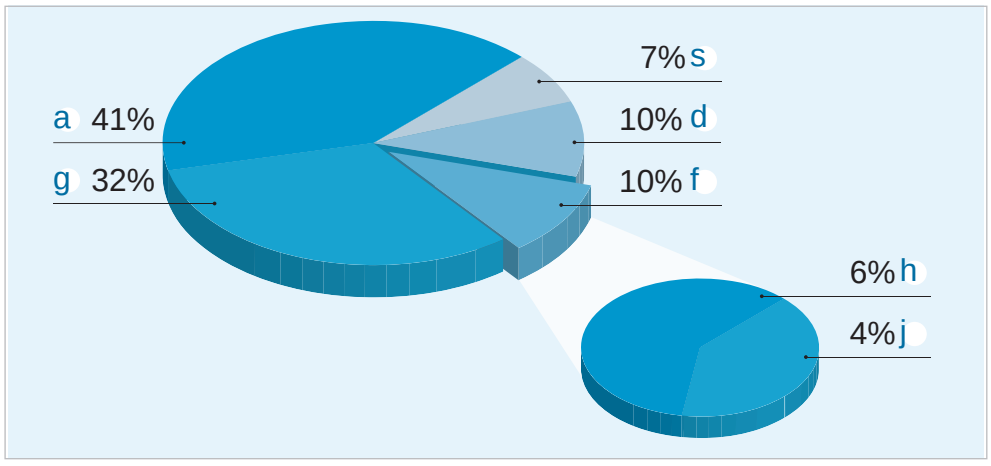
1.3 Manufacturing and processing methods

1.3.1 Raw materials

Raw materials required for the production of plastics are natural products such as cellulose, DPBM DSVEF PJM BOE OBUVSBM HBT "U UIF SFÌOFSZ DSVEF PJM JT TFQBSBUFE several components. It is separated into boiling ranges; distillation results in gas, petrol, petroleum and gasoil. The residue is bitumen. All components consist of hydrocarbons, XIJDI{EJËFS JO TJ[F BOE TIBQF PG UIF NPMFDVMFT 5IF NPTU JNQPSUBOU DPNQP production of plastics is naphtha.Naphtha is broken up and converted into ethylene, propylene, butylene and other hydrocarbon compounds in a thermal cracking process.

1.3.2 Manufacturing

Plastics are formed by connecting a large number of similar basic building blocks (monomers), using a chemical bond. The majority of the raw materials required for this purpose comes from the processing of crude oil, but in some cases raw materials from SFOFXBCMF TPVSDFT BSF BMTP VTFE $POUSBSZ UP FYQFDUBUJPOT POMZ BCPVU QSPEVDUT DPNJOH GSPN UIF SFÌOFSZ HP UP UIF QMBTUJDT JOEVTUSZ 5IF DIFNJ BDDPVOU{GPS BSPVOE PG UPUBM DSVEF PJM DPOTVNQUJPO JO (FSNBOZ JOD QSPEVDUJPO *O UIF QSPEVDUJPO PG QMBTUJDT UISFF EJËFSFOU NFUIPET BSF V



Use of petroleum
in production areas
Tra c
Miscellaneous
Industry
Chemistry
Heater
of this 6% plastic
other materials

5õ Manufacturing of plastics

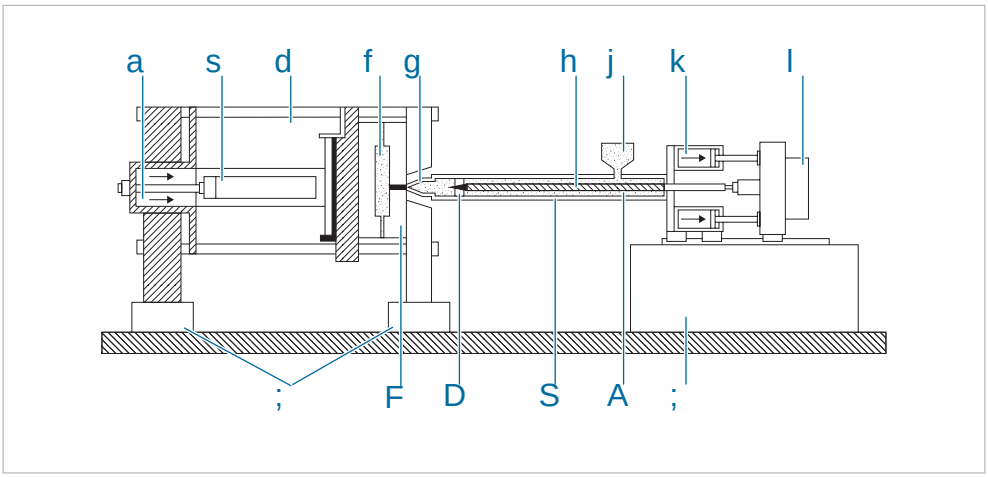
Polymerisation	Polycondensation	Polyaddition
Polymerisation is the most widely used process in the synthesis of plastics. Polymerisation refers to the attachment of monomers to macromolecule chains without elimination of foreign substances. 8IFO VTJOH F H QPMZNFSJTBUJPO JT VTFE UP QSPEVDF polyethylene, polybutene, polypropylene, polyvinyl chloride are formed.	In the polycondensation process, equal and dissimilar monomers are arranged JO{B NBDSPNPMFDVMF DIBJO XJUI simultaneous elimination of a by-product, e.g. water, hydrochloric acid. 8IFO VTJOH QPMZDPOEFOTBUJPO JT VTFE UP QSPEVDF polyamides, polyesters are formed.	8IFO VTJOH QPMZBEEJUJPO macromolecules are formed from JO{B NBDSPNPMFDVMF DIBJO XJUI structure, but without elimination PG {B{CZ QSPEVDU 5IJT QSPEVDU 8IFO VTJOH QPMZBEEJUJPO PG QP

1.3.3 Processing

('{1JQJOH{4ZTUFNT VTFT B WBSJFUZ PG QMBTUJD QSPDFTTJOH UFDIOJRVFT " EJTU CFUXFFO JOKFDUJPO NPVMEJOH FYUSVTJPO BOE GPBNJOH 5IF JOKFDUJPO NPVME UP{QSPEVDF ÌUUJOHT BOE WBMWFT QJQF BSF FYUSVEFE 1JQFT BSF QSF JOTVMBU

Injection moulding

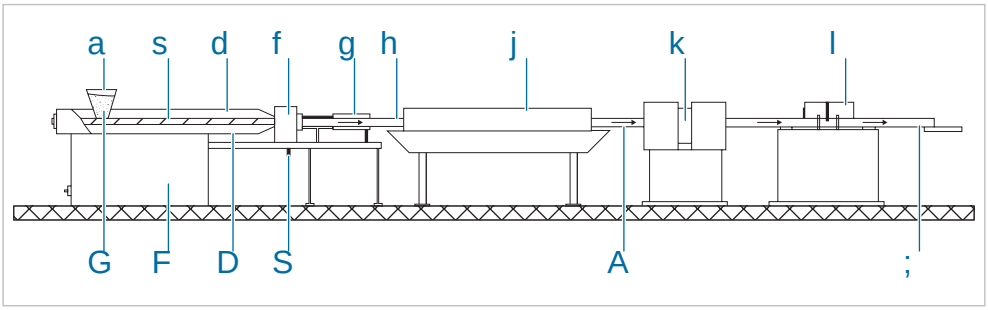
An injection moulding machine is used to melt (plasticise) the respective material and injected into a mould—the moulding tool—under pressure. Inside the mould tool, the material is cooled and thus reverts to its solid state. The resulting volume shrinkage is compensated
CZ{WFSZ IJHI QSFTTVSFT #Z SPUBUJOH UIF QMBTUJDJTJOH TDSFX NBUFSJBM GP
JT{QSFQBSFE "GUFS PQFOJOH UIF UPPM UIF ÌOJTIFE QBSU JT SFNPWFE 5IF WP
UPPM EFUFSNJOFT UIF TIBQF BOE UIF TVSGBDF TUSVDUVSF PG UIF ÌOJTIFE QBSU



Components of a typical plasticising/injection unit
- Locking cylinder
- Opening cylinder
- Opening and locking cylinder
- Workpiece
- Injection nozzle
- Plasticising screw
- Plastic pellets
- Injection cylinder
- Worm gear drive
- Machine bed
- Plasticising cylinder
- Heater
- Non-return valve
- Moulding tool

Extrusion

"O FYUSVTJPO NBDIJOF JOUFHSBUFT UIF GPMMPXJOH QSPDFTT TUFQT
- &YUSVTJPO
- 2. Shaping
- 3. Calibrating
- 4. Cooling
- 5. Removing
- 4FQBSBUJOH



Components of a typical extrusion system
- Hopper
- Plasticising screw
- Heater
- Moulding tool (pro le nozzle)
- Calibration distance
- Pipe
- Cooling section
- Haul-o /pulling machine
- Device for cutting into lengths
- Hollow section
- Pipe
- Compressed air
- Plasticising cylinder
- Extruder
- Plastic pellets

5IF FYUSVEFS TZTUFN DPOTJTUT PG UIF IPQQFS UIF QMBTUJDJTJOH DZMJOEFS
TDSFX T BOE UIF ESJWF 5IF UBTLT PG UIF FYUSVEFSnT DPNQPOFOUT BSF UIF TE
injection unit during injection moulding.

5IF FYUSVEFS UPPM SFTUT EJSFDUMZ BHBJOTU UIF FYUSVEFS HVJEJOH UIF NBTT
TIBQJOH UIF QSPÌMF PG UIF QJQF 'PS QJQF VOEFS E NN UPPMT XJUI TJFWF S
XFCT BSF VTFE GPS ÌYJOH 'PS MBSHFS QJQF PWFS E NN TQJSBM EJTUSJCVUJ
cooling section and calibration section are connected in the manufacturing of the pipe. This is possible by using vacuum tank calibration with multiple water showers. A caterpillar haul-
PË QVMMJOH NBDIJOF JT VTFE UP IBOEMF UIF QVMMJOH JO QJQF NBOVGBDUVSJO
IBVM PË QVMMJOH NBDIJOF JT BEBQUFE UP UIF QFSGPSNBODF PG UIF FYUSVEFS
NVTU NPWF XJUI UIF FYUSVEFE QJQF EVSJOH DVUUJOH QSPDFTT

2 Properties of Plastic Piping Materials

2.1 Acrylonitrile-butadiene-styrene (ABS)

ABS properties (reference values)

Property	Value[1]	Units	Test standard
% F O T J U Z	0.925	H D N Ž	EN ISO 1183-1
Yield stress at 23 °C	20	/ N N •	EN ISO 527-1
Tensile modulus at 23 °C	450	/ N N •	EN ISO 527-1
Charpy notched impact strength at 23 °C	20	L + N •	& / * 4 0
Charpy notched impact strength at -40 °C	È	L + N •	& / * 4 0
Heat distortion temperature) % 5 { " { { . 1 B	È	°C	EN ISO 75-2
7 J D B U I F B U E J T U P S U J P O È E F N Q F S B U V S F #		°C	* 4 0
Thermal conductivity at 23 °C	0.19	8 N ,	ASTM E1530
8 B U F S B C T P S Q U J P O B U Ç $		%	& / * 4 0
Color	similar 7001	-	RAL
- J N J U J O H P Y Z H F O J O E F Y	19 0 *	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calculations.

General

Acrylonitrile-butadiene-styrene (ABS) is a versatile polymer. In addition to its application in piping systems, ABS is mainly common in automotive applications and in high-quality I P V T F I P M E E F W J D F T 5 I F X J E F B S F B P G B Q Q M J D B U J P O S F M B U F T U P U I F W F S T B U J M of ABS which can be adapted to the respective application by taking advantage of the variable composition of the components acrylonitrile, styrene and polybutadiene.

" # 4 C F M P O H T U P U I F B N P S Q I P V S U I F S N P Q M B T U J D T 8 I J M F B D S Z M P O J U S J M F Q S P W material and contributes to an improved chemical resistance relative to polystyrene, the T U Z S F O J D D P N Q P O F O U Q S P W J E F T C P U I T U S F O H U I B O E B R V B M J U Z T V S G B D F Ì O J T I the chemically bound polybutadiene rubber components give the material its impact strength, F W F O B U W F S Z M P X U F N Q F S B U V S F S 5 I F " # 4 V S E F C Z (' { 1 J Q J O H 4 Z T U F N T T I P X T B between toughness and strength, making it especially suitable for low temperature applications. Accordingly, the areas of application are mainly refrigeration and air-conditioning systems as well as water treatment.

Advantages of ABS

- High impact strength even at low temperatures
- Corrosion resistance
- Simple installation via solvent cement joints
- Low thermal conductivity
- Halogen free
- Low weight
- Low pressure losses due to smooth surfaces
- Good abrasion resistance
- Trouble-free recycling

UV and weather resistance

*G UIF "#4 QJQJOH TZTUFN JT FYQPTFE UP EJSFDU TVOMJHIU PWFS B MPOH QFSJ
TIJOF BOE UIF DPMPVS TIJGUT UP MJHIU HSFZ %VF UP UIF WFSZ IJHI JNQBDU TU
resulting loss of toughness generally causes no problems in moderate climate zones. For
FYUSFNF XFBUIFS DPOEJUJPOT PS WFSZ IJHI MPBET PO UIF QJQJOH TZTUFN XF C
recommend protecting the surface from direct sunlight.

Chemical resistance

ABS shows a good resistance against a broad range of media. For detailed information,
PCTFSWF UIF DPNQSFIFOTJWF MJTU PG DIFNJDBM SFTJTUBODF GSPN ('{1JQJOH 4
BVUIPSJ[FE ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abrasion resistance

*O BEEJUJPO UP UIF FYDFMMFOU JNQBDU TUSFOHUI UIF CVUBEJFOF SVCCFS DPN
an outstanding resistance to abrasion. Because of this property, piping systems made of ABS
have been used for solids and slurries, such as those found in mining, for a long time.
"#4{PËFST TJHOJÌDBOU BEWBOUBHFT GPS NBOZ PG TVDI BQQMJDBUJPOT DPNQBSF

Application limits

The application limits of the material on the one hand depend on embrittlement and softening
UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSWJ
application. The pressure-temperature diagrams give details on application temperatures
and pressures.

Combustion behavior

"#4 TFMG JHOJUFT BU UFNQFSBUVSFT FYDFFEJOH ‹$ "#4 CVSOT XIFO FYQPTFE
ÍBNF BGUFS SFNPWJOH UIF ÍBNF UIF NBUFSJBM DPOUJOVFT CVSOJOH 5IF PYZH
.BUFSJBMT UIBU CVSO XJUI MFTT UIBO PG PYZHFO JO UIF BJS BSF DPOT
ÍBNNBCMF

#BTJDBMMZ UPYJD TVCTUBODFT BSF SFMFBTFE UIPVHI BMM CVSOJOH QSPDFTTFT
HFOFSBMMZ UIF DPNCVTUJPO QSPEVDU NPTU EBOHFSPVT UP IVNBOT 8IFO "#4 CV
DBSCPO EJPYJEF DBSCPO NPOPYJEF BOE XBUFS BSF GPSNFE 5FTUT IBWF TIPXO
UPYJDJUZ PG UIF QSPEVDUT PG DPNCVTUJPO BSF TJNJMBS PS FWFO MPXFS UIBO
ucts such as wood, wool and cotton. ABS combustion gases are not corrosive. Nevertheless,
the burning forms soot. Because of this, smoke develops during combustion.

8BUFS GPBN BOE DBSCPO EJPYJEF BSF TVJUBCMF ÌSF ÌHIUJOH BHFOUT

Electrical properties

Like most thermoplastics, ABS is not conductive. This means that no electrochemical
corrosion takes place in ABS systems. However, the non-conductive properties have to be
taken into account because an electrostatic charge can develop in the piping. ABS provides
HPPE FMFDUSJDBM JOTVMBUJPO QSPQFSUJFT {5DFN TQFDJÌD WPMVNF SFTJTUBODF
TQFDJÌD TVSGBDF SFTJTUBODF 15 UIBU JT UP TBZ UIF FMFDUSJDBM SFTJTUBODF
UIFSF JT B EBOHFS PG ÌSFT PS FYQMPTJPO

Physiological properties

'PSNVMBUJPOT PG "#4 VTFE CZ ('{1JQJOH 4ZTUFNT BSF JO HFOFSBM OPO UPYJD B
JOFSU 'PS EFUBJMT SFHBSEJOH FYJTUJOH BQQSPWBMT GPS BQQMJDBUJPOT XJU
TUVË QMFBTF DPOUBDU ZPVS ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

2.2 Polyethylene (PE)

PE properties (reference values)

Property	PE 80-Value[1]	PE 100-Value[1]	Units	Test standard
% F O T J U Z	0.93	0.95	H D N Ž	EN ISO 1183-1
Yield stress at 23 °C	18	25	/ N N •	EN ISO 527-1
Tensile modulus at 23 °C	700	900	/ N N •	EN ISO 527-1
Charpy notched impact strength at 23 °C	110	83	L + N •	& / * 4 0 F "
Charpy notched impact strength at -40 °C	7	13	L + N •	& / * 4 0 F "
Thermal conductivity at 23 °C	0.43	0.38	8 N ,	& /
8 B U F S B C T P S Q U J P	0.01 - 0.04	0.01 - 0.04	%	& / * 4 0
Color	9005	9005	RAL	
- J N J U J O H P Y Z H F O	17.0	10.4	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calculations.

General

Polymers which consist of hydrocarbons with formula C_nH_{2n} with a double bond (ethylene, Q S P Q Z M F O F C V U F O F J T P C V U F O F B S F D P M M F D U J W F M Z S F G F S S F E B T Q P M Z P M F belongs to this group. It is a semi-crystalline thermoplastic. Polyethylene is the best known polymer. The chemical formula is: $-(CH_2-CH_2)_n-$, making polyethylene an environmentally friendly hydrocarbon product. PE as well as PP belong to the non-polar materials. Because of this, it does not dissolve in common solvents and hardly swells. As a result, PE pipe cannot be solvent cemented. The appropriate jointing method for this material is welding.

High molecular PE grades of medium to high density have become state of the art for J O E V T U S J B M Q J Q J O H J O T U B M M B U J P O T 5 I F H S B E F T B S F D M B T T J Ì F E J O B D D P S E B O Q S F T T V S F S F T J T U B O D F J O 1 & .3 4 .1 B B O E 1 & .3 4 .1 B *O U I J T D P O U F Y U talk about PE grades of the 3rd generation, while PE80 grades belong, in most cases, to the O E H F O F S B U J P O 1 & H S B E F T P G U I F T U H F O F S B U J P O r 1 & B D D P S E J O H U P D V S S have practically no application anymore. The internal pressure resistance is tested according U P *4 0 B O E D B M D V M B U F E J O D P N Q M J B O D F U P *4 0

In piping construction, PE is mostly used for buried gas and water lines. For this range of applications, polyethylene has become the dominant material in numerous countries. But also building technology and industrial piping installations make use of the advantages of this material.

Advantages of PE

- Low weight
- 0 V U T U B Í F Y J C I M J U Z
- Good abrasion resistance (abrasion resistance)
- Corrosion resistance
- % V D U J M F C S F B L J O H Q S P Q F S U J F T
- High impact strength even at low temperatures
- Good chemical resistance
- Fusible

UV and weather resistance

Because of the black pigments used, polyethylene is very weather-resistant. Even longer F Y Q P T V S F U P E J S F D U T V O M J H I U X J O E B O E S B J O I B S E M Z D B V T F T B O Z E B N B H F U P

Chemical resistance

Polyethylene shows a good resistance against a broad range of media. For detailed J O G P S N B U J P O P C T F S W F U I F M J T U P G D I F N J D B M S F T J T U B O D F G S P N ('{1 J Q J O H 4 Z S F T Q P O T J C M F ('{1 J Q J O H 4 Z T U F N T S F Q S F T F O U B U J W F

Abrasion resistance

1PMZFUIZMFOF IBT FYDFMMFOU SFTJTUBODF BHBJOTU BCSBTJPO "T B SFTVMU 1
VTFE JO OVNFSPVT BQQMJDBUJPOT GPS USBOTQPSUJOH TPMJET BOE TMVSSJFT
UIBU 1& PËFST DPOTJEFSBCMF BEWBOUBHFT PWFS NFUBM GPS NBOZ TVDI BQQMJ

Application limits

The application limits of the material on the one hand depend on embrittlement and softening
UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSWJ
application. The pressure-temperature diagrams give details on application temperatures
and pressures.

Combustion behavior

1PMZFUIZMFOF CFMPOHT UP UIF ÍBNNBCMF QMBTUJDT 5IF PYZHFO JOEFY BNPVO
PYZHFO JOEFY CFMPX B QMBTUJD NBUFSJBM JT DPOTJEFSFE UP CF ÍBNNBCM
DPOUJOVFT UP CVSO XJUIPVU TPPU BGUFS SFNPWJOH UIF ÍBNF #BTJDBMMZ UPYJ
SFMFBTFE UISPVHI BMM CVSOJOH QSPDFTTFT QBSUJDVMBSMZ DBSCPO NPOPYJEF
QSJNBSJMZ DBSCPO EJPYJEF DBSCPO NPOPYJEF BOE XBUFS BSF GPSNFE

Electrical properties

Like most thermoplastics, polyethylene is non-conductive. This means that no
electrochemical corrosion takes place in PE systems.

However, the non-conductive properties have to be taken into account because an
electrostatic charge can build up in the pipe. Polyethylene provides good electrical insulation
QSPQFSUJFT 5IF TQFDJÌD WPMVNFO SFTJTUBODF JT 10$13 Ω 5IFTF ÌHVFSFT IBWF UP CF UBLFO JOUP BDDPVOU XIFSFWFS UIFSF JT
JHOJUJPO SJTL PG FYQMPTJPO

Physiological properties

5IF CMBDL QPMZFUIZMFOF NBUFSJBMTGSPN ('{1JQJOH 4ZTUFNT BSF BVUIPSJ[FE G
BQQMJDBUJPOT 5IF PSHBOPMFQUJD QSPQFSUJFT PG UIF ÌUUJOHT BSF JO BDDPS
TUBOEBSET 6TBHF JO BMM SFMBUFE BSFBT JT UIVT QPTTJCMF 'PS EFUBJMT SFH
BQQSPWBMT GPS BQQMJDBUJPOT XJUI ESJOLJOH XBUFS PS GPPETUVËT QMFBTF
('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

2.3 Polypropylene (PP)

PP properties (reference values)

Property	PP-R value[1]	PP-H-value[1]	Units	Test standard
% F O T J U Z	0.90 - 0.91	0.90 - 0.91	H D N Ž	EN ISO 1183-1
Yield stress at 23 °C	25	31	/ N N •	EN ISO 527-1
Tensile modulus at 23 °C	900	1300	/ N N •	EN ISO 527-1
Charpy notched impact strength at 23 °C	20	50	L + N •	& / * 4 0 F "
Charpy notched impact strength at 0 °C	3.4	4.8	L + N •	& / * 4 0 F "
) F B U E J T U P S U J P O U F N Q F S 7 5 B U V S F 9 5 # { . 1 B	75	95	°C	EN ISO 75-2
8 B U F S B C T P S Q U J P O B U	0.1	0.1	%	& / * 4 0
Color	/ F V U S B M 7032	7032	-	RAL
- J N J U J O H P Y Z H F O J O E F Y	19 0 *	19	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calculations.

General

1 P M Z Q S P Q Z M F O F 1 1 J T B T F N J D S Z T U B M M J O F U I F S N P Q M B T U J D C F M P O H J O H U P density is lower than that of other thermoplastics. Its mechanical characteristics, its chemical S F T J T U B O D F B O E F T Q F D J B M M Z J U T S F M B U J W F M Z I J H I F B U E F Í F D U J P O U F N Q F S B U propylene one of the most important materials used in piping installations today. PP is formed by the polymerisation of propylene (C_3H_6) using Ziegler-Natta catalysts.

5 I F S F B S F U I S F F E J Ë F S F O U N B U F S J B M U Z Q F T X I J D I B S F D O N W F O U J O B M M Z T V Q Q installations:

- Isotactic PP-homopolymer (PP-H)
- PP block copolymer (PP-B)
- PP random copolymer (PP-R)

Because of its high long-term behavior, PP-H types are preferred for industrial applications.

5 I F N P S F Í F Y J C M F 1 1 3 J T V T F D Q S F E P N J O B O U M Z J O Q M V N C J O H B Q Q M J D B U J O T tensile modulus and high long-term creep resistance at high temperature. PP-B is mainly used for sewage piping systems because of its high impact strength especially at low temperatures and its relatively low resistance to elevated temperatures. Most of the 1 1 { H S B E F T B S F P Ë F S F E X J U I O V D M F B U J O H B H F O T C F D B V T F 1 1 D S Z T U B M M J [F T B U slower than PE. This way, we achieve lower internal stress and a more homogenous N P S Q I P M P H Z * U J T E J Ë B S F E N U C B U I O F U C O E T U X F D Z by adding only few ppm (parts per million) of nucleating agents. PP, just like PE, belongs to the non-polar materials. For this reason, PP does not dissolve in common solvents and, in addition, hardly swells. As a result, PP pipe cannot be solvent-cemented. The appropriate jointing N F U I P E G P S U I J T N B U F S J B M J T X F M E J O H ' P S J O E V T U S J B M B Q Q M J D B U J O T (' { 1 J Q nucleated PP-H (PROGEF Standard, PROGEF Plus) and PP-R (PROGEF Standard, 1 3 0 (& ' { / B U V S B M 5 I F M P O H U F S N C F I B W J P S X B T U F S U F E J O M P O H U F S N U F S U B D B M D V M B U F B D D P S E J O H U P * 4 0 " D D P S E J O H U P * 4 0 P V S J O E V S U S J D M B S S J Ì F E B T . 3 4 {

Advantages of PP

- Low weight
- Good abrasion resistance (abrasion resistance)
- Corrosion resistance
- # B M B O D F E S B U J P P G T U J Ë O F S S B O E U P V H I O F S S
- Good chemical resistance
- 8 F M E B C M F
- High temperature resistance

UV and weather resistance

PP is sensitive to UV radiation, particularly the non pigmented PROGEF Natural system, so
UIBU QSPMPOHFE FYQPTVSF UP EJSFDU TVOMJHIU TIPVME CF BWPJEFE *O PVUTJ
BEWBOUBHFPVT UP QSPUFDU UIF NBUFSJBM GSPN EJSFDU TVOMJHIU FYQPTVSF $
('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF GPS TVJUBCMF QSPUFDUJWF NFBTVSFT

Chemical resistance

Polypropylene shows a good resistance against a broad range of media. For detailed
JOGPSNBUJPO PCTFSWF UIF MJTU PG DIFNJDBM SFTJTUBODF GSPN ('{1JQJOH 4Z
SFTQPOTJCMF ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abrasion resistance

PP has a good resistance against abrasion. For many applications, PP demonstrates similar or better properties than metals.

Application limits

The application limits of the material on the one hand depend on embrittlement and softening
UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSWJ
application. The pressure-temperature diagrams give details on application temperatures and pressures.

Combustion behavior

1PMZQSPQZMFOF JT B ÍBNNBCMF QMBTUJD 5IF PYZHFO JOEFY BNPVOUT UP 8
JOEFY CFMPX B QMBTUJD NBUFSJBM JT DPOTJEFSFE UP CF ÍBNNBCMF 11 ESJ
CVSO XJUIPVU TPPU BGUFS SFNPWJOH UIF ÍBNF #BTJDBMMZ UPYJD TVCTUBODFT
CVSOJOH QSPDFTTFT XIJMF DBSCPO NPOPYJEF JT HFOFSBMMZ UIF DPNCVTUJPO
EBOHFSPVT UP IVNBOT 8IFO 11 CVSOT QSJNBSJMZ DBSCPO EJPYJEF DBSCPO NP
are formed.

Electrical properties

Like most thermoplastics, polypropylene is non-conductive. This means that no electrochemical corrosion takes place in PP systems.

However, the non-conductive properties have to be taken into account because an electrostatic charge can build up in the pipe. Polypropylene provides good electrical
JOTVMBUJPO QSPQFSUJFT 5IF TQFDJÌD˜VDRMVNF ESJFMDBSJDF JT BU MFBTU
TUSFOHUI JT {L7 NN #FDBVTF PG UIF QPTTJCMF EFWFMPQNFOU PG FMFDUSPTUB
is recommended when using PP in applications where there is a hazard of ignition or
FYQMPTJPO

Physiological properties

'PSNVMBUJPOT VTFE CZ ('{1JQJOH 4ZTUFNT BSF HFOFSBMMZ OPO UPYJD BOE CJP
EFUBJMT SFHBSEJOH FYJTUJOH BQQSPWBMT GPS BQQMJDBUJPOT XJUI ESJOLJOH
DPOUBDU UIF SFTQPOTJCMF ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

2.4 Polyvinyl chloride, unplasticized (PVC-U)

PVC-U properties (reference values)

Property	Value[1]	Units	Test standard
%FOTJUZ	1.38	HDNŽ	EN ISO 1183-1
Yield stress at 23 °C	È	/NN•	EN ISO 527-1
Tensile e-modulus at 23 °C	È	/NN•	EN ISO 527-1
Charpy notched impact strength at 23 °C	È	L+N•	&/*40
Charpy notched impact strength at 0 °C	È	L+N•	&/*40
7JDBU IFBU EJTUPSUJPO UFNQFSBUVSF #	È	L	&/*40
Thermal conductivity at 23 °C	0.15	8N,	&/
8BUFS BCTPSQUJPO BU	Ç$	%	&/*40
Color	7011	-	RAL
-JNJUJOH PYZHFO JOEFY	42 0*	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calcula tions.

General

1PMZWJOZMDIMPSJEF 17$ JT POF PG UIF NPTU JNQPSUBOU BOE PMEFTU QMBTU DPOTVNQUJPO PG 17$ JT FYDFFEFE POMZ CZ 1& BOE 11 17$ XBT QSPEVDFE GPS early as the middle of the 19th century. An industrial manufacturing process was not patented until the year 1913. Nowadays, PVC plays an important role in many industrial and consumer good applications.

17$ JT B QPMZNFS DPOUBJOJOH BQQSPYJNBUFMZ CZ XFJHIU PG DIMPSJOF 5I becomes a processable and usable material only by using additives. The choice of the additives allows a wide variation of its characteristics and an adjustment to the planned application. There are two classes of PVC materials. Soft PVC (PVC-P) which is created by BEEJOH QMBTUJDJ[FST F H QIUIBMBUFT 5IJT UZQF JT OPU VTFE BU ('{1JQJOH also called unplasticized PVC (PVC-U), is used for piping system construction.

PVC-U is an amorphous thermoplastic. The properties of PVC-U molded parts are strongly dependent on the composition of the individual components, but also on the processing.
#FDBVTF PG PVS ZFBST PG FYQFSJFODF JO 17$ QSPDFTTJOH BOE UIF DPOUJOV PVS PXO GPSNVMBUJPO PG NBUFSJBMT ('{1JQJOH 4ZTUFNT IBT CFDPNF B CFODIN 17$ 6 QJQJOH 5IF MPOH UFSN CFIBWJPS XBT UFTUFE JO MPOH UFSN UFTUT BDDP BOE DBMDVMBUFE BDDPSEJOH UP *40 "DDPSEJOH UP *40 PVS 17$ 6 UZQ as MRS 25.

Advantages of PVC-U

- Versatility of use
- Very good chemical and corrosion resistance
- Proven physiological interness and thus usable for food applications
- /P JÍVFODF PO UIF ESJOLJOH XBUFS RVBMJUZ
- Biologically inert, no support of microbiological growth
- &YDFMMFOU NFDIBOJDBM QSPQFSUJFT
- Safe cementing, e.g. with Tangit

UV and weather resistance

17$ 6 JT WFSZ XFBUIFS SFTJTUBOU &WFO MPOHFS FYQPTVSF UP EJSFDU TVOMJH IBSEMZ BOZ EBNBHF UP UIF NBUFSJBM %FTQJUF JUT WFSZ HPPE SFTJTUBODF UP MPTFT TPNF PG JUT JNQBDU TUSFOHUI *O FYUSFNF BQQMJDBUJPOT JU DBO CF UIF NBUFSJBM GSPN EJSFDU TVOMJHIU FYQPTVSF $POUBDU UIF SFTQPOTJCMF (' representative for suitable protective measures.

Chemical resistance

PVC-U shows a good resistance against a broad range of media. For detailed information, PCTFSWF UIF MJTU PG DIFNJDBM SFTJTUBODF GSPN ('{1JQJOH 4ZTUFNT PS DPOU ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abrasion resistance

As a relatively hard thermoplastic, the resistance of PVC-U against abrasion is lower than those of other pipe materials. For this reason, it is rarely used for transporting solids.

Application limits

The application limits of the material on the one hand depend on embrittlement and softening UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSWJ application. The pressure-temperature diagrams give details on application temperatures and pressures.

Combustion behavior

The high chlorine content of PVC-U causes an advantageous combustion behavior. Self- JHOJUJPO SFTVMUJOH GSPN UFNQFSBUVSF JOÍVFODFT PDDVST POMZ BU ‹$ 17 FYQPTFE UP BO PQFO ÍBNF CVU FYUJOHVJTIFT JNNFEJBUFMZ BGUFS SFNPWJOH U PYZHFO JOEFY -0* BNPVOUT UP 8JUI BO PYZHFO JOEFY CFMPX B QMBTU DPOTJEFSFE UP CF ÍBNNBCMF

Because the combustion of PVC-U produces hydrogen chloride, which forms a corrosive acid in connection with water, immediate cleaning of areas susceptible to corrosion is necessary BGUFS B ÌSF %BOHFS UP QFSTPOOFM GSPN IZESPDIMPSJD BDJE)$M JT NJOJNB PEPS BMMPXT FBSMZ FTDBQF GSPN UPYJD DPNCVTUJPO HBTFT NBJOMZ GSPN UIF NPOPYJEF 5IFSF BSF OP SFTUSJDUJPOT GPS UIF DIPJDF PG ÌSFÌHIUJOH BHFOUT

Electrical properties

17$ 6 MJLF BMM VONPEJÌFE UIFSNPQMBTUJDT JT OPO DPOEVDUJWF 5IJT NFBOT electrochemical corrosion takes place in PVC-U systems. On the other hand, these non-conductive properties have to be taken into account because an electrostatic charge can develop in the piping.

4QFDJBM BUUFOUJPO NVTU CF QBJE UP UIJT GBDU JO FOWJSPONFOUT JO XIJDI F occur. Various methods are available to prevent the occurrence of electrostatic charges. ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWFT DBO QSPWJEF TVQQPSU B DPSSFDU JOTUB 5IF TQFDJÌD WPMVNF SFTJTUBODF JT BU MFBTU

Physiological properties

5IF 17$ 6 GPSNVMBT XFSF EFWFMPQFE CZ ('{1JQJOH 4ZTUFNT GPS VTF XJUI ESJO GPPE "MM 17$ 6 QSPEVDU PËFSFE CZ (' 1JQJOH 4ZTUFNT BSF GSFF PG MFBE BOE residual monomer content of vinyl chloride lies below the detection limit of modern analytical methods.

'PS EFUBJMT SFHBSEJOH FYJTUJOH BQQSPWBMT GPS BQQMJDBUJPOT XJUI ESJOL QMFBTF DPOUBDU ZPVS BVUIPSJ[FE ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

2.5 Polyvinyl chloride, chlorinated (PVC-C)

PVC-C properties (reference values)

Property	Value[1]	Units	Test standard
%FOTJUZ	1.5	HDNŽ	EN ISO 1183-1
Yield stress at 23 °C	È	/NN•	EN ISO 527-1
Tensile e-modulus at 23 °C	È	/NN•	EN ISO 527-1
Charpy notched impact strength at 23 °C	È	L+N•	&/*40
Charpy notched impact strength at 0 °C	È	L+N•	&/*40
Heat distortion temperature	È	°C	EN ISO 75-2
)%5 " .1B			
7JDBU IFBU EJTUPSUJPO UÈEFNQFSBUVSF #VSOJOH #*40			
Thermal conductivity at 23 °C	0.15	8N,	&/
8BUFS BCTPSQUJPO BU	0.1	%	&/*40
Color	7038	-	RAL
-JNJUJOH PYZHFO JOEFY	-0*	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calcula tions.

General

The abbreviation PVC-C stands for chlorinated polyvinyl chloride (also referred to as chlori nated PVC or PVC-C), a material in use since 1958. PVC-C is an amorphous thermoplastic that JT DSFBUFE CZ QPTUDIMPSJOBUJOH 17$ %VSJOH UIJT QSPDFTT DIMPSJOF JT DI PVC chain. Thus, PVC-C is a PVC-U-related material which, because of its chemical structure, is characterized by a higher temperature resistance than PVC-U with other properties such BT UIF IJHI UFOTJMF TUSFOHUI HPPE JNQBDU SFTJTUBODF BOE UIF FYDFQUJPOB SFNBJO VOBËFDUFE *UT ÍBNF SFTJTUBODF JT CFUUFS UIBO UIBU PG 17$ 6

These properties have made PVC-C a preferred material for piping and fabrication of devices in the chemical industry as well as for several other industrial applications with demanding requirements (e.g. the aircraft industry). In pressure piping systems, PVC-C is suitable for TUSPOHMZ DPSSPTJWF FOWJSPONFOUT XIFSF NBUFSJBMT TVDI BT TUBJOMFTT TU SFJOGPSDFE QMBTUJDT POMZ SFBDI B TIPSU TFSWJDF MJGF UJNF 17$ $ JT VTFE products, pumps, valves as well as for the entire range of accessories associated with transport of liquids.

Advantages of PVC-C

- Very good mechanical properties, even at elevated temperatures
- &YDFMMFOU DIFNJDBM SFTJTUBODF
- No electrochemical corrosion
- Long service life, even under intensely corrosive conditions
- Simple installation using solvent cementing
- Smooth inner surface
- Very low thermal conductivity
- &YDFQUJPOBM ÌSF SFTJTUBODF

UV and weather resistance

17$ $ JT WFSZ XFBUIFS SFTJTUBOU &WFO MPOHFS FYQPTVSF UP EJSFDU TVOMJH IBSEMZ BOZ EBNBHF UP UIF NBUFSJBM %FTQJUF JUT WFSZ HPPE SFTJTUBODF UP MPTFT TPNF PG JUT JNQBDU TUSFOHUI *O FYUSFNF BQQMJDBUJPOT JU DBO CF UIF NBUFSJBM GSPN EJSFDU TVOMJHIU FYQPTVSF $POUBDU UIF SFTQPOTJCMF (' representative for suitable protective measures.

Chemical resistance

PVC-C shows a good resistance against a broad range of media. For detailed information, PCTFSWF UIF MJTU PG DIFNJDBM SFTJTUBODF GSPN ('{1JQJOH 4ZTUFNT PS DPOU ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abrasion resistance

As a relatively hard thermoplastic, the resistance of PVC-C against abrasion is lower than those of other pipe materials. For this reason, it is rarely used for transporting solids.

Application limits

The application limits of the material on the one hand depend on embrittlement and softening UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSWJ application. The pressure-temperature diagrams give details on application temperatures and pressures.

Combustion behavior

%VF UP JUT IJHI DIMPSJOF DPOUFOU 17$ $ TIPXT BO FYDFQUJPOBMMZ HPPE DPN XJUIPVU UIF BEEJUJPO PG ÍBNF SFUBSEBOUT

17$ $ TFMG JHOJUFT BU UFNQFSBUVSFT FYDFFEJOH ‹$ 17$ $ CVSOT XIFO FYQ ÍBNF CVU JNNFEJBUFMZ FYUJOHVJTIFT XIFO UIF ÍBNF JT SFNPWFE 5IF PYZHFO J UP XJUI MFTT UIBO PG PYZHFO UIF QMBTUJD JT DPOTJEFSFE UP CF ÍBNN

Since the combustion of PVC-C produces hydrogen chloride, which forms a corrosive acid in connection with water, immediate cleaning of areas susceptible to corrosion with water DPOUBJOJOH EFUFSHFOU JT OFDFTTBSZ BGUFS B ÌSF %BOHFS UP QFSTPOOFM GS minimal because its pungent odor allows recognition even in lowest concentrations (1 ppm to QQN UIFSFCZ BMMPXJOH BO FBSMZ FTDBQF GSPN UPYJD DPNCVTUJPO HBTFT PEPSMBTNPO

3FDPNNFOEFE ÌSF ÌHIUJOH BHFOUT BSF XBUFS DBSCPO EJPYJEF PS GPBN

Electrical properties

17$ $ JT MJLF BMM VONPEJÌFE UIFSNPQMBTUJDT OPO DPOEVDUJWF 5IJT NFBOT electrochemical corrosion takes place in PVC-C systems. On the other hand, these non-conductive characteristics have to be taken into account because an electrostatic charge can develop in the piping.

4QFDJBM BUUFOUJPO NVTU CF QBJE UP UIJT GBDU JO FOWJSPONFOUT JO XIJDI F occur. Various methods are available to prevent the occurrence of electrostatic charges.

('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWFT DBO QSPWJEF TVQQPSU JO TFMFDUJOH UI

5IF TQFDJÌD WPMVNF SFTJTUBODF JT BU MFBTU

Physiological properties

'PS EFUBJMT SFHBSEJOH FYJTUJOH BQQSPWBMT GPS BQQMJDBUJPOT XJUI ESJOL please contact your GF Piping System representative.

2.6 Polyvinylidene uoride (PVDF)

PVDF properties (reference values)

Property	Value[1]	Units	Test standard
%FOTJUZ	1.78	HDNŽ	EN ISO 1183-1
Yield stress at 23 °C	È	/NN•	EN ISO 527-1
Tensile e-modulus at 23 °C	È	/NN•	EN ISO 527-1
Charpy notched impact strength at 23 °C	È	L+N•	&/*40
Charpy notched impact strength at 0 °C	È	L+N•	&/*40
Heat distortion temperature)%5 " .1B	È	°C	EN ISO 75-2
Crystallite melting point	È	°C	ISO 11357-3
Thermal conductivity at 23 °C	0.19	8N,	&/
8BUFS BCTPSQUJPO BU	Ç$ I	%	&/*40
Color	opaque	-	-
-JNJUJOH PYZHFO JOEFY	È0*	%	ISO 4589-1

[1] Typical characteristics measured at the material should not be used for calcula tions.

General

1PMZWJOZMJEFOFÍVPSJEF 17%' JT B TFNJ DSZTUBMMJOF UIFSNPQMBTUJD XJUI mechanical, physical and chemical properties. These result from the chemical structure of 17%' 17%' CFMPOHT UP UIF DMBTT PG ÍVPSJOBUFE QPMZNFST XIPTF CFTU LOPX JT QPMZUFUSBÍVPSPFUIZMFOF 15'& 15'& JT DIBSBDUFSJ[FE CZ BO FYUSFNF IFB the best chemical resistance of all polymers. A great disadvantage is that it cannot be QSPDFTTFE MJLF PUIFS UIFSNPQMBTUJDT F H JOKFDUJPO NPMEJOH JOUP ÌUUJO hand, combines various advantages of PTFE with good processability into structural parts. 5IF ÍVPSJOF DPOUFOU JO 17%' BNPVOT UP CZ XFJHIU

17%' GSPN ('{1JQJOH 4ZTUFNT VTFE JO UIF 4:(&' TZTUFN JT DIBSBDUFSJ[FE CZ B NFDIBOJDBM CFIBWJPS BOE IJHI UFNQFSBUVSF SFTJTUBODF #FDBVTF PG UIF FYD QSFTTVSF UFNQFSBUVSF SBOHF JO XIJDI 4:(&' 17%' DBO CF VTFE JU IBT PQFOFE XJUI UIF TQFDJÌD QSPQFSUJFT PG UIF 17%' NBUFSJBM DPNQMFUFMZ OFX BSFBT plastic piping. This includes the semiconductor industry, the chemical and pharmaceutical industry, electroplating technology, the pulp and paper industry, the automotive industry and XBUFS USFBUNFOU 1JQFT ÌUUJOHT BOE WBMWFT BSF OPU QJHNFOUFE BOE PQBF By avoiding the addition of any additives, the purity as well as the outstanding chemical SFTJTUBODF BOE QIZTJPMPHJDBM JOFSUOFTT PG UIF NBUFSJBM SFNBJO DPNQMF

Advantages of PVDF

- Outstanding mechanical properties, even at elevated temperatures
- No electrochemical corrosion
- Long service life, even under intensely corrosive conditions
- Outstanding resistance against UV and radiation
- Very pure material by avoiding the use of additives
- No support of microbiological growth
- Secure jointing by high-quality fusioning technology
- Very low thermal conductivity
- &YDFMMFOU ÍBNF SFUBSEBOU QSPQFSUJFT

UV and weather resistance

17%' JT WFSZ XFBUIFS SFTJTUBOU &WFO MPOHFS FYQPTVSF UP EJSFDU TVOMJHI DBVTFT OP EBNBHF UP UIF NBUFSJBM $POUBDU UIF SFTQPOTJCMF ('{1JQJOH 4ZT for more detailed information.

Chemical resistance

17%' TIPXT B HPPE SFTJTUBODF BHBJOTU B CSPBE SBOHF PG NFEJB 'PS EFUBJM
PCTFSWF UIF MJTU PG DIFNJDBM SFTJTUBODF GSPN ('{1JQJOH 4ZTUFNT PS DPOU
('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abrasion resistance

17%' IBT BO FYDFMMFOU SFTJTUBODF BHBJOTU BCSBTJPO 'PS NBOZ BQQMJDBUJ
demonstrates similar or better properties than metals.

Application limits

The application limits of the material on the one hand depend on embrittlement and softening
UFNQFSBUVSFT BOE PO UIF PUIFS IBOE PO UIF OBUVSF BOE UIF FYQFDUFE TFSW
application. The pressure-temperature diagrams give details on application temperatures
and pressures.

Combustion behavior

17%' EJTQMBZT BO FYDFQUJPOBMMZ HPPE DPNCVTUJPO CFIBWJPS XJUIPVU UIF B
QSPUFDUJPO BEEJUJWFT .BUFSJBM EFDPNQPTJUJPO TUBSUT BU ‹$ 5IF PYZH
XJUI MFTT UIBO UIF NBUFSJBM JT DPOTJEFSFE UP CF ÍBNNBCMF 4JODF
PG 17%' QSPEVDFT IZESPHFO ÍVPSJEF XIJDI GPSNT B DPSSPTJWF BDJE JO DPOO
immediate cleaning of areas susceptible to corrosion with water containing detergent is
OFDFTTBSZ BGUFS B ÌSF "EEJUJPOBM DPNCVTUJPO QSPEVDUT BSF DBSCPO NPO
EJPYJEF 4VJUBCMF ÌSF ÌHIUJOH BHFOUT BSF TBOE BOE FYUJOHVJTIJOH GPBN 5
lead to corrosive acids.

Electrical properties

17%' JT MJLF BMM VONPEJÌFE UIFSNPQMBTUJDT OPO DPOEVDUJWF 5IJT NFBOT
FMFDUSPDIFNJDBM DPSSPTJPO UBLFT QMBDF JO 17%' TZTUFNT 0O UIF PUIFS IBO
conductive characteristics have to be taken into account because an electrostatic charge can
develop in the piping. Special attention must be paid to this fact in environments in which
FYQMPTJWF HBTFT NBZ PDDVS 7BSJPVT NFUIPET BSF BWBJMBCMF UP QSFWFOU U
FMFDUSPTUBUJD DIBSHFT ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWFT DBO QSPWJEF
SJHIU POF 5IF TQFDJÌD WPMVNF S$FTDJTUBODF PG UIF NBUFSJBM JT HSFBUFS UIBO
resistance is 10^{14} ˜D N

Physiological properties

17%' JT QIZTJPMPHJDBMMZ OPO UPYJD BT MPOH BT JU JT VTFE BU UFNQFSBUVSF
‹$ %VSJOH QSPDFTTJOH BEFRVBUF WFOUJMBUJPO NVTU CF FOTVSFE BOE EF
CF FYUSBDUFE

High-purity properties

As is can be processed and utilized without the use of additives (no pigments, thermo-
TUBCJMJ[FST QSPDFTTJOH BJET PS ÌMMFST 17%' JT QBSUJDVMBSMZ TVJUFE GP
UIF IJHIFTU EFHSFF PG QVSJUZ 5IF 17%' SBX NBUFSJBMT VTFE CZ ('{1JQJOH 4ZT
requirements of the semiconductor and pharmaceutical industries. In addition, products
NBEF PG 17%' FYIJCJU B WFSZ TNPPUI TVSGBDF -FBDI PVU UFTUT BDDPSEJOH U
regularly for quality control.

3 Approvals and Standards

3.1 Approvals of products

7BSJPVT BQQSPWBMT BSF JO QMBDF GPS BMM QJQJOH TZTUFNT GSPN ('{1JQJOH 4
important approvals are listed in the following overview. The current status of the approvals
DBO CF PCUBJOFE GSPN BO BVUIPSJ[FE ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF

Abbreviation	Approval authority	Approved product range	Material
ABS	American Bureau of Shipping	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PVC-U, PVC-C
AVS	Attestation de Conformité Sanitaire	Gaskets	&1%.
BSI	British Standard Institution	Fittings	PVC-U
BV	Bureau Veritas	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PP-H, PVC-C, PVC-U
CCS	$IJOB $MBTTJÌDBUJPO 4PDJFUZ	1JQFT ÌUUJOHT WBMWFT	PE100, PVC-C
CSTB	$FOUSF 4DJFOUJÌRVF FU Fittings Bâtiment		PVC-U
%*#U	%FVUTDIFT *OTUJUVU G×S #BVUFDIOJL	1JQFT ÌUUJOHT WBMWFT	11 17% 1& 'JUUJO
%/7	%FU /PSTLF 7FSJUBT	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PP-H, PVC-C, PVC-U
%7(8	%FVUTDIFS 7FSFJO EFT (BT VOE 8BTTFSGBDIFT	Gaskets	&1%.
		Rohre, Fittings, Ventile	PE, PP-H, PVC-C, PVC-U
'%"	'PPE BOE %SVH "ENJOJTUSBUJPO	Gaskets	',.
GL	Germanischer Lloyd	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PP-H, PVC-C, PVC-U
GOST-R	Rosstandart	1JQFT ÌUUJOHT WBMWFT	11 17$ $ 17$ 6
IIP	Instituto Italiano dei Plastici	Fittings	PE, PVC-U
,*8"	,FVSJOHTJOTUJUVVU WPPS #VJ[FOCFUPOJOH artikelen	Fittings	PE, PVC-U
,58	,VOTUTUPË 5SJOLXBTTFSUFDIOJL grundlagen und Leitlinien	Gaskets	&1%.
		Fittings	PE, PVC-U
LNE	Laboratoire Nationale d‘ Essais	Pipes	PVC-U
LR	Lloyd's Register of Shipping	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PVC-U, PVC-C, PP-H
NAMSA	North American Science Associates	Gaskets	&1%. ',. 15'&
/,	/JQQPOKJ,PHZP LBJ	1JQFT ÌUUJOHT WBMWFT	ABS, PB, PE, PP, PVC-C, PVC-U
NSF	National Sanitary Foundation		
±7(8	"VTUSJBO "TTPDJBUJPO GPS Gaskets BOE 8BUFS	Gaskets	&1%.
		1JQFT ÌUUJOHT WBMWFT	1M&W 11 17%'
PZH	Panstwowy Zaklad Higieny	Fittings, valves	ABS, PP-H, PVC-U
RINA	Registro Italiano Navale	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PP-H, PVC-C, PVC-U
RMROS	Russian Maritime Register of Shipping	1JQFT ÌUUJOHT WBMWFT	ABS, PE100, PVC-C, PVC-U
RTN	3045&$)/"%;03	1JQFT ÌUUJOHT WBMWFT	11 17$ $ 17$ 6
47(8	4XJTT "TTPDJBUJPO GPS Gaskets BOE 8BUFS	Gaskets	&1%.
		Fittings, valves	PB, PE, PP
TSSA	Technical Standards & Safety Authority	1JQFT ÌUUJOHT WBMWFT	PVC-U, PVC-C, PP-H
83"4	8BUFS 3FHVMBUJPOT "EWJTPSZ 4DIFNF 8BUFS #ZFMBXT 4DIFNF	Gaskets	&1%.
		1JQFTÌUUJOHT	ABS, PE, PVC-U, PVC-C

"CCSFWJBUJPOT PG BQQSPWBMT FEJUJPO +VMZ

3.2 Standards and guidelines

3.2.1 Relevant standards and standards met for valves

Standards for valves (edition: July 2015)

Standard	Name
ISO 9393-2	Thermoplastics valves for industrial applications - Pressure test methods and requirements - Part 2: Test conditions and basic requirements
ISO 9393-1	Thermoplastics valves for industrial applications - Pressure test methods and requirements - Part 1: General
* 4 0	Graphical symbols for diagrams - Part 8: Valves and dampers
EN ISO 5211	Industrial valves - Part-turn actuator attachments
& / * 4 0	Industrial valves - Ball valves of thermoplastic materials
& / * 4 0	*OEVTUSJBM WBMWFT #VUUFSÍZ WBMWFT PG UIFSNPQMBTUJD NBUFSJ
& / * 4 0	Industrial valves - Check valves of thermoplastic materials
& / * 4 0	*OEVTUSJBM WBMWFT %JBQISBHN WBMWFT PG UIFSNPQMBTUJD NBUF
& / * 4 0	Industrial valves - Gate valves of thermoplastic materials
EN ISO 21787	Industrial valves - Valves of thermoplastic materials
EN 593	*OEVTUSJBM WBMWFT .FUBMMJD CVUUFSÍZ WBMWFT
& /	Industrial valves - Testing of metallic valves - Part 2: Tests, test procedu res and acceptance criteria - Supplementary requirements
& /	Industrial valves - Testing of metallic valves - Part 1: Pressure tests, test procedures and acceptance criteria - Mandatory requirements
& /	Industrial valves - Shell design strength - Part 2: Calculation method for steel valve shells
EN 13774	7BMWFT GPS HBT EJTUSJCVUJPO TZTUFNT XJUI NBYJNVN PQFSBUJOH Q MFTT UIBO PS FRVBM UP CBS 1FSGPSNBODF SFRVJSFNFOUT
EN 14141	Valves for natural gas transportation in piping systems - Performance requirements and tests
EN 15389	Industrial valves - Performance characteristics of thermoplastic valves when used as construction products
" 4 . & #	Face-to-face and end-to-end dimensions of valves
% * /	'BDF UP GBDF BOE DFOUFS UP GBDF EJNFOTJPOT PG WBMWFT 7BMWFT thread connection
% * /	0WFSBMM MFOHHUIT PG WBMWFT 7BMWFT XJUI QJQF VOJPO DPOOFDUJP
% * /	5FDIOJDBM DPOEJUJPOT PG EFMJWFSZ GPS WBMWFT 7BMWFT GPS QPU service, requirements and testing
% * /	Technical conditions of delivery of valves - Valves for gas installations and gas piping systems - Requirements and tests
% * /	5FDIOJDBM EFMJWFSZ DPOEJUJPOT GPS WBMWFT SFRVJSFNFOUT BOE UFTU GPS WBMWFT GPS VTF XJUI ÍBNNBCMF MJRVJET
% * /	Valves for drinking water installations on private premises - Anti-vacuum WBMWF UZQFT % BOE & 3FRVJSFNFOUT BOE UFTUT
% * /	'JUUJOHT GPS EPNFTUJD JOTUBMMBUJPO OPOGFSSPVT NFUBM VOJPO
% * /	Stop valves for domestic water supply - Piston type gate valves - PN 10
% * /	Stopvalves for domestic water supply - Two-way valves - Vertical bonnet UZQF 1/ 4USBJHIU QBUUFSO HMPCF WBMWF 5FDIOJDBM SVMF PG UI $BVUJPO "QQMJFT JO DPOOFDUJPO XJUI %*/ &/
% * /	Gas stop valves for domestic gas installations up to 5 bar - Requirements and tests
% * /	)JHI EFOTJUZ QPMZFUIZMFOF)%1& WBMWFT UBQQJOH WBMWFT SFR and test
% * /	Fittings for the food, chemical and pharmaceutical industries - Clamp connections for stainless steel tubes - Fusion type
% * /	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
+ * 4 #	Face-to-face and end-to-end dimensions of valves
+ * 4 #	General rules for inspection of valves

3.2.2 Relevant standards and guidelines for anges

Standards for anges (edition: July 2015)

Standard	Name
ISO 5752	.FUBM WBMWFT GPS VTF JO ÍBOHFE QJQF TZTUFNT 'BDF UP GBDF BOE face dimensions
ISO 7005-3	.FUBMMJD ÍBOHFT 1BSU $PQQFS BMMPZ BOE DPNQPTJUF ÍBOHFT
ISO 7005-2	.FUBMMJD ÍBOHFT 1BSU $BTU JSPO ÍBOHFT
ISO 7005-1	1JQF ÍBOHFT 1BSU 4UFFM ÍBOHFT GPS JOEVTUSJBM BOE HFOFSBM piping systems
ISO 7483	%JNFOTJPOT PG HBTLFUT GPS VTF XJUI ÍBOHFT UP *40
ISO 7483 Technical Corrigendum 1	%JNFOTJPOT PG HBTLFUT GPS VTF XJUI ÍBOHFT UP *40 5FDIOJDBM Corrigendum 1
ISO 8483	Plastics piping systems for pressure and non-pressure drainage and sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin - Test methods to prove the design of CPMUFE ÍBOHF KPJOUT
*40	5IFSNPQMBTUJDT QJQF GPS ÍVJET VOEFS QSFTTVSF .BUJOH EJNFOTJ ÍBOHF BEBQUFST BOE MPPTF CBDLJOH ÍBOHFT
EN ISO 10931	Plastics piping systems for industrial applications - Poly(vinylidene ÍVPSJEF 17%' 4QFDJÌDBUJPOT GPS DPNQPOFOUT BOE UIF TZTUFN
EN ISO 15493	Plastics piping systems for industrial applications - Acrylonitrile-butadie-ne-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorina UFE QPMZ WJOZM DIMPSJEF 17$ $ 4QFDJÌDBUJPOT GPS DPNQPOFOU system - Metric series
EN ISO 15494	Plastics piping systems for industrial applications - Polybutene (PB), QPMZFUIZMFOF 1& BOE QPMZQSPQZMFOF 11 4QFDJÌDBUJPOT GPS I and the system - Metric series
EN 558+A1	Industrial valves - Face-to-face and center-to-face dimensions of metal WBMWFT GPS VTF JO ÍBOHFE QJQF TZTUFNT 1/ BOE $MBTT EFTJHOBU
EN 1092-1+A1	$JSDVMBS ÍBOHFT GPS QJQF WBMWFT ÌUUJOHT BOE BDDFTTPSJFT 1/ r 1BSU 4UFFM ÍBOHFT
EN 1092-2	'MBOHFT BOE UIFJS KPJOUT $JSDVMBS ÍBOHFT GPS QJQF WBMWFT Ì BDDFTTPSJFT 1/ EFTJHOBUFE 1BSU $BTU JSPO ÍBOHFT
EN 1514-8	'MBOHFT BOE UIFJS KPJOUT %JNFOTJPOT PG HBTLFUT GPS 1/ EFTJHO ÍBOHFT 1BSU 1PMZNFSJD 0 SJOH HBTLFUT GPS HSPPWFE ÍBOHFT
EN 1515-1	Flanges and their joints - Bolting - Part 1: Selection of bolting
EN 1759-3	'MBOHFT BOE UIFJS KPJOUT $JSDVMBS ÍBOHFT GPS QJQF WBMWFT Ì BDDFTTPSJFT $MBTT EFTJHOBUFE 1BSU $PQQFS BMMPZ ÍBOHFT
EN 1759-1	'MBOHFT BOE UIFJS KPJOUT $JSDVMBS ÍBOHFT GPS QJQF WBMWFT Ì BDDFTTPSJFT $MBTT EFTJHOBUFE 1BSU 4UFFM ÍBOHFT /14 UP
"4.& #	1JQF ÍBOHFT BOE ÍBOHFE ÌUUJOHT /14 UISPVHI /14 NFUSJD JODI standard
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS NBDIJOF NBEF oÌCFSHMBTTp HMBTT ÌCF GPS DIFFESNPTSUFUÚBOH HFT
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS DPOUBDU NPMEFE oÌCFSHMBTTp HMBTT GPS DIFFESNPTSUFUÚBOH HFT
BS 10:2009	4QFDJÌDBUJPO GPS ÍBOHFT BOE CPMUJOH GPS QJQF WBMWFT BOE ÌUU
#4	$JSDVMBS ÍBOHFT GPS QJQF WBMWFT BOE ÌUUJOHT $MBTT EFTJHOBU JSPO BOE DPQQFS BMMPZ ÍBOHFT 4QFDJÌDBUJPO GPS DBTU JSPO ÍBO
%*/	1JQF ÌUUJOHT BOE KPJOU BTTFNCMJFT GPS QPMZCVUFOF QSFTTVSF QJ 5ZQF{1#{ 1BSU %JNFOTJPOT PG CVTIJOHT ÍBOHFT BOE TFBMJOH elements for socket fusioning
%*/	1JQF KPJOUT BOE UIFJS FMFNFOUT PG HMBTT ÌCFS SFJOGPSDFE QPMZ 1BSU #VTIJOHT ÍBOHFT ÍBOHFE BOE CVUU KPJOUT HFOFSBM RVB requirements and test methods
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE BTTFNCMJFT DPMMBST ÍBOHFT KPJOU SJOHT EJNFOTJPOT
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%*/	7BDVVN UFDIOPMPHZ RVJDL SFMFBTF DPVQMJOHT DMBNQFE UZQF DP

Standard	Name
%*/	7BDVVN UFDIOPMPHZ ÍBOHFT EJNFOTJPOT
%74	Calculation of thermoplastic tanks and apparatuses - Flanged joints
%74 Supplement 4	$BMDVMBUJPO PG UIFSNPQMBTUJD UBOLT BOE BQQBSBUVTFT 'VTJPO fusioned collars - Constructive details
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJ assembly
+*4 #	4UFFM QJQF ÍBOHFT
+*4 #	$BTU JSPO QJQF ÍBOHFT

3.2.3 Relevant standards for threads

Standards for threads (edition: July 2015)

Standard	Name
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads - Part 1: %JNFOTJPOT UPMFSBODFT BOE EFTJHOBUJPO
ISO 7-2	1JQF UISFBET XIFSF QSFTTVSF UJHIU KPJOUT BSF NBEF PO UIE UISFBET 7FSJÌDBUJPO CZ NFBOT PG MJNJU HBVHFT
*40	*40 HFOFSBM QVSQPTF TDSFX UISFBET #BTJD QSPÌMF 1BSU .FUSJ threads
ISO 1502	ISO general-purpose metric screw threads - Gauges and gauging
EN ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads - 1BSU{ %JNFOTJPOT UPMFSBODFT BOE EFTJHOBUJPO
EN ISO 228-2	Pipe threads where pressure-tight joints are not made on the threads - 1BSU 7FSJÌDBUJPO CZ NFBOT PG MJNJU HBVHFT
EN ISO 228-1 addendum 1	Pipe threads where pressure-tight joints are not made on the threads - 1BSU %JNFOTJPOT UPMFSBODFT BOE EFTJHOBUJPO -JNJUT PG TJ[F
&/	Pipe threads where pressure tight joints are made on the threads - Part 1: 5BQFS FYUFSOBM UISFBET BOE QBSBMMFM JOUFSOBM UISFBET %JNFO tolerances and designation
&/	Pipes threads where pressure tight joints are made on the threads - 1BSU{ 7FSJÌDBUJPO CZ NFBOT PG MJNJU HBVHFT
ASME B1.20.1	Pipe Threads, general purpose, inch
ASTM F1498	4UBOEBSE TQFDJÌDBUJPO GPS UBQFS QJQF UISFBET ‹ GPS UIFSNPQM BOÈEUJOHT
BS 21:1985	4QFDJÌDBUJPO GPS QJQF UISFBET GPS UVCFT BOE ÌUUJOHT XIFSF QSF joints are made on the threads
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBE 1SPÌMFT
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBE (FOFSBM QMBO
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBE "MMPXBODFT BOE UPMFSBOD trapezoidal screw threads of general purpose
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBE /PNJOBM EJNFOTJPOT
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBET -JNJUJOH TJ[FT GPS OVU UI GSPN{ UP NN OPNJOBM EJBNFUFS
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBET -JNJUJOH TJ[FT GPS OVU UI GSPN{ UP NN OPNJOBM EJBNFUFS
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBET -JNJUJOH TJ[FT GPS CPMU GSPN{ UP NN OPNJOBM EJBNFUFS
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBET -JNJUJOH TJ[FT GPS CPMU GSPN{ UP NN OPNJOBM EJBNFUFS
%*/	*40 NFUSJD USBQF[PJEBM TDSFX UISFBET HBVHJOH PG FYUFSOBM BOE UISFBET HBVHF EJNFOTJPOT BOE EFTJHO GFBUVSFT
%*/	(FOFSBM QVSQPTF LOVDLMF UISFBET 1BSU 1SPÌMFT OPNJOBM TJ[F
%*/	(FOFSBM QVSQPTF LOVDLMF UISFBET 1BSU %FWJBUJPOT BOE UPMF
%*/	.FUSJD CVUUSFTT UISFBET UISFBE QSPÌMFT
%*/	.FUSJD CVUUSFTT UISFBET HFOFSBM QMBO
%*/	.FUSJD CVUUSFTT UISFBET EFWJBUJPOT BOE UPMFSBODFT
%*/	4UVE FOET BOE QPSUT PG ÌUUJOHT WBMWFT BOE QMVH TDSFXT 1BSU %JNFOTJPOT GPS QJQF UISFBE
%*/	4UFFM DPOEVJU UISFBE %JNFOTJPOT

Standard	Name
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
+*4 ,	6OQMBTUJDJ[FE QPMZ WJOZM DIMPSJEF 17$ 6 QJQF ÌUUJOHT GPS X

3.2.4 Relevant standards for pipe and ttings made of ABS

Standards for pipe and ttings made of ABS (edition: July 2015)

Standard	Name
ISO 727-1	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZS plain sockets for pipe under pressure - Part 1: Metric series
ISO 727-2	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZS plain sockets for pipe under pressure - Part 2: Inch-based series
ISO 8283-4	1MBTUJDT QJQF BOE ÌUUJOHT %JNFOTJPOT PG TPDLFUT BOE TQJHPU EJTDIBSHF TZTUFNT JOTJEF CVJMEJOHT 1BSU "DSZMPOJUSJMF CVU styrene (ABS)
EN ISO 15493	Plastics piping systems for industrial applications - Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and DIMPSJOBUFE QPMZ WJOZM DIMPSJEF 17$ $ 4QFDJÌDBUJPOT GPS D and the system - Metric series
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS SJHJE BDSZMPOJUSJMF CVUBEJFOF TUZ NBUFSJBMT GPS QJQF BOE ÌUUJOHT
#4	"DSZMPOJUSJMF CVUBEJFOF TUZSFOF "#4 QSFTTVSF QJQF 4QFDJÌDB
#4	"DSZMPOJUSJMF CVUBEJFOF TUZSFOF "#4 ÌUUJOHT GPS VTF XJUI "#4 QJQ4IFQFDJÌDBUJPO
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF tion of two-pipe systems

3.2.5 Relevant standards and guidelines for pipe and ttings made of PE

Standards for pipe and ttings made of PE (edition: July 2015)

Standard	Name
ISO 3458	1MBTUJDT QJQJOH TZTUFNT .FDIBOJDBM KPJOUT CFUXFFO ÌUUJOHT B pipe - Test method for leak-tightness under internal pressure
ISO 3459	1MBTUJD QJQJOH TZTUFNT .FDIBOJDBM KPJOUT CFUXFFO ÌUUJOHT BO pipe - Test method for leak-tightness under negative pressure
ISO 3501	1MBTUJDT QJQJOH TZTUFNT .FDIBOJDBM KPJOUT CFUXFFO ÌUUJOHT B pipe - Test method for resistance to pull-out under constant longitudinal force
ISO 3503	1MBTUJDT QJQJOH TZTUFNT .FDIBOJDBM KPJOUT CFUXFFO ÌUUJOHT B pipe - Test method for leak-tightness under internal pressure of assem- blies subjected to bending
ISO 4437-1	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 1: General
ISO 4437-2	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 2: Pipes
ISO 4437-3	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 3: Fittings
ISO 4437-4	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 4: Valves
ISO 4437-5	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 5: Fitness for purpose of the system
*40	1& NFUBM BOE 11 NFUBM BEBQUPS ÌUUJOHT GPS QJQF GPS ÍWJET VOEF %FTJHO MFOHHUIT BOE TJ[F PG UISFBET .FUSJD TFSJFT
*40 54	1PMZFUIZMFOF QJQF BOE ÌUUJOHT GPS UIF TVQQMZ PG HBTFPVT GVFM practice for design, handling and installation
*40	1MBTUJDT QJQF BOE ÌUUJOHT &RVJQNFOU GPS GVTJPOJOH KPJOUJOH systems - Part 3: Operator's badge

Standard	Name
*40	1MBTUJD QJQF BOE ÌUUJOHT .FDIBOJDBM DPNQSFTTJPO KPJOUT GPS pressure pipe in the water supply
EN ISO 15494	Plastics piping systems for industrial applications - Polybutene (PB), QPMZFUIZMFOF 1& BOE QPMZQSPQZMFOF 11 4QFDJÌDBUJPOT GPS and the system - Metric series
EN 12201-1	Plastics piping systems for water supply - Polyethylene (PE) - Part 1: General
EN 12201-2+A1	Plastics piping systems for water supply - Polyethylene (PE) - Part 2: Pipes
EN 12201-3+A1	Plastics piping systems for water - Polyethylene (PE) - Part 3: Fittings
EN 12201-4	Plastics piping systems for water supply - Polyethylene (PE) - Part 4: Valves
EN 12201-5	Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 5: Fitness for purpose of the system
EN 1555-1	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 1: General
EN 1555-2	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 2: Pipes
EN 1555-3+A1	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 3: Fittings
EN 1555-4	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 4: Valves
EN 1555-5	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 5: Fitness for purpose of the system
EN 12007-2	(BT JOGSBTUSVDUVSF 1JQJOH TZTUFNT GPS NBYJNVN PQFSBUJOH QS UP BOE JODMVEJOH CBS 1BSU (FOFSBM GVODUJPOBM SFRVJSFNF version EN 12007-1:2012
$&/ 54	Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 7: Guidance for the assessment of conformity
$&/ 54	Plastics piping systems for the supply of gaseous fuels - Polyethylene (PE) - Part 7: Guidance for assessment of conformity
"45. %	4UBOEBSE QSBDUJDF GPS IFBU GVTJPO KPJOJOH PG QPMZPMFÌO QJQF
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS CVUU IFBU GVTJPO QPMZFUIZMFOF 1& ÌUUJOHT GPS QPMZFUIZMFOF 1& QMBTUJD QJQF BOE UVCJOH
%*/	)JHI EFOTJUZ QPMZFUIZMFOF)%1& WBMWFT UBQQJOH WBMWFT SFR and test
%*/	1PMZFUIZMFOF 1& 1JQFT 1& 1& %JNFOTJPOT
%*/	Polyethylene (PE) pipe - PE 80, PE 100 - General quality requirements, testing
%*/	Pressure piping systems made from thermoplastics materials - Metal and QMBTUJDT DPNQSFTTJPO ÌUUJOHT GPS QPMZFUIZMFOF 1& QJQF (FO requirements and testing
%*/	1SFGBCSJDBUFE IJHI EFOTJUZ QPMZFUIZMFOF 1&)% NBOIPMFT GPS V TFXFSBHF TZTUFNT EJNFOTJPOT BOE UFDIOJDBM EFMJWFSZ DPOEJUJ
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%7(8 71	Gas-Absperrarmaturen aus Polyethylen (PE 80 und PE 100) - "OGPSEFSVOHFO VOE 1S×GVOHFO (BT WBMWFT NBEF PG QPMZFUIZMFO and PE 100] - Requirements, testing)
%74 4VQQMFNFOUO	$BMDVMBUJPO PG UBOLT BOE BQQBSBUVT NBEF PG UIFSNPQMBTUJDT factors
%74	Fusioning of thermoplastics - Heated tool fusion of pipe, piping system components and sheets made of PE
%74	*OEVTUSJBM QJQJOH TZTUFNT NBEF PG UIFSNPQMBTUJDT 1MBOOJOH tion - Above-ground pipe systems
%74 Supplement 1	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT $BMDVMBUJPO FYBNQMF

Standard	Name
%74 Supplement 2	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU ground pipe systems - Recommendations for the internal pressure and leak tests
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJ assembly
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF tion of two-pipe systems
+*4 ,	Polyethylene pipe for the supply of gaseous fuels

3.2.6 Relevant standards and guidelines for pipe and ttings made of PP

Norm	Bezeichnung
ISO 3213	1PMZQSPQZMFOF 11 QJQF &ËFDU PG UJNF BOE UFNQFSBUVSF PO UI strength
*40	1& NFUBM BOE 11 NFUBM BEBQUPS ÌUUJOHT GPS QJQF GPS ÍVJET VOEF %FTJHO MFOHUIT BOE TJ[F PG UISFBET .FUSJD TFSJFT
EN ISO 15494	Plastics piping systems for industrial applications - Polybutene (PB), QPMZFUIZMFOF 1& BOE QPMZQSPQZMFOF 11 4QFDJÌDBUJPOT GPS I and the system - Metric series
%*/	1PMZQSPQZMFOF 11 QJQF 11) 11 # 11 3 11 3$5 %JNFOTJPOT
%*/	Polypropylene (PP) pipe - PP-H, PP-B, PP-R, PP-RCT - General quality requirements and testing
%*/ Supplement 1	1JQFT PG QPMZQSPQZMFOF 11 DIFNJDBM SFTJTUBODF PG QJQF BOE
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%74	Fusioning of thermoplastics - Non-contact heated tool butt fusion of pipe, piping system components and sheets - Methods, equipment, parameters
%74	Fusioning of thermoplastics - Heated tool fusioning of pipe, piping parts and panels made of PP
%74	*OEVTUSJBM QJQJOH TZTUFNT NBEF PG UIFSNPQMBTUJDT 1MBOOJOH tion - Above-ground pipe systems
%74 Supplement 1	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT $BMDVMBUJPO FYBNQMF
%74 Supplement 2	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU ground pipe systems - Recommendations for the internal pressure and leak tests
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJ assembly
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF tion of two-pipe systems

Standards and guidelines for pipe and ttings made of PP (edition: July 2015)

3.2.7 Relevant standards and guidelines for pipe and ttings made of PVC-C

Standards for pipe and ttings made of PVC-C (edition: July 2015)

Standard	Name
ISO 727-1	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZSF plain sockets for pipe under pressure - Part 1: Metric series
ISO 727-2	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZSF plain sockets for pipe under pressure - Part 2: Inch-based series
EN ISO 15493	Plastics piping systems for industrial applications - Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and DIMPSJOBUFE QPMZ WJOZM DIMPSJEF 17$ $ 4QFDJÌDBUJPOT GPS D and the system - Metric series
ASTM F437	4UBOEBSE TQFDJÌDBUJPO GPS UISFBEFE DIMPSJOBUFE QPMZ WJOZM D 17$ $ QMBTUJD QJQF ÌUUJOHT 4DIFEVMF
"45.' ' .	4UBOEBSE TQFDJÌDBUJPO GPS DIMPSJOBUFE QPMZ WJOZM DIMPSJEF pipe, Schedules 40 and 80
ASTM F1970	4UBOEBSE TQFDJÌDBUJPO GPS TQFDJBM FOHJOFFSFE ÌUUJOHT BQQVS valves for use in poly (vinyl chloride) (PVC) or chlorinated poly (vinyl chloride) (PVC-C) systems
%*/	$IMPSJOBUFE QPMZWJOZM DIMPSJEF 17$ $ QJQF %JNFOTJPOT
%*/	Chlorinated polyvinyl chloride (PVC-C) pipe - General quality require ments, testing
%*/ Supplement 1	Chlorinated polyvinyl chloride (PVC-C) pipe, PVC-C 250 - General quality SFRVJSFNFOUT BOE UFTUJOH DIFNJDBM SFTJTUBODF
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%74	"EIFTJWF CPOEJOH PG QJQF BOE ÌUUJOHT NBEF PG UIFSNPQMBTUJDT Chlorinated polyvinyl chloride (PVC-C)
%74	"EIFTJWF CPOEJOH PG QJQF BOE ÌUUJOHT NBEF PG UIFSNPQMBTUJDT Chlorinated polyvinyl chloride (PVC-C)
%74	*OEVTUSJBM QJQJOH TZTUFNT NBEF PG UIFSNPQMBTUJDT 1MBOOJOH tion - Above-ground pipe systems
%74 Supplement 1	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT $BMDVMBUJPO FYBNQMF
%74 Supplement 2	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU ground pipe systems - Recommendations for the internal pressure and leak tests
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJ assembly
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF tion of two-pipe systems

3.2.8 Relevant standards and guidelines for pipe and ttings made of PVC-U

Standards and guidelines for pipe and ttings made of PVC-U (edition: July 2015)

Standard	Name
* 4 0	1JQF BOE ÌUUJOHT PG QMBTUJDT NBUFSJBMT 'JUUJOHT GPS EPNFTUJD BO waste pipe - Basic dimensions: Metric series - Part 1: Unplasticized poly(vinyl chloride) (PVC-U)
ISO 727-1	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZSFOF plain sockets for pipe under pressure - Part 1: Metric series
ISO 727-2	Fittings made from unplasticized poly(vinyl chloride) (PVC-U), chlorinated QPMZ WJOZM DIMPSJEF 17$ $ PS BDSZMPOJUSJMF CVUBEJFOF TUZSFOF plain sockets for pipe under pressure - Part 2: Inch-based series
ISO 4132	6OQMBTUJDJ[FE QPMZWJOZM DIMPSJEF 17$ BOE NFUBM BEBQUPS ÌUUJOH under pressure - Laying lengths and size of threads - Metric series
EN ISO 13783	Plastics piping systems - Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double-socket joints - Test method for leak-tightness and strength while subjected to bending and internal pressure
EN ISO 1452-1	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 1: General
EN ISO 1452-2	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 2: Pipes
EN ISO 1452-3	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 3: Fittings
EN ISO 1452-4	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 4: Valves
EN ISO 1452-5	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 5: Fitness for purpose of the system
EN ISO 15493	Plastics piping systems for industrial applications - Acrylonitrile-butadie-ne-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorinated QPMZ WJOZM DIMPSJEF 17$ $ 4QFDJÌDBUJPOT GPS DPNQPOFOUT BOE U - Metric series
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS SJHJE QPMZ WJOZM DIMPSJEF 17$ DPNQP chlorinated poly(vinyl chloride) (PVC-C) compounds
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS QPMZ WJOZM DIMPSJEF 17$ QMBTUJD QJQ 40, 80, and 120
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS UISFBEFE QPMZ WJOZM DIMPSJEF 17$ QM ÌUUJOHT 4DIFEVMF
"45. %	4UBOEBSE TQFDJÌDBUJPO GPS QPMZ WJOZM DIMPSJEF 17$ QMBTUJD QJQ Schedule 40
ASTM F1970	4UBOEBSE TQFDJÌDBUJPO GPS TQFDJBM FOHJOFFSFE ÌUUJOHT BQQVSUFO valves for use in poly (vinyl chloride) (PVC) or chlorinated poly (vinyl chloride) (PVC-C) systems
# 4	4QFDJÌDBUJPO GPS VOQMBTUJDJ[FE 17$ QJQF GPS JOEVTUSJBM VTFT
# 4	+PJOUT BOE ÌUUJOHT GPS VTF XJUI VOQMBTUJDJ[FE 17$ QSFTTVSF QJQF NPMEFE VOQMBTUJDJ[FE 17$ ÌUUJOHT GPS TPMWFOU GVTJPOJOH GPS VTF pipe, including potable water supply
% * /	Unplasticized polyvinyl chloride (PVC-U) pipe - General quality requirements
% * / Supplement 1	6OQMBTUJDJ[FE QPMZWJOZM DIMPSJEF QJQF DIFNJDBM SFTJTUBODF PG Q of (PVC-U)
% * /	'JUUJOHT GPS QSFTTVSF QJQF NBEF PG QMBTUJDJ[FS GSFF QPMZWJOZMDI /BNFT TZNCPMT TJNQMJÌFE QSFTFOUBUJPOT
% * /	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPDFTT 1BSU{ (SBQIJDBM TZNCPMT PG WBMWFT QJQF BOE BDUVBUPST
% 7 4	Adhesive bonding of pipe and piping parts made of thermoplastics - Polyvinyl chloride (PVC-U)

Standard	Name
%74	*OEVTUSJBM QJQJOH TZTUFNT NBEF PG UIFSNPQMBTUJDT 1MBOOJOH BOE Above-ground pipe systems
%74 Supplement 1	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVUJPO HSPVOE QJQF TZTUFNT $BMDVMBUJPO FYBNQMF
%74 Supplement 2	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVUJPO ground pipe systems - Recommendations for the internal pressure and leak tests
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVUJPO HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJSFN assembly
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF BO of two-pipe systems
+*4 ,	Unplasticized poly (vinyl chloride) (PVC-U) pipe
+*4 ,	Unplasticized poly (vinyl chloride) (PVC-U) pipe for water supply
+*4 ,	6OQMBTUJDJ[FE QPMZ WJOZM DIMPSJEF 17$ 6 QJQF ÌUUJOHT GPS XBUFS

3.2.9 Relevant standards and guidelines for pipe and ttings made of PVDF

Standards and guidelines for pipe and ttings made of PVDF (edition: July 2015)

Standard	Name
ISO 10931	Plastics piping systems for industrial applications - Poly (vinylidene ÍVPSJEF 17%' 4QFDJÌDBUJPOT GPS DPNQPOFOUT BOE UIF TZTUFN
EN ISO 10931	Plastics piping systems for industrial applications - Poly (vinylidene ÍVPSJEF 17%' 4QFDJÌDBUJPOT GPS DPNQPOFOUT BOE UIF TZTUFN
"45. '	4UBOEBSE TQFDJÌDBUJPO GPS QPMZWJOZMJEFOF ÍVPSJEF 17%' DPSS drainage systems
"45.%	4UBOEBSE TQFDJÌDBUJPO GPS VONPEJÌFE QPMZ WJOZMJEFOF ÍVPSJEF NPMEJOH FYUSVTJPO BOE DPBUJOH NBUFSJBMT
%*/	$IFNJDBM BQQBSBUVT %PDVNFOUBUJPO JO UIF MJGF DZDMF PG QSPD - Part 4: Graphical symbols of valves, pipe and actuators
%74 Supplement 4	Calculation of tanks and apparatus made of thermoplastics - $IBSBDUFSJTUJD WBMVFT PG UIF 17%' QJQF
%74	Fusioning of thermoplastics - Non-contact heated tool butt fusion of pipe, piping system components and sheets - Methods, equipment, parameters
%74	Fusioning of thermoplastics - Heated tool fusion of pipe, piping system DPNQPOFOUT BOE TIFFUT NBEF PG 17%'
%74	*OEVTUSJBM QJQJOH TZTUFNT NBEF PG UIFSNPQMBTUJDT 1MBOOJOH tion - Above-ground pipe systems
%74 Supplement 1	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT $BMDVMBUJPO FYBNQMF
%74 Supplement 2	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU ground pipe systems - Recommendations for the internal pressure and leak tests
%74 Supplement 3	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO BOE FYFDVU HSPVOE QJQF TZTUFNT 'MBOHF DPOOFDUJPOT %FTDSJQUJPO SFRVJ assembly
%74	*OEVTUSJBM QJQJOH NBEF PG UIFSNPQMBTUJDT %FTJHO TUSVDUVSF tion of two-pipe systems

3.2.10 Relevant standards for GRP pipe

Standards for GRP pipe (edition: July 2015)

Standard	Name
* 4 0	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF 5FTU NFUIPE UP QSPWF UIF SFTJTUBODF UP JOJUJBM SJOH EFÍ
* 4 0	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF %FUFSNJO MPOH UFSN TQFDJÌD SJOH DSFFQ TUJËOF-TT VOEFS XFU DPOEJUJPOT B tion of the wet creep factor
ISO 10471	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF %FUFSNJO long-term ultimate bending strain and the long-term ultimate relative ring EFÍFDUJPO VOEFS XFU DPOEJUJPOT
ISO 10928	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF BOE ÌUUJOHT .FUIPET GPS SFHSFTTJPO BOBMZTJT BOE UIFJS V *OUFOEFE SFQMBDFNFOU CZ *40 %*4
ISO 1172	5FYUJMF HMBTT SFJOGPSDFE QMBTUJDT 1SFQSFHT NPMEJOH DPNQP MBNJOBUFT %FUFSNJOBUJPO PG UIF UFYUJMF HMBTT BOE NJOFSBM Ì Calcination methods
ISO 14828	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF %FUFSNJO MPOH UFSN TQFDJÌD SJOH SFMBYBUJPO TUJËOFTT VOEFS XFU DPOEJU DBMDVMBUJPO PG UIF XFU SFMBYBUJPO GBDUPS
* 4 0	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF %FUFSNJO resistance to cyclic internal pressure
ISO 7432	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF BOE ÌUUJOH methods to prove the design of locked socket-and-spigot joints, including double-socket joints, with elastomeric seals
ISO 7509	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF %FUFSNJOBUJPO PG UJNF UP GBJMVSF VOEFS TVTUBJOFE JOUF
ISO 7511	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF BOE ÌUUJOHT 5FTU NFUIPET UP QSPWF UIF MFBL UJHIUOFTT PG under short-term internal pressure
* 4 0	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF %FUFSNJOBUJPO PG JOJUJBM TQFDJÌD SJOH TUJËOFTT
ISO 8483	Plastics piping systems for pressure and non-pressure drainage and sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin - Test methods to prove the design of CPMUFE ÍBOHF KPJOUT
ISO 8513	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipe - Test methods for the determination of the apparent initial longitudi nal tensile strength
ISO 8521	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipe - Test methods for the determination of the apparent initial circumfe rential tensile strength
ISO 8533	Plastics piping systems for pressure and non-pressure drainage and sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin - Test methods to prove the design of cemented or wrapped joints
* 4 0	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF BOE ÌUUJOH NFUIPET GPS MFBL UJHIUOFTT PG ÍFYJCMF KPJOUT
* 4 0 5 4	6OEFSHSPVOE JOTUBMMBUJPO PG ÍFYJCMF HMBTT SFJOGPSDFE QJQF C unsaturated polyester resin (GRP-UP) - Part 1: Installation procedures
& /	1MBTUJDT QJQJOH TZTUFNT (MBTT SFJOGPSDFE QMBTUJDT DPNQPOF mination of the amounts of constituents using the gravimetric method
EN 705	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF BOE ÌUUJOHT .FUIPET GPS SFHSFTTJPO BOBMZTFT BOE UIFJS V
& /	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF %FUFSNJOBUJPO PG UIF DSFFQ GBDUPS VOEFS ESZ DPOEJUJPO
EN 1394	(MBTT SFJOGPSDFE UIFSNPTFUUJOH QMBTUJDT (31 QJQF %FUFSNJO MPOH UFSN TQFDJÌD SJOH SFMBYBUJPO TUJËOFTT VOEFS XFU DPOEJU DBMDVMBUJPO PG UIF XFU SFMBYBUJPO GBDUPS
EN 1447+A1	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) QJQF %FUFSNJOBUJPO PG UJNF UP GBJMVSF VOEFS TVTUBJOFE JOUF

Standard	Name
"% PE HP 110 R	$FOUSJGVHBMMZ DBTU HMBTT SFJOGPSDFE QPMZFTUFS SFTJO &1 (' QJQF ÌUUJOHT BOE plastics (GRP) with and without liner
BS 7159:1989	Code of practice for design and construction of glass-reinforced plastics (GRP) piping systems for individual plants or sites
BS 8010-2.5:1989	Code of practice for piping systems. Piping systems on land: design, construction and installation. Glass reinforced thermosetting plastics
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE VTF JO DIFNJDBM QJQJOH TZTUFNT 5FDIOJDBM EFMJWFSZ DPOEJUJPO
%*/	$FOUSJGVHBMMZ DBTU HMBTT ÌCFS SFJOGPSDFE FQPYZ SFTJO &1 (' %JNFOTJPOT
%*/	8PVOE HMBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJOT 61 (' QJQF HFO quality requirements and testing
%*/	8PVOE HMBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF 5ZQF dimensions
%*/	8PVOE HMBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF 5ZQF dimensions
%*/	8PVOE HMBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF 5ZQF dimensions
%*/	8PVOE HMBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF 5ZQF dimensions
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE BTTFNCMJFT ÌUUJOHT HFOFSBM RVBMJUZ SFRVJSFNFOUT BOE UFTUJ
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE &MCP%XJTNFOTJPOT
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BO K /P[[MFT %JNFOTJPOT
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE 3FEVDFS%SJNFOTJPOT
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE BTTFNCMJFT DPNNBST ÍBOHFT KPJOU SJOHT EJNFOTJPOT
%*/	1JQF KPJOUT BOE UIFJS FMFNFOUT PG HMBTT ÌCFS SFJOGPSDFE QPMZ 1BSU #VTIJOHT ÍBOHFT ÍBOHFE BOE CVUU KPJOUT HFOFSBM RVB requirements and test methods
%*/	(MBTT ÌCFS SFJOGPSDFE QPMZFTUFS SFTJO 61 (' QJQF ÌUUJOHT BOE -BNJOBKUPFJBUJNFOTJPOT
%*/	(MBTT ÌCFS SFJOGPSDFE FQPYZ SFTJO &1 (' QJQF ÌUUJOHT BOE KPJO 5FFT %JNFOTJPOT
%*/	5FTUJOH PG HMBTT ÌCFS SFJOGPSDFE QMBTUJDT QJQF EFUFSNJOBUJF MPOHJUVEJOBM TIFBS TUSFOHUI PG UZQF # QJQF ÌUUJOHT

4 Material Selection – Chemical Resistance

4.1 Introduction

Pipes made from plastics are used not only for drinking water, water for general use and XBTUFXBUFS CVU BMTP GPS USBOTQPSUJOH BHHSFTTJWF MJRVJET BOE HBTFT 5 designs, such as lined metal, ceramic or glass pipe can in many cases be replaced by plastic systems. Questions regarding the chemical resistance of piping materials to media are as important as the mechanical parameters for the installation of the piping system.

('{1JQJOH 4ZTUFNT BUUFNQUT UP QSFTFOU SFTJTUBODF TUBUFNFOUT JO PSEFS U suitable material for your application.

The recommendations given in the ChemRes Plus database are not only based upon the long BOE FYUFOTJWF BQQMJDBUJPOBM FYQFSJFODF PG (' CVU PSJHJO BT XFMM GSPN laboratories. Such tests may have been initiated by particular customer or general market demands.

%BUB DBO GVSUIFSNPSF EFSJWF GSPN OBUJPOBM PS JOUFSOBUJPOBM DPPQFSBU institutes and, if necessary, ISO or standardization authorities.

In any case we seek to give our recommendations as close to the individual application as possible. This includes statements to long-term stability, nature of media impact, hints to static and dynamic utilization, limits of process conditions and e.g. the impact of single, BMUFSOBUJOH PS NJYFE NFEJB

i GF Piping Systems' service comprises personal contact on site at the customer as well as by phone, email or via web pages as the ChemRes Plus database. Statements about the chemical resistance of plastics to media and materials not listed in the ChemRes Plus database can be requested from GF Piping Systems.

The GF ChemRes Plus database for the chemical resistance of plastic piping materials is subject to frequent updating and addition. Please be aware that the chemical resistance statements cannot consider the following aspects:

- *OÍVFODF PG TZOFSHJTUJD FËFDUT
- *OÍVFODF PG EZOBNJD FËFDUT
- *OÍVFODF PG MPOH UFSN FËFDUT
- #FIBWJPS PG NFEJB NJYUVSFT PS BMUFSOBUJOH ÌMMJOH PG QJQJOH TZTUFN
- 5ZQF PG DPSSPTJPO EBNBHF

Information about the permissible operating pressure

! Guarantee and liability claims

The statements in this chapter concerning chemical resistance of materials must be WBMJEBUFE GPS BOZ TQFDJÌD VTF DBTF BOE EP OPU BMMPX BOZ JOGFSFODF F liability claims. The function of valves depends not only on the chemical resistance of the material and the gaskets, but on a number of additional factors. For this reason, it is not possible to unrestrictedly apply this information to valves made of the same material.

('{1JQJOH 4ZTUFNT SFGFSU UP UIF (FOFSBM 5FSNT BOE $POEJUJPOT PG 4BMF change without notice.

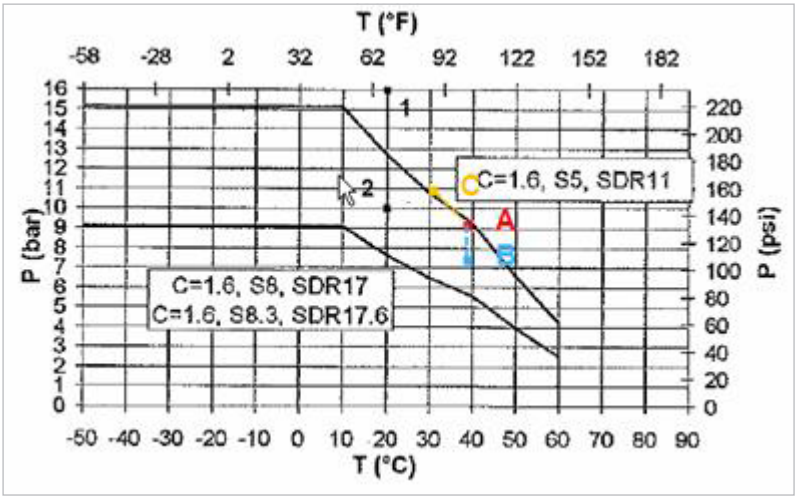
4.1.1 General information regarding chemical resistance

De-rating factor

5IF QSFTTVSF UFNQFSBUVSF EJBHSBNT PG ('{1JQJOH 4ZTUFNT DPWFS B TFSWJDF
They apply to water or aqueous solutions that do not impact the material properties.

4PNF NFEJB DBO BËFDU UIF NFDIBOJDBM TUBCJMJUZ PG QJQJOH NBUFSJBMT XJU
BUUBDLJOH UIF NBUFSJBM F H UISPVHI QFSNFBUJPO PS TXFMMJOH *G QJQF BS
pressure and temperatures, the service life of the system may be reduced. A de-rating factor
SFEVDFT UIF NBYJNVN QSFTTVSF PS UFNQFSBUVSF PG B TZTUFN
3FEVDUJPO GBDUPST BSF HFOFSBMMZ CFUXFFO BOE JO B GFX DBTFT IJ

Example



"O BRVFPVT NFEJVN JO B 1& QJQJOH TZTUFN DBO CF PQFSBUFE XJUI B NBYJNV
a temperature of 40 °C (point A in the pressure-temperature diagram) at a service life of 25 years.

IZESPDIMPSJD BDJE IBT B SFEVDUJPO GBDUPS PG GPS 1& 5IF NBYJNVN
pressure at 40°C for the same service life (point B) can be calculated:

$$\frac{9}{1.2} = 7.5 \text{ bar}$$

$POWFSTFMZ UIF NBYJNVN PQFSBUJOH UFNQFSBUVSF DBO CF EFUFSNJOFE BU
pressure (point C):

9 1.2 = 10.8 ba

" QSFTTVSF PG CBS PO UIF 4%3 MJOF DPSSFTQPOET UP B UFNQFSBUVSF F

Solvent cement joints with Tangit / DTX cement

Piping systems of ABS, PVC-U and PVC-C are preferentially cemented with Tangit. Some
BHHSFTTJWF NFEJB BU IJHIFS DPODFOUSBUJPOT EP IPXFWFS SFRVJSF %59 BT B
higher chemical resistance.

5IF VTF PG %59 SFTVMUT JO B GFX MJNJUBUJPOT

- %F SBUJOH GBDUPS PG BT TQFDJÌFE JO UIF EBUB UBCMF
- .BYJNVN BQQMJDBUJPO UFNQFSBUVSF
- Reduction of the service life to 10 years

5IF GPMMPXJOH NFEJB PS DPODFOUSBUJPOT SFRVJSF B DFNFOU KPJOU XJUI %59

Medium	Concentration	De-rating factor	Temperature
Sulfuric acid	$\mathrm{H_2SO_4}$)	" '	N B Y ‹ $
		" '	N B Y ‹ $
Hydrochloric acid	) $ M	" '	N B Y ‹ $
Nitric acid	r $\mathrm{)_3}$ / 0	" '	N B Y ‹ $ r
			N B Y ‹ $
4 P E J V N 1 P U B T T J V N r hypochlorite	/ B 0 $ M 0 $ M'		N B Y ‹ $
) Z E S P H F O P Y J E F	r $\mathrm{)_2O_2}$)	" '	N B Y ‹ $
) Z E S P Í V B P D J E	< 40% HF	" '	N B Y ‹ $

%ZUFY JT SFDPNNFOEFE FYDMVTJWFMZ GPS TVMGVSJD BDJE r DISPNJD B DISPNJVN TVMGVS $\mathrm{)_2SO_4}$ BDJE $\mathrm{)_2Cr_2O_7}$ / B $\mathrm{Cr_2)_2O_7}$ BOE OJUSJD BDJE r BMM XJUI NBYJNVN ‹ $ BOE CBS

5IF EF SBUJOH GBDUPS SFEVDFT UIF NBYJNVN TUSFTT PG B QSFTTVSF MFWFM NBYJNVN CBS BU B HJWFO UFNQFSBUVSF 'PS QSFTTVSF MFWFMT PG 1/ PS MP factor is no longer applied.

! Due to the unique properties of DTX, a special processing technique is required. For additional information, see Planning Fundamentals, chapter 12, "Jointing technology".

Gaskets

Below are general guidelines for the use of sealing materials for this purpose:

Material	Composition	Remarks	Maximum temperature	
			Constant	Short term
& 1 % .	Ethylene-propylene-co-polymer	• Generally applicable for alkaline and weak acidic media • Good resistance to aggressive media • Unsuitable for oils and greases	90 °C	120 °C
' , . ' ' , .	Fluorine elastomers 7 J U, B 0 M S F [	• Generally applicable for acidic media • High resistance to many solvents	150 °C	200 °C
NBR	Nitrile butadiene elastomer	• Good resistance to oils and fuels	90 °C	120 °C
		• 6 O T V J U B C M F GPS PYJEJ[JOH TVCTUBODFT		
PTFE	1 P M Z U F U S B Í V P S	• Resistant to all chemicals in this list	250 °C	300 °C

The selection of the sealing material depends not only on aspects of chemical resistance, but BMTP PO NFDIBOJDBM JOÍVFODFT

Easily ammable substances

Besides questions concerning the chemical resistance many organic media require special TBGFUZ NFBTVSFT XIFO EJNFOTJPOJOH QJQJOH TZTUFNT EVF UP UIFJS IJHI ÍBNN

5IF SFDPNNFOEBUJPOT PG UIF $IFN3FT 1MVT EBUBCBTF SFGFS FYDMVTJWFMZ UP resistance of the media with the corresponding materials and in no way replace technical instructions or safety guidelines for the design of piping systems. Corresponding FYQMBOBUJPOT DBO CF GPVOE F H JO UIF "5&9 "4.& "45. PS /'1" HVJEFMJOFT

i For general notes see Planning Fundamentals, chapter 4 "Dimensioning", section 2.5 "Plastic piping systems in highly combustible locations/transport of explosive media". However, these do not replace the detailed expertise of planning companies.

Fusion joints

'VTJPO KPJOUT PG UIF TFNJ DSZTUBMMJOF UIFSNPQMBTUJDT 1& 11 BOE 17%' IBW DIFNJDBM SFTJTUBODF BT UIF SFTQFDUJWF NBUFSJBM)PXFWFS GVTJPO KPJOUT QSFTTVSF MFWFMT EVF UP QSPDFTTFT XIJDI DBO MFBE UP TNBMMFS PS MBSHFS DSBDL JOEVDJOH NFEJB 5P NJOJNJ[F UIFTF SJTLT QSPGFTTJPOBM FYFDVUJPO PG essential.

> For more information see the corresponding fusion technologies in Planning Fundamentals, chapter 4, section 5 "Jointing technology".

Compressible media

Particular consideration and care is demanded for the design of plastic piping systems for gases or liquids with a considerable amount of dissolved gases with high vapour pressure.

Suitable materials for compressible media are not prone to brittle fracture . The materials of DIPJDF BSF EVDUJMF NBUFSJBMT MJLF 1& BOE "#4 11) 17$ 6 17$ $ BOE 17%' BS QSPDFTT QSFTTVSFT Ç CBS)JHIFS QSFTTVSFT BSF QPTTJCMF JG TFDPOEBSZ systems are applied, the outer piping of which provides protection against fragments from fractures.

-PX CPJMJOH NFEJB PS ÍVJET XJUI EJTTPMWFE HBTFT NBZ HFOFSBUF DPOTJEFSB JODSFBTFT VOEFS VOGBWPVSBCMF PQFSBUJPO DPOEJUJPOT 5ZQJDBM FYBNQMFT BNNPOJVN IZESPYJEF BU DSJUJDBM Q) 5IPTF QSFTTVSFT NBZ FYDFFE UIF NBYJN values for the given piping system and need to be prevented by suitable process conditions

F H BEBQUJPO PG UIF UFNQFSBUVSF QSPÌMF

6OEFS DPOEJUJPOT PG IJHI ÍPX TQFFET TFWFSBM OPO BRVFPVT NFEJB NBZ HFOF DIBSHF *O DPNCJOBUJPO XJUI ÍBNNBCMF NFEJB UIJT DBO QSPWJEF BEEJUJPOBM MBZPVU PG UIF QJQJOH TZTUFNT &YQFSJFODFE FOHJOFFSJOH DPNQBOJFT BSF B challenges.

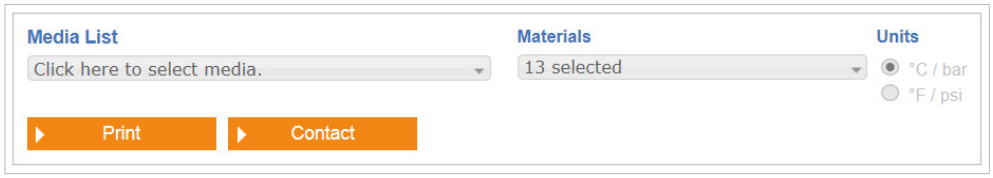
4.2 ChemRes Plus online database

4.2.1 General information

The ChemRes Plus database is supposed to serve as an orientation for the choice of a suitable piping material. Since the suitability of a material is not only determined by the pure chemical SFTJTUBODF QSPÌMF CVU BMTP CZ QSPDFTT EFUBJMT XIJDI BSF VTVBMMZ OPU SF always recommended to contact the GF specialists for an individual and more detailed assessment.

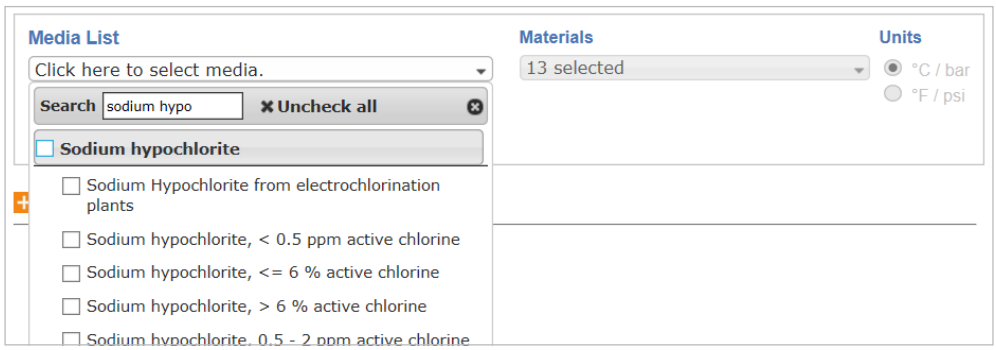
The ChemRes Plus database is available at www.gfps.com/tools

$BMM VQ UIF EBUBCBTF BU XXX HGQT DPN UPPMT VOEFS $IFNJDBM 3FTJTUBODF

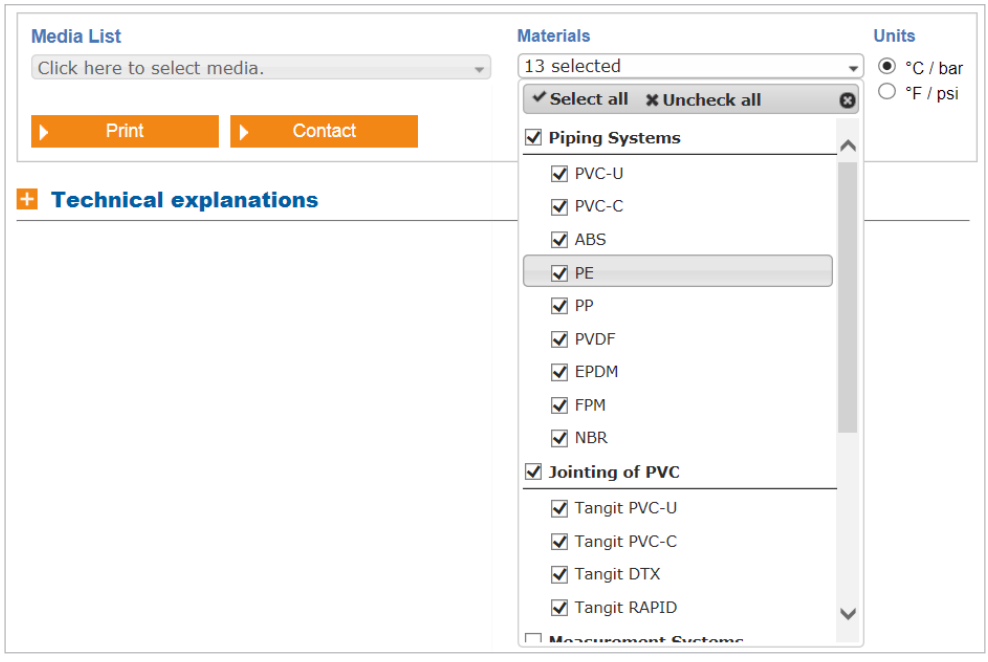


*O PSEFS UP MPDBUF B TQFDJÌD NFEJVN Media List and enter the UIF HSFZ CBS PG UIF corresponding name, e.g. sodium hypochlorite.

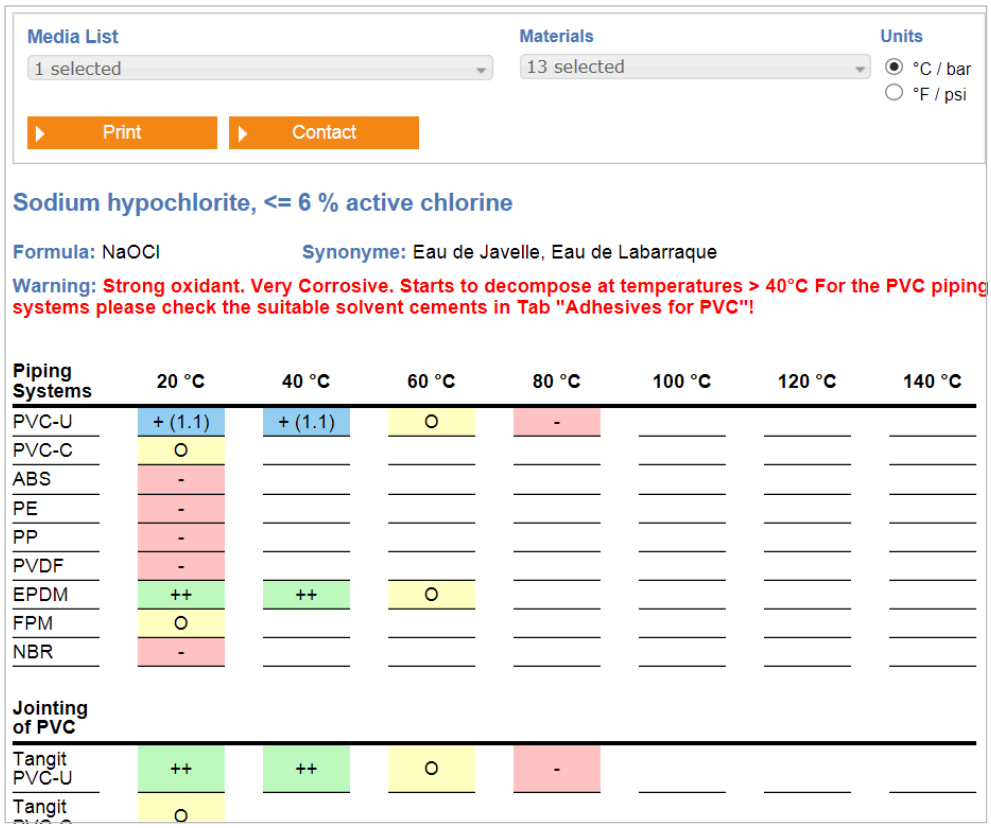
Synonyms can also be entered as an alternative, e.g. chlorine bleach.



5P USBDL UIF SFTJTUBODF QSPÌMF PG POF PS TFWFSBM NBUFSJBMT DIPPTF UIF B the list Materials 5IF HSPVQT 1JQJOH 4ZTUFNT BOE +PJOUJOH PG 17$ BSF QSF TFMFDUF



"GUFS TFMFDUJOH UIF SFRVJSFE NBUFSJBMT BOE NFEJB UIF SFTJTUBODF QSPÌMF
shown.



Classi cation

5IF DIFNJDBM SFTJTUBODF PG NBUFSJBMT JO UIF $IFN3FT 1MVT EBUBCBTF JT DM
symbols:

Symbol	Meaning	Description
++	Recommended	The material is unrestrictedly suitable for the medium within the temperature limits applicable for the NFEJVN 5IFSF JT OP PS POMZ B WFSZ TNBMM OFHBUJWF FË on the material properties.
+ (AF)	Recommended with restrictions	5IF NBUFSJBM JT TVJUBCMF GPS UIF NFEJVN IPXFWFS UIF NBYJNVN UFNQFSBUVSF PS QSFTTVSF JT TVCKFDU UP reduction by an individual de-rating factor. See the TFDUJPO %F SBUJOH GBDUPS "MUFSOBUJWFMZ B ÍBU NBYJNVN QSFTTVSF PS UFNQFSBUVS may apply.
O	Consultation with ('{1JQJOH 4ZTUFNT UFE 8F SFDPNNFOE DPOTVMUJOH (' UP PCUBJO BO individual assessment of the conditions.	Starting at this temperature, the use of the material is
-	Not suitable	The material is not suitable for the application or only under special conditions since the medium considerably impacts material properties.

Design and Installation

of Plastic Piping Systems

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*EFOUJÌDBUJPO 110

4ZNCPMT %*/{ *40{ 112

"CCSFWJBUJPOT BOE VOJUT PG NFBTVSF 113

1.5 SI units

$PWFSTJPO UBCMFT

2 Pipeline Design 118

-POH UFSN CFIBWJPS PG UIFSNPQMBTUJD NBUFSJBMT 118

3BOHF PG BQQMJDBUJPOT GPS QJQF BOE ÌUUJOHT

$BMDVMBUJPO PG BMMPXBCMF QSFTTVSF SFRVJSFE XBMM UIJ

8BUFS IBNNFS

1JQJOH TZTUFNT JO IJHIMZ DPNCVTUJCMF MPDBUJPOT USBOT

1JQJOH TZTUFNT GPS USBOTQPSUJOH DPNQSFTTFE BJS 150

1JQJOH TZTUFNT VOEFS WBDVVN 152

1JQJOH TZTUFNT GPS TVSGBDF ÌOJTIJOH BOE WBSOJTIJOH UF

(BTLFUT

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3.2 Pressure loss

IV

4 Installation 165
[EJNFOTJPO NFUIPE
)BOEMJOH QMBTUJD QJQFMJOF TZTUFNT
$"% MJCSBSZ
-FOHUI DIBOHFT BOE ÍFYJCMF TFDUJPOT
*OTUBMMBUJPO 190
1JQF DMBNQJOH EJTUBODF BOE GBTUFOJOH PG JOTUBMMBUJP
*OUFSOBM QSFTTVSF BOE MFBL UFTU 205
.PEJÌDBUJPOT SFQBJST DPNNJTTJPOJOH 212
5 Jointing technology – Mechanical, cementing and welding 213
5.1 Mechanical joints 213
4PMWFOU DFNFOU KPJOUJOH VTJOH 5BOHJU
DPNQPOFOU DFNFOU KPJOUJOH VTJOH 5BOHJU 3"1*%
4QFDJBM DFNFOUT 239
3FUSPÌU PG CSBODI ÌUUJOHT JOUP BO FYJTUJOH "#4 17$ 6 PS
$FNFOUJOH EJËFSFOU QJQF NBUFSJBMT
*OGSBSFE GVTJPO KPJOUJOH
#VUU GVTJPO KPJOUJOH IFBUJOH FMFNFOU CVUU GVTJPO DP
4PDLFU GVTJPO KPJOUJOH IFBUJOH FMFNFOU TPDLFU GVTJPO
5.10 Electrofusion (heating element fusion joints) .....
#$' 1MVT GVTJPO KPJOUJOH CFBE BOE DSFWJDF GSFF 251

1 Symbols, SI-Units and Conversion Tables

1.1 Metric and British system of units

5 I Fmetric system uses both the pipe outside diameter (d in mm) and the nominal diameter
%/ JO NN GPS UIF TJ[F EFÌOJUJPO 5IF QJQF PVUTJEF EJBNFUFS JT UIF TQFDJÌF
EJBNFUFS PG UIF QJQF 5IF OPNJOBM EJBNFUFS DMBTTJÌFT UIF JOOFS EJBNFUFS
DPNQBSBCMF XJUI NFUBM QJQF 5IF %/ OVNCFST PG NFUBM BOE QMBTUJD QJQF B

*ODI TZTUFNT BSF POMZ EFTJHOBUFE CZ UIF OPNJOBM EJBNFUFS JO JODIFT BOE
EJNFOTJPOT PG UIF JNQFSJBM QJQF UP #4 BOE UIF "NFSJDBO QJQF UP "/4* "4
TJNJMBS CVU OPU JEFOUJDBM

.FUSJD BOE JODI QJQF PG TBNF OPNJOBM TJ[F DBO CF DPOOFDUFE CZ BEBQUPST

Comparison of metric and Inch based pipe sizes

Metric sizes		Inch sizes
Pipe outer diameter d (mm)	Nominal diameter DN (mm)	Nominal diameter DN (Inch)
10		¸
12	8	¼
	10	¹
20	15	½
25	20	¾
32	25	1
	32	1¼
50		1½
	50	2
		2½
90	80	3
110	100	
125	100	-
125[1)]	125	-
	125	5
	150	
180[2)]	150	-
200	200	8
225	200	8
250	250	
280	250	10
315	300	12
355	350	
		18
	500	-
500	500	20
		-
		28
800	800	32
900	900	
1000	1000	

1) 4PMWFOU DFNFOU TPD systems only
2) Butt fusion systems only

1.2 Identi cation

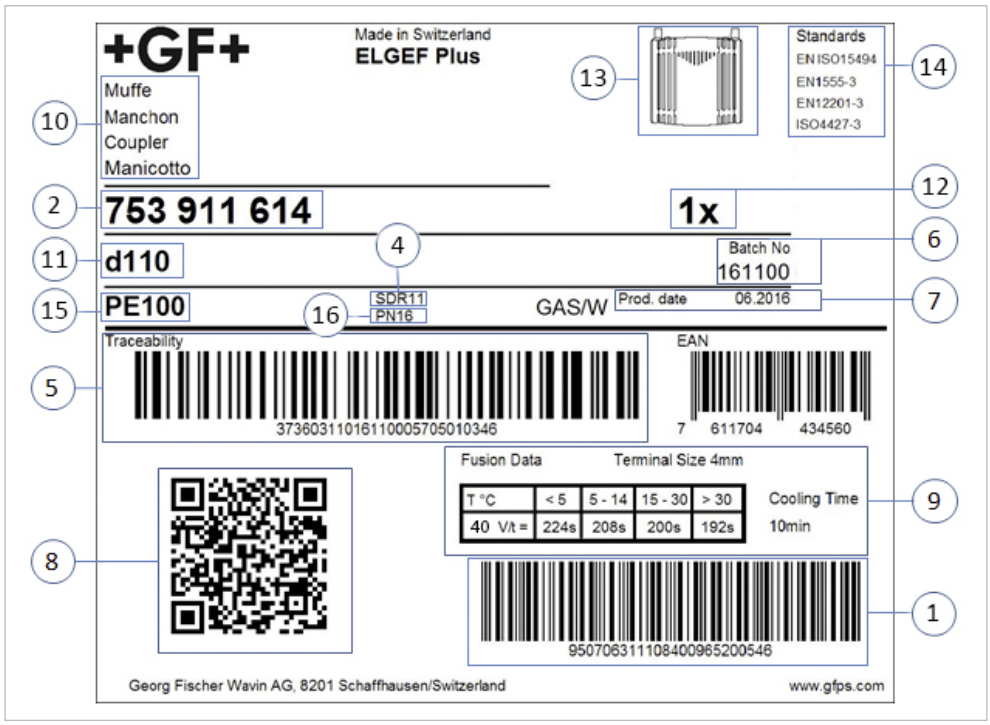
1.2.1 Fittings

Packaging label using PE electrofusion tting with the most comprehensive content as an example

Barcode label

8FMEJOH #4D{PEF
Item number
$PPMJOH UJNF
4%3 $MBTT PG UIF 1JQ
5SBDFBCJM*J4UZ DPEF
Batch-Nr.
Production month and year
YY.XXX
6OJUBSZ 23 $PEF
.BOVGBDUVSJOH EBUB
Product name
Dimension
Number of items
Product picture
"QQSPWBM /PSNT
Material
.BYCMFFE QSFTTVSF
$PMPS CBS
ZFMMPX (BT
CMV8FBUFS

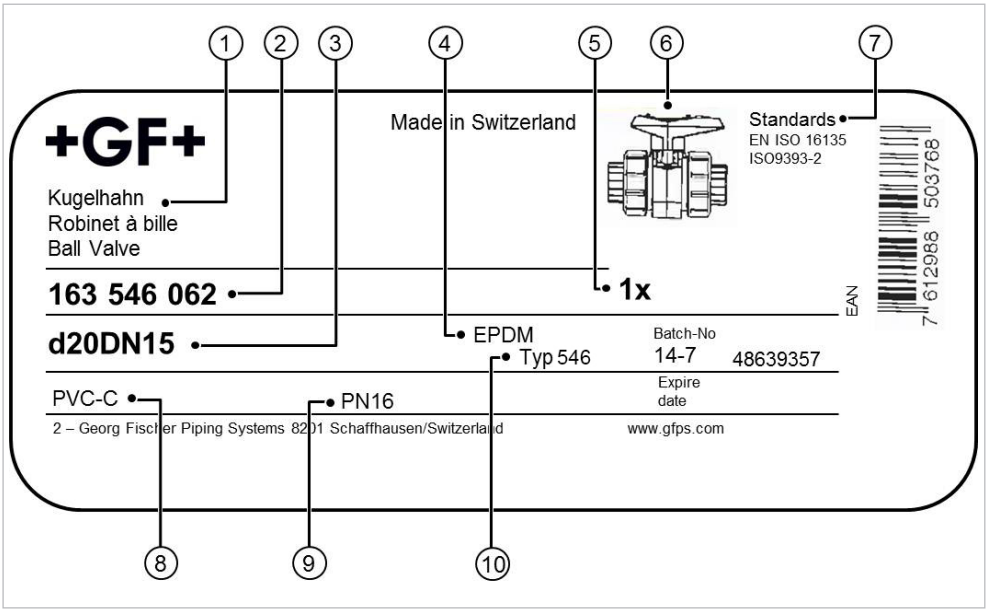
Bag label



'VSUIFS JOGPSNBUJPO UP FBDI QSPEVDU DBO CF EPXOMPBEFE XJUI UIF VOJUBSZ EBUBCBTF PG PVS POMJOF TFSWJDFT *O UIJT XBZ B DPOTPMJEBUJPO PG BMM JO BOE JOTUBMMBUJPO JT QPTTJCMF JO PSEFS UP HFOFSBUF DPNQMFUF OFUXPSL E

1.2.2 Valves

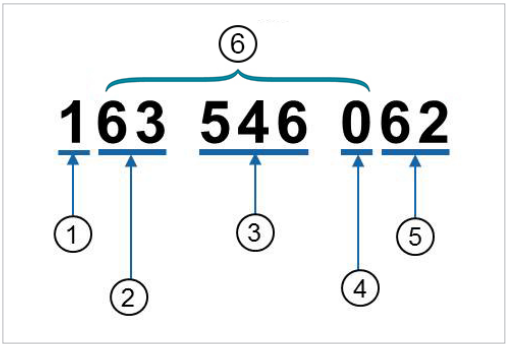
Packaging label using ball valve type 546 as an example



Product name
$PEF OVNCFS
Dimension
(BTLFU NBUFSJBM
1BDLBHFE OVNCFS PG
Product image
"QQSPWBMT TUBOEBSE
7BMWF NBUFSJBM
Nominal pressure
5ZQF

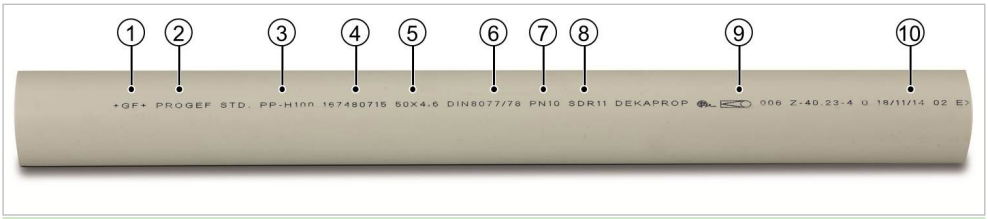
Code numbers

5IF DPEF OVNCFST UZQJDJBMMZ DPOTJTU PG UIF GPMMPXJOH



$MBTT
Material
5ZQF
7BSJBOU
4J[F

1.2.3 Pipe



Nr.	Designation type	Example
	Manufacturer's logo	
	Name of piping system	1 3 0 (& '
	Material	PP-H
	$ P E F O V N C F S	
	/ P N J O B M X J E U I %/ Y X B M M Y U I J D L O F T T F	
	4 U B O E B S E B Q Q S P W B M %*/	
	Pressure (PN)	PN10
	SDR	11
	" Q Q S P W B M T Z N C P M	
	%B U F P G N B O V G B D U V S F %% .. ::	

1.3 Symbols (DIN 2429, ISO 14617)

Symbols	Connection	Symbols	Valves
	Pipe		7 B M W F H F O F S B M
	1 J Q JF O T V M B U F E		# B M M W B M W F
	$ S P T TXJJOUH P V U connection		% J B Q I S B H N W B M W F
	5 F F		Flap trap
	Flange connection		Pump
	Hose		7 B M W F Í B O H F E
	Slope		# V U U F S Í Z W B M W F
	$ P O O F D U J P O		$ I F D L W B M W F
	Reduction		" D U V B U P S
	$ P O U B Í JB OOFH $F E		

1.4 Abbreviations and units of measure

1.4.1 Abbrevitations for materials

Abbreviation	Name
"#4	"DSZMPOJUSJMF CVUBEJFOF TUZSFOF
$3	$IMPSPQSFOF SVCCFS F H OFPQSFOF
EPDM	Ethylene propylene rubber
FKM	'MVPSJOBUFE SVCCFS F H 7JUPO
GRP	(MBTT ÌCFS SFJOGPSDFE QMBTUJDT
Ms	Brass
NBR	Nitrile rubber
NR	Natural rubber
PB	Polybutylene
PE	Polyethylene
PE-X	$SPTTMJOLFE QPMZFUIZMFOF
PP	Polypropylene
15'&	1PMZUFUSBÍVPSFUIZMFOF
17$	1PMZWJOZMDIMPSJEF
17$ $	1PMZWJOZMDIMPSJEF QPTUDIMPSJOBUFE JODSFBTFE DIMPSJOF DPOUFOU
17$ 6	1PMZWJOZMDIMPSJEF VOQMBTUJDJTFE
17%'	1PMZWJOZMJEFOFÍVPSJEF
.$*	Malleable cast iron
61 ('	6OTBUVSBUFE QPMZFTUFS SFTJO ÌCFSHMBTT SFJOGPSDFE

1.4.2 Abbreviations for procedures

Abbreviation	Name	
$	Design factor	$PNCJOBUJPO PG WBSJBUJPOT JO NBUFSJBM DPNQPTJtion and pipe manufacturing
S	Pipe series	8BMM UIJDLOFTT PG B QJQF XJUI B HJWFO PVUFS diameter
SDR	Standard dimension ratio	3BUJP PG EJBNFUFS UP XBMM UIJDLOFTT
MFR	.FMU ÍPX SBUF	7JTDPTJUZ PG UIF NPMUFO QMBTUJD NBUFSJBM
MRS	.JOJNVN3FRVJSFE4USFOHUI	Pressure resistance of a pipe material

1.4.3 Dimensions and units

Abkürzung	Bezeichnung
E E E E	0EVUFS EJBNFUFS
DN	Nominal diameter
4$	4J[F PG IFYBHPO IFBE CPMUT
"-	Number of bolt holes
s	8SFODI TJ[F
g	8FJHIU JO HSBNT
SP	/VNCFS PG JUFNT QFS TUBOEBSE QBDLBHF
GP	/VNCFS PG JUFNT QFS MBSHF QBDLBHF
e	8BMM UIJDLOFTT PG QJQF
PN	/PNJOBM QSFTTVSF BU ‹$ XBUFS ZFBST
Rp	$ZMJOESJDBM JOOFS QJQF UISFBE BDD UP *40
R	$POJDBM PVUFS QJQF UISFBE BDD UP *40
ppm	Parts per million
1 bar	/ N N .QB QTJ

Dimensions must be listed in NN BOE PS JODI BOE SFG nominal or standard dimension. Subject to construction and design changes.

1.5 SI units

1.5.1 SI base units

Base size Name	Sign	SI base units Name	Sign
Length	l	Meter	m
Mass	m	Kilogram	LH
5JNF	t	Second	s
Electric current	I	"NQFSF	"
5IFSNPEZOBNJD temperature	T	,FMWJO	K
"NPVOU PG TVCTUBODF	n	Mole	mol
Luminous intensity	ln	$BOEFMB	cd

1.5.2 Internationally de ned pre xes

Meaning	Pre x Name	Sign	Factor as Decimal power	Decimal number
2VJOUJMMJPO	JPYOB	E	10^{18}	
2VBESJMMJPO	peta	P	10^{15}	
5SJMMJPO	tera	5	10^{12}	
Billion	giga	G	10^{9}	
Million	mega	M	10	
5IPVTBOE	LJMP	L	10^{3}	
Hundred	hecto	h	10^{2}	
5FO	EFLB	da	10^{1}	
5FOUI	deci	d	10^{-1}	
Hundredth	centi	c	10^{-2}	
5IPVTBOEUI	milli	m	10^{-3}	
Millionth	micro	µ	10	
Billionth	nano	n	10^{-9}	
5SJMMJPOUI	pico	p	10^{-12}	
2VBESJMMJPOUI	femto	f	10^{-15}	
2VJOUJMMJPOUI	atto	a	10^{-18}	

1.5.3 Units

Size	Sign	SI unit	Permissible units outside of SI	Conversion into corresponding SI unit and relationships	Units and conversions no longer permissible
Length	l	m			p N 4 N N
" S F B	"	m^2			C $^{-28}$ m^2 B ^{2} m^2 I B m^2 R N R E N R D N
7 P M V N F	7	m^3	l	M $^{-3}$ m^3	
Solid angle	~	SR		T S ^{2} N N	‹ q sr H q sr
5 J N F	t	s	min h d	N J O T I T E T	
' S F R V F O D Z	f	) [		) [T	
4 Q F S E P U B U J P O B M G S F R V F O D Z	m	s^{-1}	min^{-1} 6 N J O	1 min^{-1} $^{-1}$ T 6 N J O N J O	
7 F M P D J U Z	W	N T	L N I	L N I N T	
" D D F M F S B U J P O	g	N T		Normal-Fallbeschleunigung g_n N T	(B M $^{-2}$ N T
Mass	m	L H	t	U Ž L H	R L H
Density	U	L H ^{3}N	U ^{3}N L H M	U ^{3}N L H N L H M ^{3} L H N	
Moment of inertia	J	L H q N			L Q q^2 N T L H q N
Force	F	N		/ L H ^{2}q N T	E Z O $^{-5}$ N Q $^{-3}$ q N L Q /
5 P S R V F	M	/ q N			L Q N / N / N M C G U
Pressure	p	Pa	bar	1 B ^{2}/ N C B S ^{5} Pa	B U N C B S B U C B S 5 P S S $^{-3}$ baq N 8 4 $^{-3}$ lopar N N) H $^{-3}$ baq
Stress	V	/ N^2 Pa		/ N N 1 B	L Q^2 N /^{2} N L Q ^{2}D N $^{-3}$ / N^2 L Q N N q / N^2
% Z O B W J D D P T J U Z		1 B q T		1 B q T ^{2}/ q T N	1 1 P J T F 1 B q T
, J O F N B W J D D P T J U Z		m^2 T		1 m^2 T 1 B q I H q N	4 U 4 U P L F m^2 T
8 P S L F O F S H Z	8 E	J	F 7 8 q I	+ /N 8 4 8 q I , +	D B M + L Q N + F S H J
Electric charge	2	$		$ " q T	
& M F D U S J D W P M U G B H F	7			7 8 "	
Electric current	I	"			
Electric resistance	R	~		~ 7 "	~ B C T ~
1 P X F S	P	8		8 + T /N T 8 7 q "	1 4 8 L D B M I 8 L Q N T 8
Electric capacitance	$	F		' $ 7	
. B H O F U J D Ì F M E T H U S F O H U N					0 F " N
. B H O F U J D Í V Y	)	8 C		8 C 7 q T	. Y $^{-8}$ 8 C
. B H O F U J D Í V Y E F B O T J U Z 5				5 8 ^{3}C N	(5
Inductance	L	H		) 8 C "	
Electric conductance	G	S		4 ~	
5 I F S N P E Z O B N J D temperature	5	K		— ‹ $ — , 0 ‹ $,	
$ F M T U J W F N Q F S B U V S G F		‹ $		— ‹ $ — , 0 , ‹ $	
5 I F S N D B B M Q B D J U Z	$	+ ,			, D M H S B E $^{-3}$ + , $ M + ,

1.6 Conversion tables

1.6.1 Viscosities

Kinematic viscosity Centistokes density	Absolute viscosity centipoise	Degree Engler	Saybolt Universal second (SSU)	Redwood 1 second (standard)	Saybolt Furol second	Ford Cup no. 4 second	Degree Barbey	Cup no. 15 second	Absolute viscosity poise density 1.0	Kinematic viscosity m²/s
1.0	1.0	1.0	31	29	-	-	-	-	0.01	Y
2.0	2.0	1.1		30	-	-		-	0.02	Y
3.0	3.0	1.2	35	33	-	-		-	0.03	Y
		1.3		35	-	-	1820	-	-	Y
5.0	5.0	1.39		38	-	-	1300	-	0.05	Y
					-	-	1085	-		Y
					-	-	930	-		Y
8.0	8.0		53		-	-		-	0.08	Y
9.0	9.0		55		-	-		-	0.09	Y
10	10		59	52	-	-		-	0.10	Y $^{-5}$
20	20	2.9		85	15	-	320	-	0.2	Y $^{-5}$
		5.3	185		21	-	159	-		Y $^{-5}$
			280		30					Y $^{-5}$
80	80	10.5		322	38	25.9			0.8	Y $^{-5}$
100	100	13.2				32			1.0	Y
200	200				92		32.5	11.2	2.0	Y
		52.8	1888			111	15.9			Y
			2832							Y
800	800						8.1	35	8.0	Y
1000	1000	132							10	Y $^{-3}$
5000	5000				2300		1.23		50	Y $^{-3}$
10 000	10 000	1320					-		100	Y $^{-2}$
50 000	50 000				23 000		-		500	Y $^{-2}$

"CTPMVUF WJTDPTJUZ DFOUJQPJTF LJOFNBUJD WJTDPTJUZ DFOUJTUPLFT q E {DFOUJTUPLFT DPOWFSTJPO UP 446 » 446 DFOUJTUPLFT q

1.6.2 Flow volume

m³/h	l/min	l/s	m³/s	Imp. gal/min	US gal/min	cu. ft./h	cu. ft./s
1.0			q			35.311	q $^{-3}$
	1.0		q $^{-5}$	0.220		2.119	q
		1.0	q $^{-3}$	13.20	15.853		q $^{-2}$
		1000	1.0	13 200	15 838		35.311
			q $^{-5}$	1.0	1.201		q $^{-3}$
			q $^{-5}$	0.833	1.0	8.0238	q $^{-3}$
0.0283		0.008	q		0.125	1.0	q
		28.32	q $^{-2}$				1.0

1.6.3 Pressure and pressure heads

bar	kg/cm ^{2}	lbf/in ^{2}	atm	ft H_2O	m H_2O	mm Hg	in. Hg	kPa
1.0							29.530	100
	1.0			32.808	10		28.959	
		1.0						
1.0133	1.0332		1.0	33.889	10.332		29.921	101.3
0.0299	0.0305		0.0295	1.0				2.99
0.0981	0.10			3.2808	1.0			9.81
q		0.0193	q			1.0		0.133
0.0339				1.1329			1.0	3.39
q $^{-5}$	q	q $^{-5}$	q	q	q $^{-5}$	q	q $^{-5}$	1.0

atm International standard atmosphere

L H D N Metric atmosphere

1.6.4 Conversion inch/mm

2 Pipeline Design

2.1 Long-term behavior of thermoplastic materials

0OF PG UIF NPTU JNQPSUBOU DIBSBDUFSJTUJDT PG QMBTUJD QJQF JT UIF SFBMJ
UIBU JT TVCKFDUFE UP JOUFSOBM QSFTTVSF 5IJT DIBSBDUFSJTUJD JT SFGFSSFE
8IFO EFUFSNJOJOH UIF MPOH UFSN CFIBWJPS UIF UFNQFSBUVSF BOE UIF ÍPX NF
essential role.

2.1.1 MRS values

5IF GPMMPXJOH UBCMF TIPXT UIF .34 WBMVFT .JOJNVN 3FRVJSFE 4USFOHUI GPS
materials used in the construction of industrial piping systems.

5IF WBMVFT BSF CBTFE PO UIFTF TUBOEBSET

- q &/ *40 "#4 17$ 6 17$ $
- q &/ *40 1# 1& 11
- q &/ *40 17%'

Material	MRS value (MPa)
"#4	
PE80	8
PE100	10
PP-H	10
PP-B	8
PP-R	8
17$ 6	25
17$ $ QJQF	25
17$ $ ÌUUJOH	20
17%'	25

2.1.2 Long-term behavior of ABS

Calculation (based on EN ISO 15493:2015)

5IF GPMMPXJOH MPPQ TUSFTT PMJBHSBN TIPXT UIF MPOH UFSN CFIBWJPS PG "#4
UFNQFSBUVSF SBOHF GSPN ‹$ UP ‹$ GSBDUVSF MJOFT BSF EJTQMBZFE 5IF
-1-{DVSWFT -PXFS 1SFEJDUBCMF -JNJU UIJT NFBOT BDDPSEJOH UP UIF EFÌOJUJ
GSBDUVSF QPJOUT BSF PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

5ZQJDBMMZ GPS BNPSQIPVT UIFSNPQMBTUJDT MJLF "#4 UIF MPOH UFSN CFIBWJP
MJOFT 5IF DVSWFT BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBHSBN J F OPU
JOUP BDDPVOU XIFO SFBEJOH WBMVFT GPS TUSFTT PS UJNF

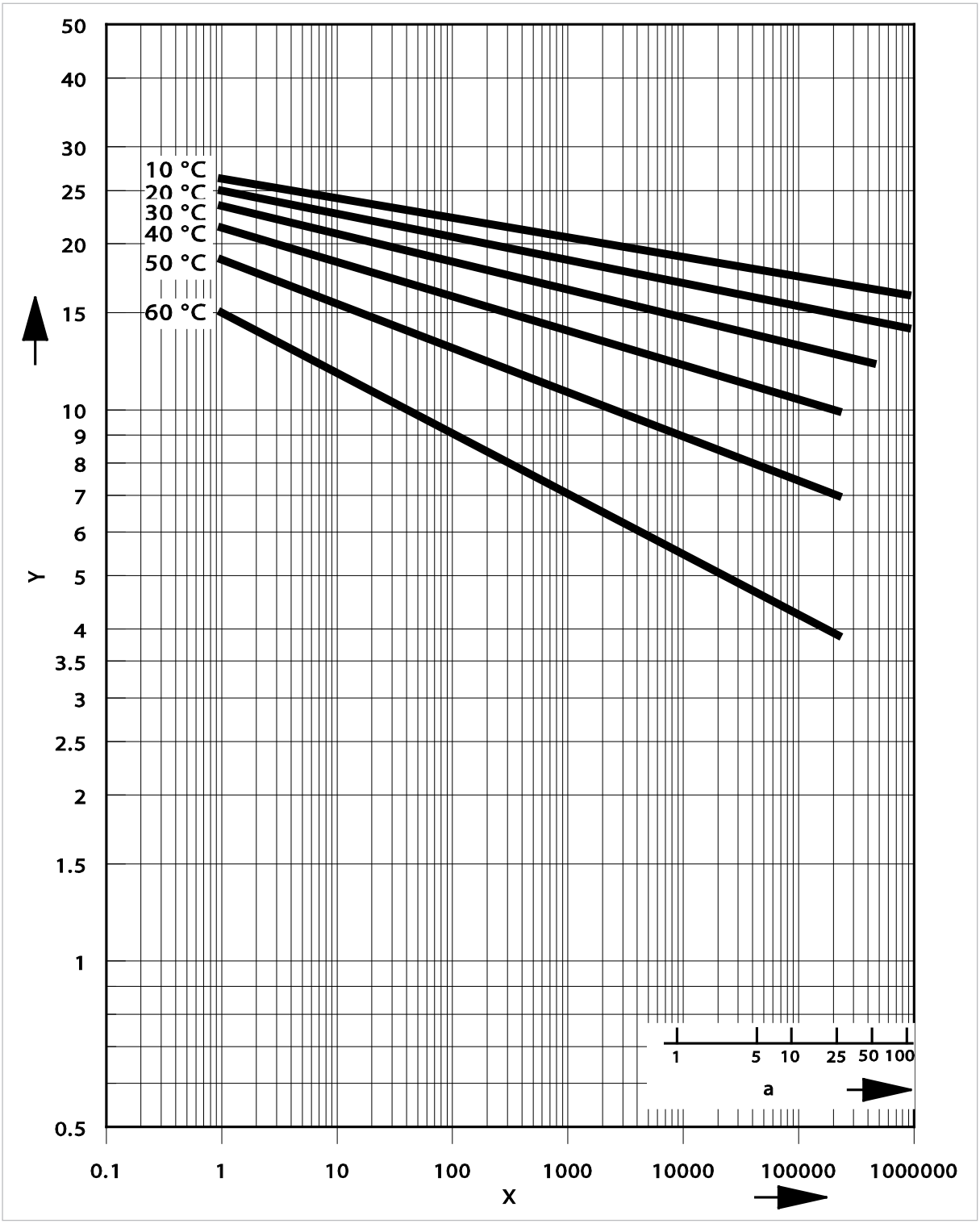
5IF MPOH UFSN CFIBWJPS XBT DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO NFUI
&/{*40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFS
EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS
‹$ UP ‹$

$$\log t = -154.8961 - 35935.57\frac{\log}{T} + 55180.34\ \frac{1}{T} + 98.73749\ \log$$

U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

5IF QSFTTVSF UFNQFSBUVSF EJBHSBN TIPXO GPS QJQF BOE ÌUUJOHT NBEF PG "#4
UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDUPS GPS B TFSWJDF MJG

Long-term behavior ABS (based on EN ISO 15493:2015)



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

2.1.3 Long-term behavior of PE

Calculation (based on EN ISO 15494:2015)

5IF GPMMPXJOH SFQFBU PG MPOH UFSN CFIBWJPST PG 1& BOE 1& 'PS UIF UF
GSPN ‹$ UP ‹$ MJOFT PG GSBDUVSF BSF EJTQMBZFE 5IFTF BSF DBMMFE -1
1SFEJDUBCMF -JNJU UIJT NFBOT BDDPSEJOH UP UIF EFÌOJUJPO UIBU PG BM
PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

Straight lines represent the long term properties of PE in the hoop stress diagram.

5IF DVSWFT BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBHSBN OPU MJOFBS Q
BDDPVOU XIFO SFBEJOH WBMVFT GPS TUSFTT PS UJNF

5IF MPOH UFSN WBMVFT IBWF CFFO DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO
&/ *40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFSJ
EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS
‹$ UP ‹$

First branch MFGU IBOE QPSUJPO PG UIF DVSWFT BT TIPXO JO UIF GPMMPXJOH MPOH

PE100

$$\log t = -45.4008 + 28444.734 \frac{1}{T} - 45.9891 \log$$

PE80

$$\log t = -42.5488 + 24078.8 \frac{1}{T} - 37.5758 \log$$

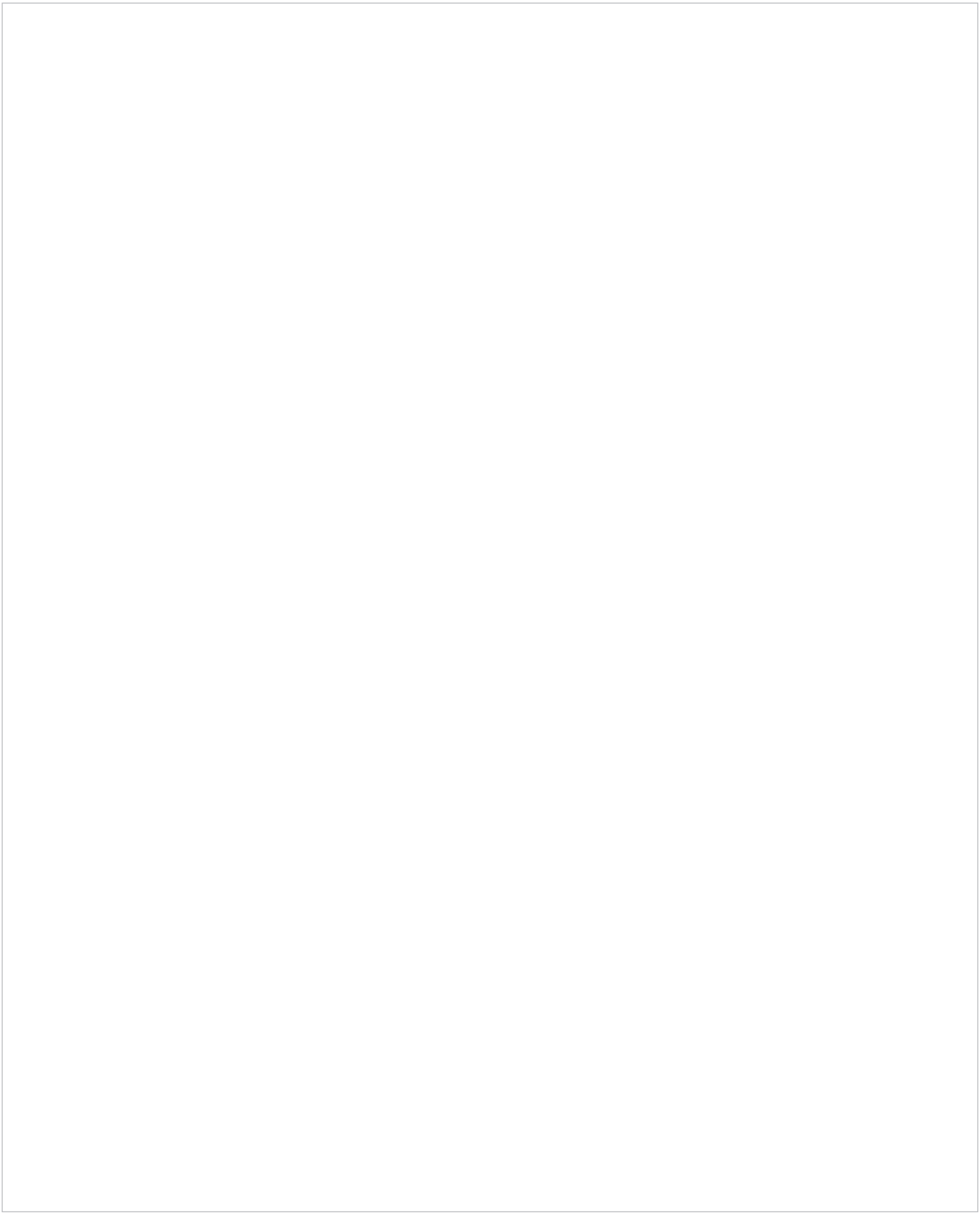
PE63

$$\log t = -19.8823 + 8619.357 \frac{1}{T} - 3.039 \log$$

U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

5IF QSFTTVSF UFNQFSBUVSF EJBHSBN UIBU XF QSPWJEF GPS QJQF BOE ÌUUJOHT
1& JT EFSJWFE GSPN UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDU
25 years.

Long-term behavior PE100 (EN ISO 15494:2015)



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
X2 Years

Long-term behavior PE80 (EN ISO 15494:2015)

:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
X2 Years

2.1.4 Long-term behavior of PP

Calculation (based on EN ISO 15494:2015)

5IF GPMMPXJOH MPOH UFSN CFIBWJPST TIPX UIF MPOH UFSN CFIBWJPS PG 11) 1
UIF UFNQFSBUVSF SBOHF GSPN ‹$ UP ‹$ GSBDUVSF MJOFT BSF EJTQMBZFE
-1- DVSWFT -PXFS 1SFEJDUBCMF -JNJU UIJT NFBOT BDDPSEJOH UP UIF EFÌOJUJ
GSBDUVSF QPJOUT BSF PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

5ZQJDBMMZ GPS TFNJ DSZTUBMMJOF QMBTUJDT MJLF 11 UIF MPOH UFSN DVSWFT
BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBHSBN J F OPU MJOFBS 1MFBTF U
SFBEJOH WBMVFT GPS TUSFTT PS UJNF

5IF MPOH UFSN CFIBWJPS XBT DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO NFUI
&/{*40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFS
EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS
‹$

5IF EPUUFE MJOFT PG UIF DVSWFT BQQMZ JG UFTUT XJUI MPOHFS UFTUJOH UJNF
‹$ BOE ‹$

⚠ The 110 °C curve has been determined separately by using water inside and air outside; it cannot be calculated with the formulas below.

First branch MFGU IBOE QPSUJPO PG UIF DVSWFT BT TIPXO JO UIF GPMMPXJOH MPOH

PP-H

$$\log t = -46.346 - 9601.1 \frac{\log}{T} + 20381.5 \frac{1}{T} + 15.24 \log$$

PP-B

$$\log t = -56.086 - 10157.8 \frac{\log}{T} + 23971.7 \frac{1}{T} + 13.32 \log$$

PP-R

$$\log t = -55.725 - 9484.1 \frac{\log}{T} + 25502.2 \frac{1}{T} + 6.39 \log$$

Second branch SJHIU IBOE QPSUJPO PG UIF DVSWFT BT TIPXO JO UIF GPMMPXJOH MPOH

PP-H

$$\log t = -18.387 + 8918.5 \frac{1}{T} - 4.1 \log$$

PP-B

$$\log t = -13.699 + 6970.3 \frac{1}{T} - 3.82 \log$$

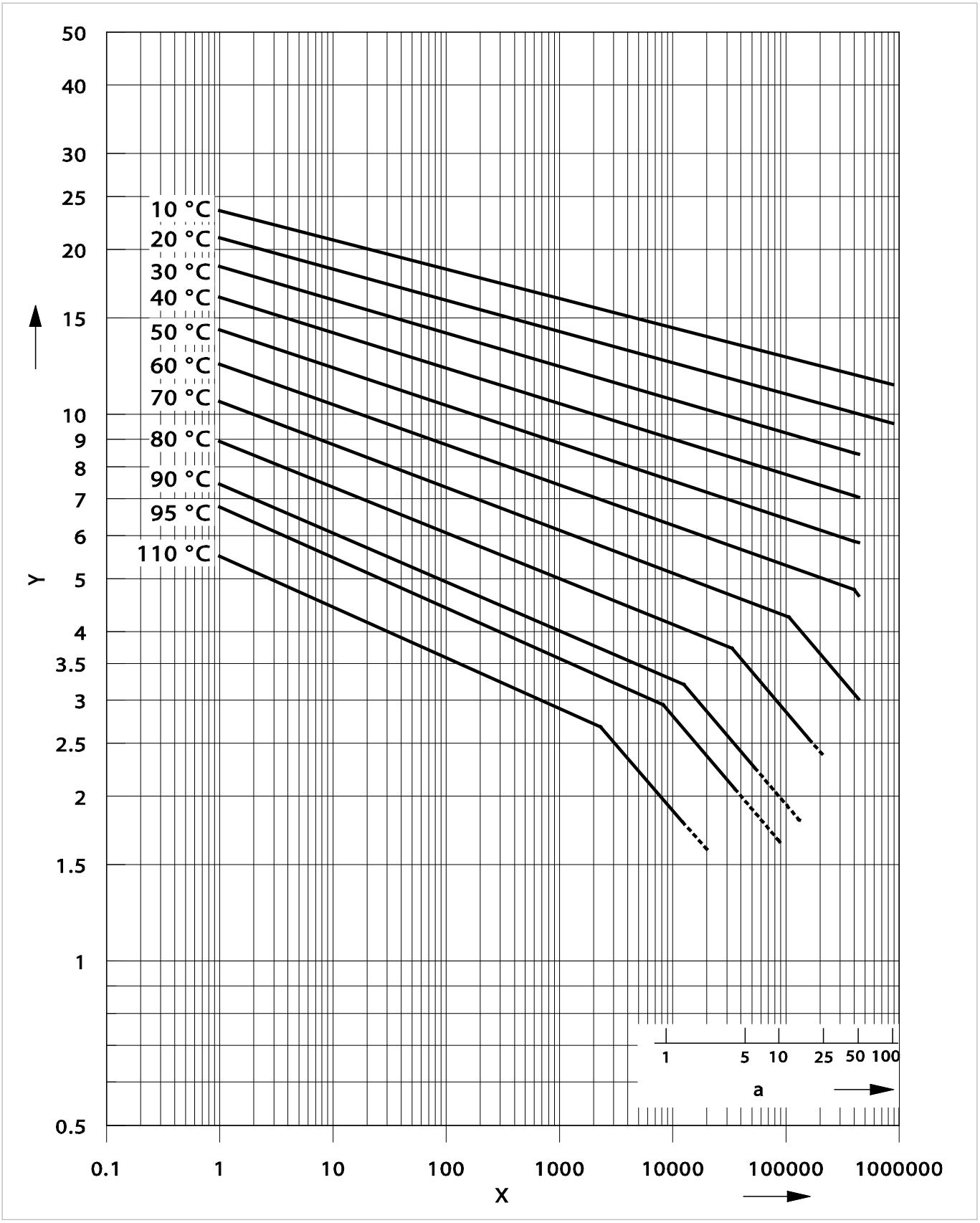
PP-R

$$\log t = -19.98 + 9507 \frac{1}{T} - 4.11 \log$$

U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

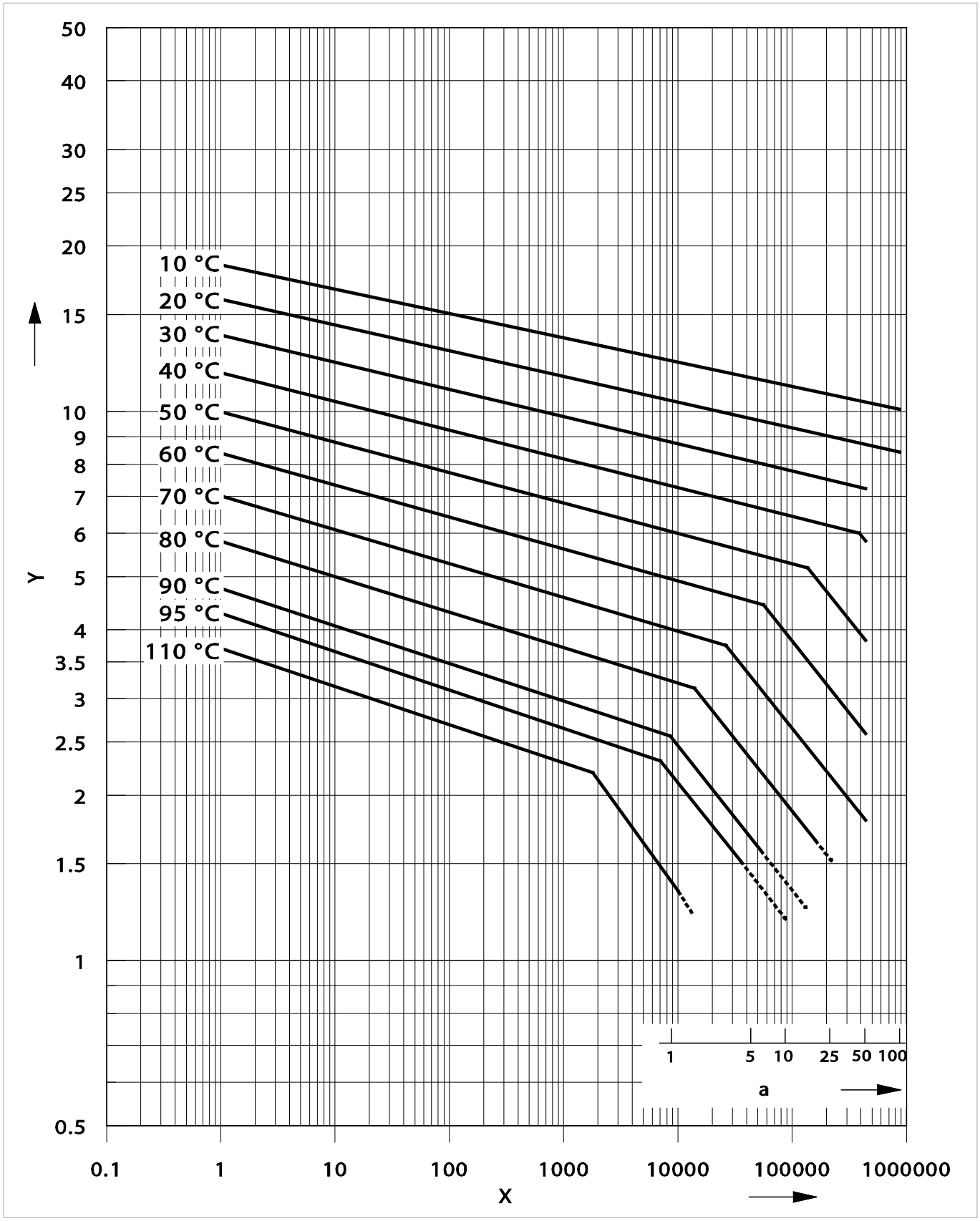
5IF QSFTTVSF UFNQFSBUVSF EJBHSBN UIBU XF QSPWJEF GPS QJQF BOE ÌUUJOHT
11 3 JT EFSJWFE GSPN UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDUF
25 years.

Long-term behavior PP-H (according EN ISO 15494:2015)



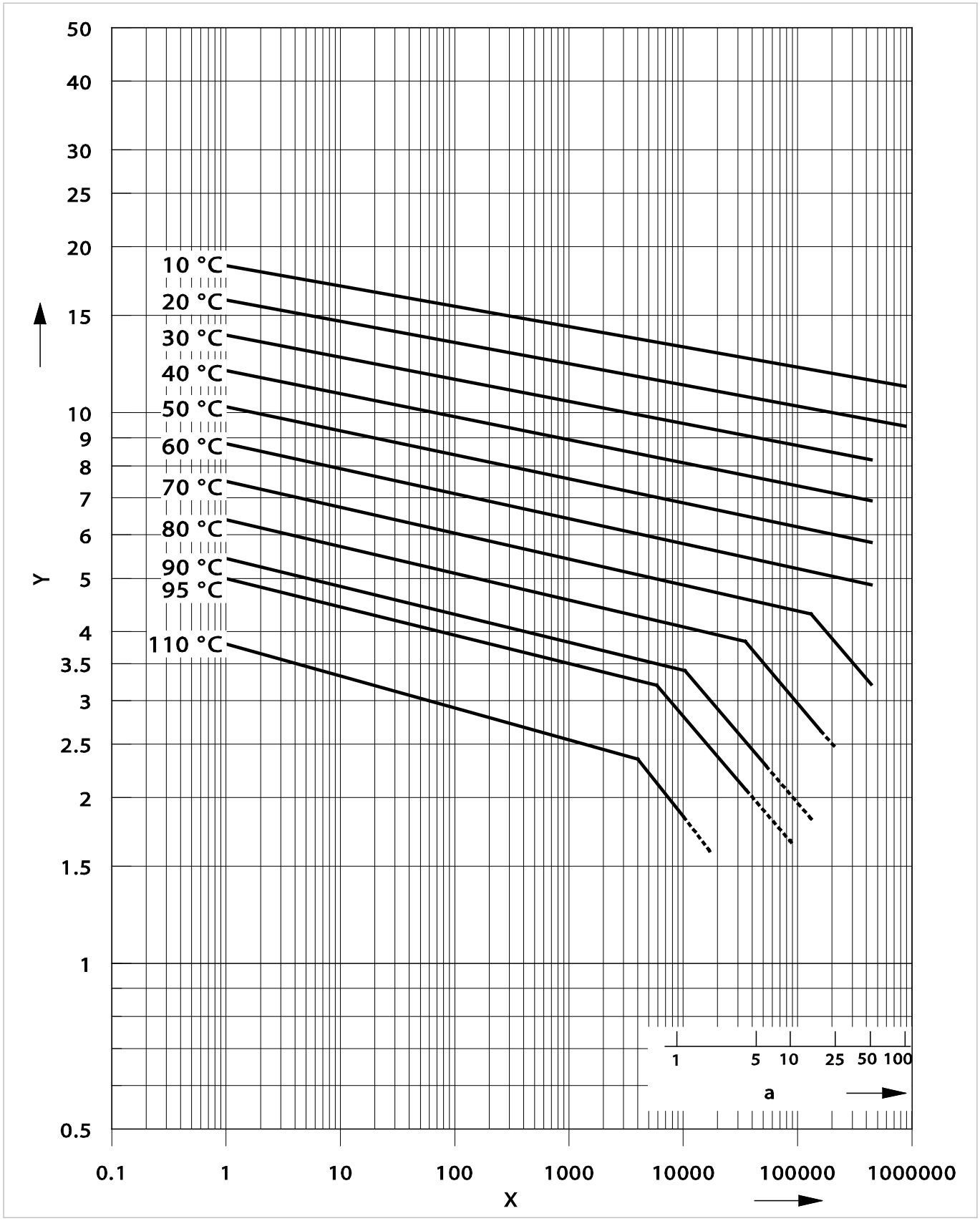
:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

Long-term behavior PP-B (according EN ISO 15494:2015)



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

Long-term behavior PP-R (according EN ISO 15494:2015)



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

2.1.5 Long-term behavior of PVC-U

Calculation (based on EN ISO 15493:2015)

5IF GPMMPXJOH MPOH UFSN CFIBWJPS TIPXT UIF MPOH UFSN CFIBWJPS PG 17$ 6
UFNQFSBUVSF SBOHF GSPN ‹$ UP ‹$ GSBDUVSF MJOFT BSF EJTQMBZFE 5IF
-1-{DVSWFT -PXFS 1SFEJDUBCMF -JNJU UIJT NFBOT BDDPSEJOH UP UIF EFÌOJUJ
GSBDUVSF QPJOUT BSF PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

5ZQJDBMMZ GPS BNPSQIPVT UIFSNPQMBTUJDT MJLF 17$ 6 UIF MPOH UFSN QSPQF
CZ TUSBJHIU MJOFT 5IF DVSWFT BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBH
1MFBTF UBLF UIJT JOUP BDDPVOU XIFO SFBEJOH WBMVFT GPS TUSFTT PS UJNF

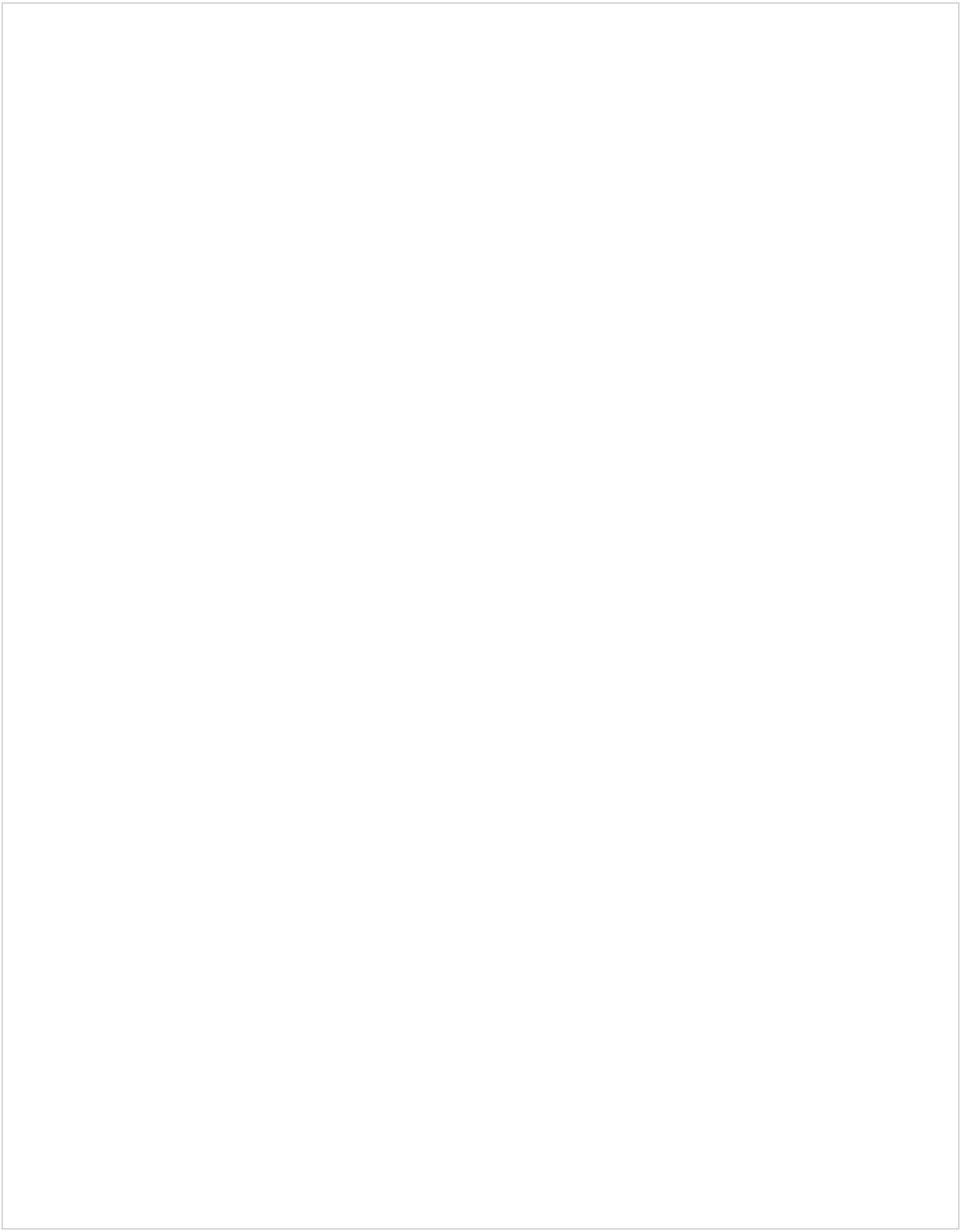
5IF MPOH UFSN CFIBWJPS XBT DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO NFUI
&/{*40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFS
EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS
‹$ UP ‹$

$$\log t = -164.461 - 29349.493 \frac{\log}{T} + 60126.534 \frac{1}{T} + 75.079 \log$$

U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

5IF QSFTTVSF UFNQFSBUVSF EJBHSBN UIBU XF QSPWJEF GPS QJQF BOE ÌUUJOHT
EFSJWFE GSPN UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDUPS GPS

Long-term behavior PVC-U



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

2.1.6 Long-term behavior of PVC-C

Calculation (based on EN ISO 15493:2015)

5IF GPMMPXJOH MPOH UFSN EJBHSBN TIPXT UIF MPOH UFSN CFIBWJPS PG 17$ $
UFNQFSBUVSF SBOHF GSPN ‹$ UP ‹$ MJOFT PG GSBDUVSF BSF EJTQMBZFE
-1- DVSWFT -PXFS 1SFEJDUBCMF -JNJU UIJT NFBOT BDDPSEJOH UP UIF EFÌOJUJ
GSBDUVSF QPJOUT BSF PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

5ZQJDBMMZ GPS BNPSQIPVT UIFSNPQMBTUJDT MJLF 17$ $ UIF MPOH UFSN CFIBW
LOFF

5IF DVSWFT BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBHSBN J F OPU MJOFBS
BDDPVOU XIFO SFBEJOH WBMVFT GPS TUSFTT PS UJNF

5IF MPOH UFSN CFIBWJPS XBT DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO NFUI
&/{*40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFS
EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS
‹$ UP ‹$

Pipe material in the temperature range of 10 °C to 95 °C

$$\log t = -109.95 - 21897 \frac{\log}{T} + 43702.87 \frac{1}{T} + 50.74202 \log$$

Fittings material in the temperature range of 10 °C to 90 °C

$$\log t = -121.699 - 25985 \frac{\log}{T} + 47143.18 \frac{1}{T} + 6303511 \log$$

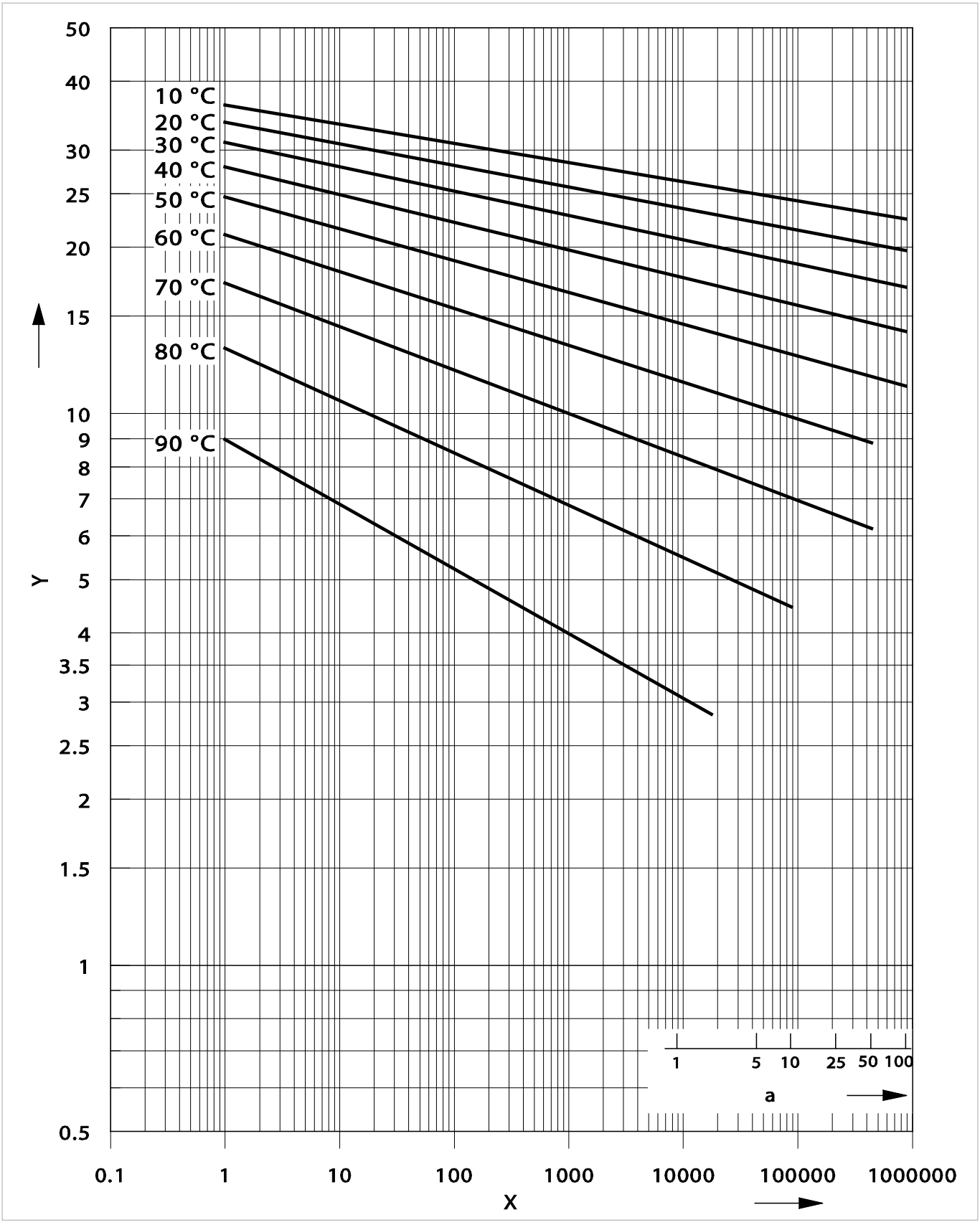
U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

5IF QSFTTVSF UFNQFSBUVSF EJBHSBN UIBU XF QSPWJEF GPS QJQF BOE ÌUUJOHT
EFSJWFE GSPN UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDUPS GPS

Long-term behavior PVC-C pipe material

:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

Long-term behavior PVC-C ttings material



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

2.1.7 Long-term behavior of PVDF

Calculation (EN ISO 10931)

5IF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFSJWFE GSPN UIF MPOH UFSN CFIBWJPS JODMVEJOH UIF EFTJHO GBDUPS GPS QJQF BOE ÌUUJOHT BSF QSFTTVSF UFNQFSBUVSF EJBHSBN UIBU XF QSPWJEF GPS QJQF BOE ÌUUJOHT BSF PO PS BCPWF UIF DPSSFTQPOEJOH DVSWF

5IF DVSWFT BSF QMPUUFE JO B EPVCMF MPHBSJUINJD EJBHSBN J F OPU MJOFBS BDDPVOU XIFO SFBEJOH WBMVFT GPS TUSFTT PS UJNF

5IF MPOH UFSN CFIBWJPS XBT DBMDVMBUFE CZ VTJOH UIF FYUSBQPMBUJPO NFUI &/{*40 8JUI UIF GPMMPXJOH FRVBUJPO QBSBNFUFS NPEFM XIJDI XBT EFSJ EJBHSBN TUSFTT UFNQFSBUVSF PS UJNF DBO CF DBMDVMBUFE GPS UIF UFNQFS ‹$ UP ‹$

First branch MFGU IBOE QPSUJPO PG UIF DVSWFT BT TIPXO JO UIF GPMMPXJOH MPOH

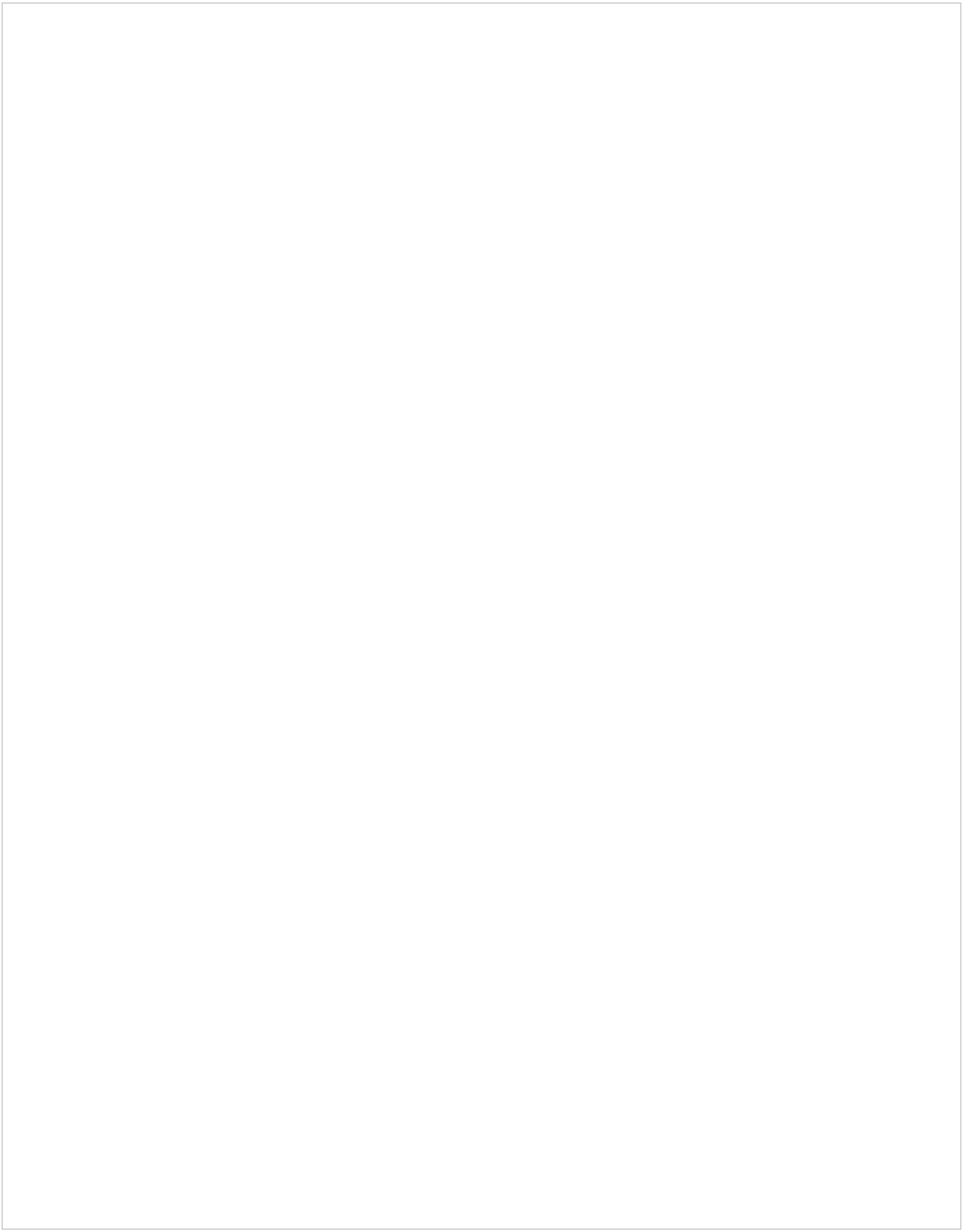
$$\log t = -165.4958 - 36518.7 \frac{\log}{T} + 78465.65 \frac{1}{T} + 57.0467 \log$$

Second branch SJHIU IBOE QPSUJPO PG UIF DVSWFT BT TIPXO JO UIF GPMMPXJOH MPOH

$$\log t = -23.19426 - 1611.69 \frac{\log}{T} + 12100 \frac{1}{T} - 0.40473 \log$$

U 5JNF UP GBJMVSF I
5 .FEJVN UFNQFSBUVSF ,
V)PPQ TUSFTT .1B .1B / NN•

Long-term behavior PVDF



:)PPQ TUSFTT .1B .1B / NN•
9 5JNF UP GBJMVSF I
a Years

2.2 Range of applications for pipe and ttings

2.2.1 In general

5IF DIPJDF PG NBUFSJBM BOE UIF QSFTTVSF SBUJOH PG UIF QJQF DPNQPOFOUT E
PQFSBUJOH TBGFUZ BOE GPS BUUBJOJOH UIF TQFDJÌFE NJOJNVN TFSWJDF MJGF

5IF EFDJTJWF JOÍVFODJOH GBDUPST BSF UIF GPMMPXJOH

- 0QFSBUJOH TFUUJOHT
- 0QFSBUJOH UFNQFSBUVSF
- Medium transported
- Duration of stress

4FQBSBUF DBMDVMBUJPOT BSF OFDFTTBSZ JG EFTJHO GBDUPST BSF EJËFSFOU P
NPEJÌFE 5IF TVJUBCJMJUZ PG UIF NBUFSJBM GPS UIF ÍPX NFEJVN DBO CF EFUFS
PG DIFNJDBM SFTJTUBODF QSPWJEFE TFQBSBUFMZ CZ ('{1JQJOH 4ZTUFNT

2.2.2 Pressure-temperature diagram for ABS

5IF GPMMPXJOH UXP QSFTTVSF UFNQFSBUVSF EJBHSBNT GPS "#4 QJQF BOE ÌUUJ
TFSWJDF MJGF PG ZFBST

5IF EFTJHO GBDUPS PG GPS #SJUJTI TZTUFNT BOE GPS NFUSJD TZTUFNT SF
('{1JQJOH 4ZTUFNT IBT CFFO JODPSQPSBUFE

5IF EJBHSBN DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XI
IBWF OP SFEVDUJPO GBDUPS GPS UIFJS DIFNJDBM SFTJTUBODF

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

⚠ The in uence of the anti-freeze compound has to be taken into account when calculat ing the allowable operating pressure. Contact your authorized GF Piping Systems representative for additional information.

According to the 10 °C curve in the long-term behavior for ABS, the following informa tion applies to the temperature range from -50 °C to +10 °C:

System	1 /	PN10	1 /
Permissible pressure	C B S	11.8 bar	. B Y C B S

British systems	Metric systems

1 1FSNJTTJCMF QSFTTVSF CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

2.2.3 Pressure-temperature diagram for PE

PE100

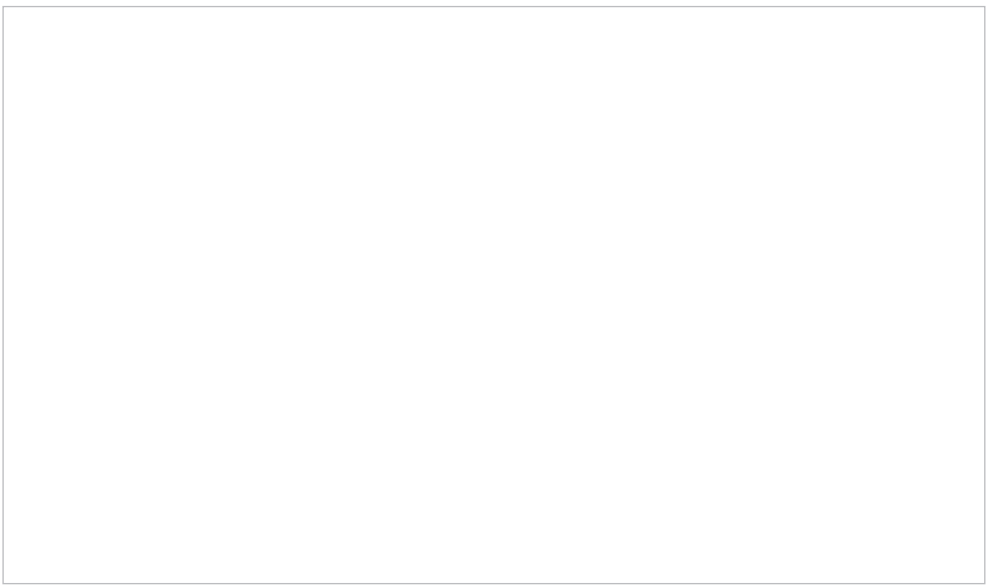
5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 1& QJQF BOE ÌUUJOHT life of 25 years.

5IF EFTJHO GBDUPS PG PS SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFC

5IF EJBHSBN DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XI IBWF OP SFEVDUJPO GBDUPS GPS DIFNJDBM SFTJTUBODF

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

In case of long-term operating pressure at temperatures above 40 °C, please contact your authorized GF Piping Systems representative.



%FTJHO GBDUPS $
4%3 GPS ‹$ XBUFS
{ZFBST
%FTJHO GBDUPS $
4%3 BOE 4 4%3 G
{‹$ XBUFS { ZFBST
P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

PE80

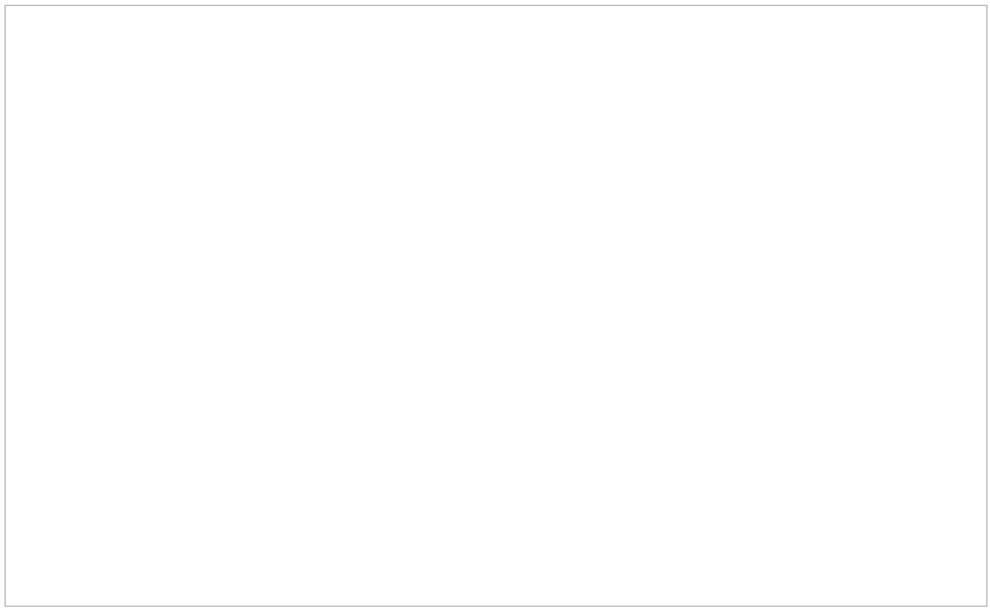
5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 1& QJQF BOE ÌUUJOHT J life of 25 years.

5IF EFTJHO GBDUPS PG SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFO JODPSC

*U DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XPSET NFE reduction factor for chemical resistance.

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

In case of long-term operating pressure at temperatures above 40 °C, please contact your authorized GF Piping Systems representative.



P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

Comparison of nominal pressure for SDR17 and SDR17.6

Determining the nominal pressure (PN)

"DDPSEJOH UP UIF TUBOEBSE UIF OPNJOBM QSFTTVSF JT B OVNFSJD WBMVF GPS
part that refers to the mechanical properties of that pipeline part. In addition to the geometric
WBMVFT TVDI BT 4%3 MPOH UFSN DSFFQ TUSFOHUI EJNFOTJPOJOH UFOTJPO B
EFTJHO GBDUPS BSF BMTP UBLFO JOUP BDDPVOU

'PS QMBTUJD QJQJOH TZTUFNT JOUFOEFE UP USBOTQPSU XBUFS UIF OPNJOBM Q
NBYJNVN QFSNJUUFE PQFSBUJOH QSFTTVSF JO CBS BU B UFNQFSBUVSF PG ‹$ E
XBUFS SFMBUJWF UP UIF NJOJNVN WBMVF PG UIF UPUBM DBMDVMBUJPO DPFÎDJ
VTJOH UIF GPMMPXJOH FRVBUJPO

$$PN = 10 \frac{s}{S} = 20 \frac{s}{(SDR - 1)}$$

σ_s Design stress (MPa)
PN Nominal pressure (bar)

Minimum required strength (MRS):

5IF WBMVF σ_s FBUPG ‹$ BOE GPS ZFBST JO XBUFS SPVOEFE EPXO UP UIF OFYU WBMV
3 {TUBOEBSE TFSJFT PG OVNCFST

σ_s JT UIF IPPQ TUSFTT EFUFSNJOFE GSPN UIF MPOH UFSN CFIBWJPS GPS B HJWF
UFNQFSBUVSF -$- TUBOET GPS -PXFS $POÌEFODF -JNJU 5IF 3 TUBOEBSE TFSJF
B 3FOBSE TUBOEBSE TFSJFT PG OVNCFST BDDPSEJOH UP *40 BOE *40

Design stress (σ_s):

5IF EFTJHO TUSFTT JT UIF QFSNJUUFE TUSFTT VOJU JO .1B GPS B QBSUJDVMBS
PQFSBUJOH DPOEJUJPO *U JT EFSJWFE CZ EJWJEJOH UIF .34 CZ DPFÎDJFOU $ BO
TIPXO JO UIF FRVBUJPO CFMPX

$$\sigma_s = \frac{MRS}{C}$$

σ_s Design stress (MPa)
$. JO J NG VBND U P S

5IF DBMDVMBUFE WBMVF JT SPVOEFE EPXO UP UIF OFYU WBMVF JO UIF 3 TUBOE
numbers.

Total operating (calculation) coe cient (C):

" UPUBM DPFÎDJFOU XJUI B WBMVF HSFBUFS UIBO POF UIBU UBLFT JOUP BDDPVOU DPOEJUJPOT BOE UIPTF DIBSBDUFSJTUJDT PG UIF QJQFMJOF DPNQPOFOU UIBU IB JODMVEFE JO UIF MPXVFS DPOÌEFODF MJNJU

*G XF VTF UIF BCPWF EFÌOJUJPO UP DBMDVMBUF UIF DPSSFTQPOEJOH OPNJOBM C DMBTTFT UIF SFTVMU GPS B 1& QJQF JT BT GPMMPXT

	SDR 17	SDR 17.6
MRS	10 MPa	10 MPa
$ NJOJNVN WBMVF GPS	1.25	1.25
V	8.0 MPa	8.0 MPa
PN	10 bar	CBS

5IF BCPWF EFÌOJUJPOT UIVT QSPEVDF B DBMDVMBUFE EJËFSFODF PG CBS JO C #VU{JO BDUVBM QSBDUJDF UIJT EJËFSFODF EPFT OPU NBUUFS BT TIPXO CFMPX

*OEVTUSJBM QJQJOH TZTUFNT BSF OPSNBMMZ EFTJHOFE GPS B TFSWJDF MJGF PG a hoop stress of V GPS UIF PQFSBUJOH QPJOU PG ZFBST BU $ GSPN UIF MPOH UFSN GPS &-5&9 56# PS $31 XF HFU B UFOTJPO PG .1B NJOJNVN WBMVF GPS C 1& {NBUFSJBMT BDDPSEJOH UP NBOVGBDUVSFS T EBUB *G XF VTF UIJT UFOTJP design tension V BOE EP OPU SPVOE JU EPXO XF HFU UIF WBMVF PG .1B

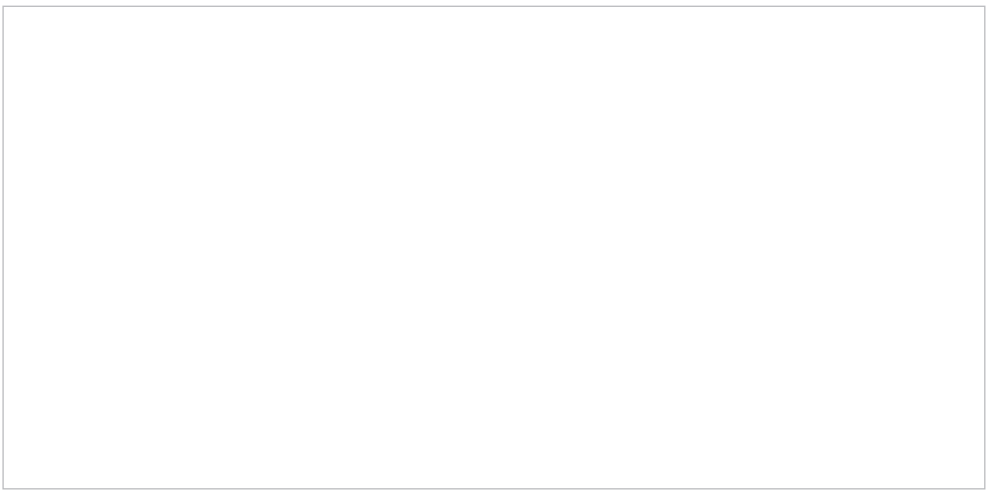
5IF BDUVBM OPNJOBM QSFTTVSF JO QSBDUJDF GPS 4%3 BOE 4%3 JT

- q 4%3 1/ CBS VOE
- q 4%3 1/ CBS

#PUI 4%3 DMBTTFT DPNQMZ XJUI SFRVJSFNFOUT GPS JOEVTUSJBM BQQMJDBUJPO

Comparison of geometric dimensions

5IF UXP 4%3 DMBTTFT EJËFS POMZ TMJHIUMZ JO XBMM UIJDLOFTT PG UIF QJQF E EJBHSBN CFMPX



d Pipe outer diameter (mm)
F 8BMM UIJDLOFTT NN

'PS CVUU GVTJPO UIF XBMM PËTFU NBZ OPU FYDFFE *O MJHIU PG UIF EJËFS UIJDLOFTTFT PG 4%3 BOE 4%3 UIF SFTVMUJOH XBMM PËTFU JT TJHOJÌDBOUM UIJT QSPWJEFT GPS USPVCMF GSFF CVUU GVTJPO PG CPUI 4%3 DMBTTFT

2.2.4 Pressure-temperature diagram for PP

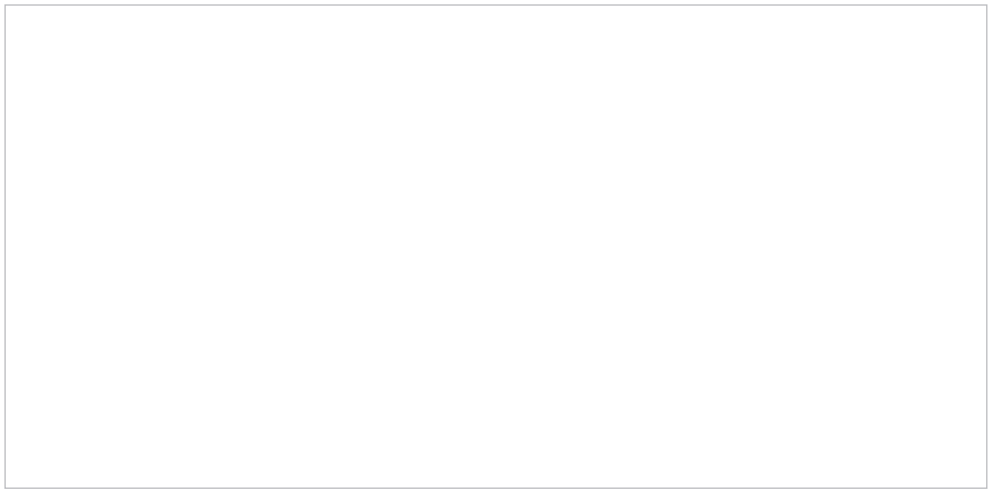
PROGEF Standard and PROGEF Plus piping system (PP-H)

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBNT GPS 11 QJQF BOE ÌUUJOHT B
MJGF PG ZFBST 5IF EFTJHO GBDUPS PG SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT
incorporated.

5IF EJBHSBNT DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS X
IBWF OP SFEVDUJPO GBDUPS GPS DIFNJDBM SFTJTUBODF

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

Pressure-temperature diagram for PP pipe and injection-molded ttings

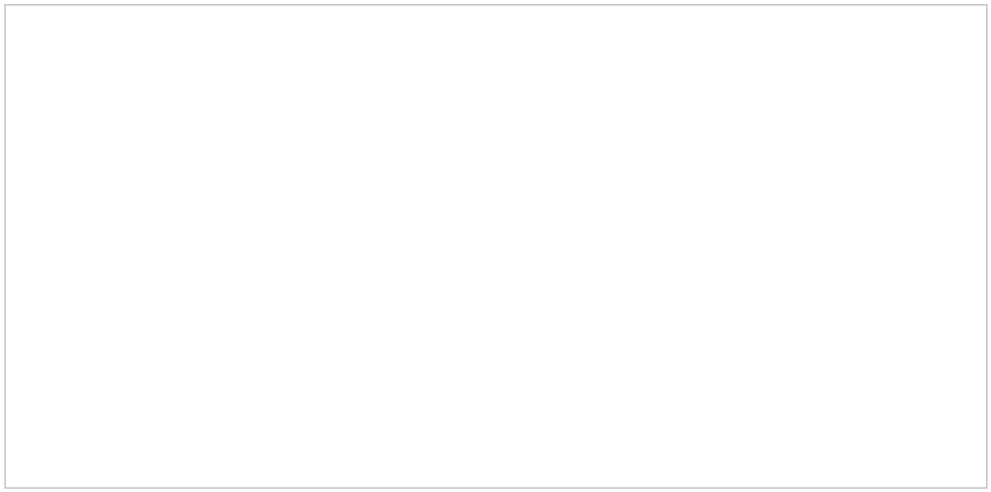


P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

⚠ In case of applications with temperatures in the range of the dotted lines, please contact your GF Piping Systems representative.

Pressure-temperature diagram for PP segment-welded ttings

4FHNFOU XFMEFE ÌUUJOHT IBWF B SFEVDUJPO GBDUPS PG GPS UIF PQFSBUJOH
pressure.



P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

PROGEF Natural piping system (PP-n)

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 130(&' /BUVSBM QJQF BOE B TFSWJDF MJGF PG ZFBST

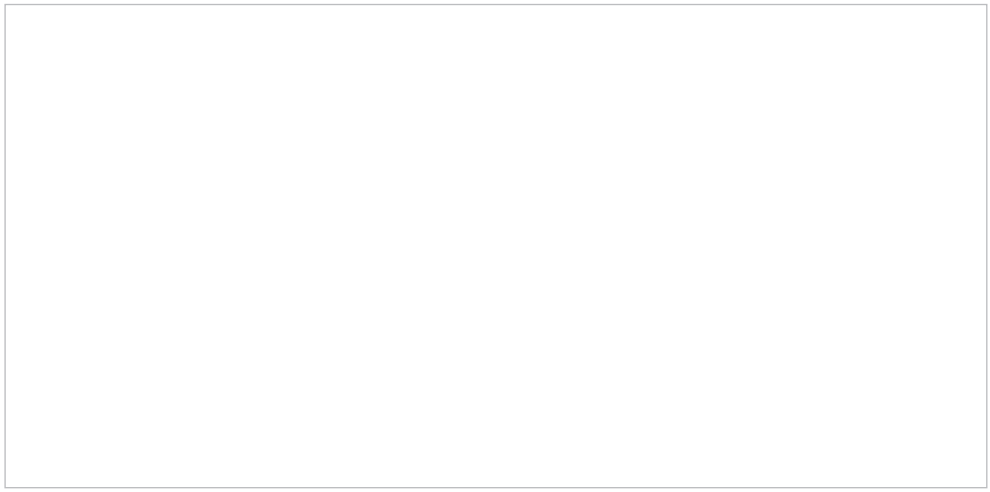
5IF EFTJHO GBDUPS PG SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFO JODPSQP

*U DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XPSET NFEJ

reduction factor for chemical resistance.

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

Using PROGEF Natural at higher temperatures can cause a discoloration of the material.



P Permissible pressure

CBS QTJ

5 5FNQFSBUVSF ‹$ ‹'

2.2.5 Pressure-temperature diagram for PVC-U

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 17$ 6 QJQF BOE ÌUUJOHT life of 25 years.

5IF EFTJHO GBDUPS PG SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFO JODPSC VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XPSET NFEJB UIBU IBW factor for chemical resistance.

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

British systems	Metric systems

1 1FSNJTTJCMF QSFTTVSF CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

⚠ PVC-U ttings d200 to d280 by GF Piping Systems are designed and tested for a nominal pressure of PN10. Sizes d315 to d400 are designed and tested for a nominal pressure of PN6

0VS FYQFSJFODF BOE UFTUT TIPX UIBU QJQF FRVBM UP PS HSFBUFS UIBO E DB XIJDI DPVME QSPEVDF BO FOMBSHFE DFNFOUJOH HBQ

('{1JQJOH 4ZTUFNT UIFSFGPSF SFDPNNFOET UIBU QJQF FRVBM PS HSFBUFS UIBO PQFSBUFE BU B NBYJNVN PQFSBUJOH QSFTTVSF ‹$ PG CBS 1MFBTF PCTFSW JOGPSNBUJPO GPS UIJT EJNFOTJPO SBOHF JO UIF DFNFOUJOH JOTUSVDUJPOT GP

2.2.6 Pressure-temperature diagram for PVC-C

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 17$ $ QJQF BOE ÌUUJOHT life of 25 years.

5IF EFTJHO GBDUPS SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFO JODPSQPSBUI GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XPSET NFEJB UIBU IBWF OP chemical resistance.

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.

6OEFS DFSUBJO DPOEJUJPOT XPSLJOH UFNQFSBUVSFT VQ UP ‹$ BSF QPTTJCMI 1MFBTF DPOUBDU ZPVS ('{1JQJOH 4ZTUFNT SFQSFTFOUBUJWF GPS BEWJDF PO BQ ('{1JQJOH 4ZTUFNT TQFDJÌDBUJPOT

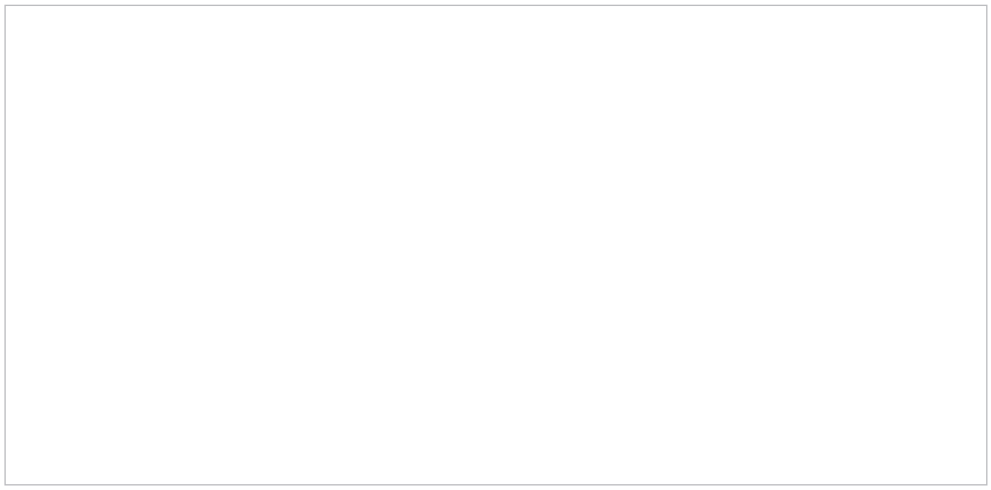
P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

2.2.7 Pressure-temperature diagram for PVDF

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS 17%' QJQF BOE ÌUUJOHT life of 25 years.

5IF EFTJHO GBDUPS PG PS SFDPNNFOEFE CZ ('{1JQJOH 4ZTUFNT IBT CFFO DBO CF VTFE GPS XBUFS PS NFEJB SFTFNCMJOH XBUFS JO PUIFS XPSET NFEJB U reduction factor for chemical resistance.

⚠ Please take into account the pressure-temperature diagrams for valves and special ttings. Because of the construction and/or sealing material used, di erences are possible when compared to pipe and ttings. More information is available in the Planning Fundamentals of the relevant types of valves and special ttings.



P Permissible pressure
CBS QTJ
5 5FNQFSBUVSF ‹$ ‹'

5IJT EJBHSBN DBO POMZ CF VTFE GPS BQQMJDBUJPOT XJUI MJRVJET *O DBTF PG QSFTTVSF BU UFNQFSBUVSFT BCPWF ‹$ QMFBTF DPOUBDU ZPVS BVUIPSJ[FE (' SFQSFTFOUBUJWF

Application example for PVDF material

5IF .JOFS T SVMF DBMDVMBUJPO NFUIPE GPS DV-NVMBUJWF EBNBHF NBZ CF V NBUF UIF FYQFDUFE EBNBHF GPS BQQMJDBUJPOT XJUI WBSZJOH DPOEJUJPOT FYQFDUFE TFSWJDF MJGF 5IF FYQFDUFE TFSWJDF MJGF JT DBMDVMBUFE CZ E damage due to each of the intermittent operating conditions.

'PS DPOUJOVPVTMZ DIBOHJOH DPOEJUJPOT PG UFNQFSBUVSF PS QSFTTVSF U BQQMJFE 5IF GPMMPXJOH FYBNQMF BO BQQMJDBUJPO JO UIF QIBSNBDFVUJDI UIF DBMDVMBUJPO TUFQT OFDFTTBSZ

Calculation basis		Main application	Steam sterilization
Pipe	SDR21	1VSJÌFE XBUFS	Saturated steam at
Design factor	2.0	XBUFS MJLF NFEJVN	BOE CBS
4FSWJDF MJGF	5 Jahre	‹$B OEC BFSQF S B Bdauy Cfor	30 minutes
		pressure	

"DDPSEJOH UP
$$T_X = \frac{100 \; T_1 \; T_2}{a_1 \; T_2 + a_2 \; T_1}$$

a_1 a_2 4IBSFT PG QBSUJBM TUSFTT QFSJPET JO PWFSBMM TUSFTT QFSJPE
5_1 5_2 4FSWJDF MJGF BU FBDI PG UIF PQFSBUJOH DPOEJUJPOT QSFTTVSF BOE constant)
5_Y $BMDVMBUFE TFSWJDF MJGF BU JOUFSNJUUFOU TUSFTT

'PS UIF BCPWF FYBNQMF UIF TFSWJDF MJGF JT DBMDVMBUFE BT

5_1 È ZFBST 5_2 I

5IF TIBSFT PG QBSUJBM TUSFTT QFSJPET JO UIF PWFSBMM TUSFTT UJNF BSF

a_1 a_2

'PS UIF DBMDVMBUFE UIF TFSWJDF MJGF JT DBMDVMBUFE BT 5
T_X = 214 608 h = 24.5 Jahr

5IJT DBMDVMBUFE TFSWJDF MJGF JT IJHIFS UIBO UIF TQFDJÌFE PQFSBUJOH MJ TJPOT PG UIJT BQQMJDBUJPO BSF TVÎDJFOU

2.3 Calculation of allowable pressure/required wall thickness

2.3.1 Selecting plastic piping components

Dimensioning of thermoplastic pipe subjected to internal pressure strictly adheres to
TUSFOHUI SFRVJSFNFOUT BOE WTFDBMDVMBUJPO GPS UIF TBGF VTF PG UIFSNPQMBTUJD QJQJOH TZTUFNT
MJTUFE JO UIF TUBOEBSET BSF CBTFE PO UIJT GPSNVMB %FWJBUJPOT POMZ PDDVS XIFO UIF
EJBNFUFST TJODF QSBDUJDBM BOE NBOVGBDUVSJOH DPOTJEFSBUJPOT NBLF JU
DFSUBJO NJOJNVN QJQF XBMM UIJDLOFTTFT

$$e = \frac{p \cdot d}{20_{zul.} + p}$$

F 1JQF XBMM UIJDLOFTT NN
d Pipe outer diameter (mm)
p Permissible operating pressure (bar)
V[VM "MMPXBCMF IPPQ TUSFTT / NN•

Nominal pressure PN

5IF EFTJHOBUJPO OPNJOBM QSFTTVSF 1/ BMTP LOPXO BT QSFTTVSF MFWFM CZ
TVÎDJFOU 5IF 1/ DMBTTJÌDBUJPO HFOFSBMMZ VTFE BMM PWFS UIF XPSME BT JOG
EJNFOTJPOJOH JT SBUIFS DPOGVTJOH XIFSF CVUU GVTJPO JT DPODFSOFE

In the case of plastic pipe established practice is to use pressure-neutral descriptions for
QJQF PG UIF TBNF QSFTTVSF DBQBDJUZ 5IJT BWPJET JODPSSFDU VTF PG QJQF J
PS VOEFS EJËFSFOU DPOEJUJPOT

*40 DMBTTJÌFT QJQF CZ TFSJFT BDDPSEJOH UP QSFTTVSF SBUJOH TP UIBU Q
TFSJFT OVNCFS IBWF UIF TBNF QSFTTVSF SBUJOH BT JT BMTP UIF DBTF JO EFTJ
OPNJOBM QSFTTVSF MFWFMT 5IF QJQF TFSJFT BSF EFOPUFE CZ UIF MFUUFS 4 5
CBTFE PO UIF GPMMPXJOH GPSNVMB

S JT B EJNFOTJPOMFTT WBMVF

$$S = \frac{10_{zul.}}{p \cdot C} = \frac{d - e}{2 \cdot e}$$

F 1JQF XBMM UIJDLOFTT NN
d Pipe outer diameter (mm)
Q 0QFSBUJOH QSFTTVSF CBS QTJ
$ %FTJHO GBDUPS

)FODF B 11 QJQF XJUI EJNFOTJPO E BOE XBMM UIJDLOFTT NN SFTVMUT JO

$$S = \frac{(110 - 10)}{(2 \cdot 10)} = 5$$

5IF EFTJHOBUJPO 4%3 4UBOEBSE %JNFOTJPO 3BUJP JT NVDI NPSF DPNNPO PO U
4%3{JOEJDBUFT UIF SBUJP PG PVUTJEF EJBNFUFS UP XBMM UIJDLOFTT

$$SDR = \frac{d}{e}$$

5IF QJQF TFSJFT EFTJHOBUJPO BOE UIF 4%3 EFTJHOBUJPO BSF DPOOFDUFE CZ U

SDR = 2 S +

*O UIF DBTF PG UIF FYBNQMF BCPWF UIJT SFTVMUT JO

SDR = 2 5 + 1 = 1

5IF NBSLFU QSJNBSJMZ GFBUVSFT UIF EFTJHOBUJPOT 1/ BOE 4%3 ('{1JQJOH 4ZTU
UIF VTF PG EJNFOTJPO BOE XBMM UIJDLOFTT BT XFMM BT 4%3 BU BMM UJNFT

2.3.2 Calculating the e ective design factor / permissible operating pressure

5P DBMDVMBUF UIF EFTJHO GBDUPS BOE BMMPXBCMF PQFSBUJOH QSFTTVSF JU J
MPOH UFSN CFIBWJPS PG UIF NBUFSJBM 4VDI B EJBHSBN BMMPXT UIF MPOH UFS
SFBE EFQFOEJOH PO UIF EFTJSFE TFSWJDF MJGF BOE PQFSBUJOH UFNQFSBUVSF
UIF XBMM UIJDLOFTT JT VTVBMMZ HSFBUFS UIBO GPS QJQF PG UIF TBNF QSFTTVS
UIF PVUTJEF EJBNFUFS BOE XBMM UIJDLOFTT PG UIF QJQF BSF VTFE UP DBMDVME
5IF EFTJHO GBDUPS JT UIFO DBMDVMBUFE CZ VTJOH UIF GPMMPXJOH GPSNVMB

$$C = \frac{s \quad 20 \quad e}{p \quad (d - e)}$$

$ %FTJHO GBDUPS
V)PPQ TUSFTT / NN•
F 1JQF XBMM UIJDLOFTT NN
d Pipe outer diameter (mm)
Q 0QFSBUJOH QSFTTVSF CBS

Similarly, the maximum permissible operating pressure is calculated by rewriting the formula above as:

$$p = \frac{20 \quad e \quad \frac{s}{C}}{d - e}$$

Example – Calculating the design factor and operating pressure

*OUFOEFE TFSWJDF MJGF +BISF
.BY PQFSBUJOH UFNQFSBUVSF ‹$
.BY PQFSBUJOH QSFTTVSF CBS
. B U F S J B M
*OUFOEFE QSFTTVSF MFWFM 1/ CBS
0VUTJEF EJBNFUFS NN
8BMM UIJDLOFTT NN
)PPQ TUSFTT 2 / NN

$$C = \frac{15.5 \quad 20 \quad 8.1}{3 \quad (110 - 8.1)} = 8.2 > 2.5$$

For the sake of clarity, the calculations are carried out using the example above, but using the usual minimum design factor for PVC-U.

$$p = \frac{20 \quad 8.1 \left(\frac{15.5}{2.5}\right)}{(110 - 8.1)} = 9.9 \text{ bar}$$

The calculation shown applies only to freely moving piping systems. Pipe that are xed in the axial direction (xed installation) must be checked for buckling. In most cases such a check leads to a reduction of maximum inner pressure, as well as shorter distances between the support brackets. Furthermore, the forces that act on the xed points must be taken into account. Contact your authorized GF Piping Systems repre sentative for additional information.

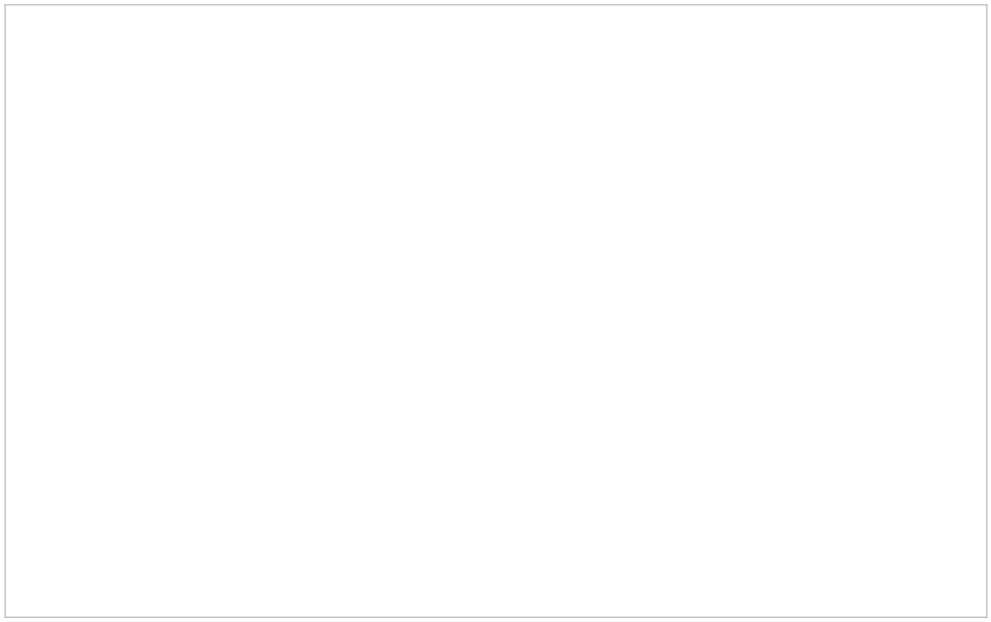
2.4 Water hammer

8BUFS IBNNFS JT B UFSN VTFE UP EFTDSJCF EZOBNJD TVSHFT DBVTFE CZ QSFTTV
QJQJOH TZTUFN 5IFZ PDDVS XIFOFWFS UIFSF JT B EFWJBUJPO GSPN UIF TUFBEZ
ÍPX SBUF JT DIBOHFE BOE NBZ CF USBOTJFOU PS PTDJMMBUJOH

8BUFS IBNNFST NBZ CF HFOFSBUFE CZ UIF GPMMPXJOH

- 0QFOJOH PS DMPTJOH B WBMWF
- 1VNQ TUBSUVQ PS TIVUEPXO
- $IBOHF JO QVNQ PS UVSCJOF TQFFE
- 8BWF BDUJPO JO B GFFE UBOL
- 5SBQQFE BJS

5IF QSFTTVSF XBWF DSFBUFE CZ XBUFS IBNNFST DBVTFT UIF QJQJOH TZTUFN UP
DPOUSBDU *O UIF QSPDFTT UIF QSPQBHBUJPO TQFFE PG UIF QSFTTVSF XBWF JT
TPVOE JO UIF DPSSFTQPOEJOH NFEJVN 5IF FOFSHZ DBSSJFE CZ UIF XBWF JT EJT
QJQJOH TZTUFN BOE UIF XBWFT BSF QSPHSFTTJWFMZ EBNQFE TFF UIF GPMMPXJ



Damped pressure wave
M 8BWF MFOHUI
p Pressure change

5IF NBYJNVN QPTJUJWF PS OFHBUJWF BEEJUJPO PG QSFTTVSF JT B GVODUJPO PG
NPEVMVT PG FMBTUJDJUZ PG UIF ÍVJE QJQF EJNFOTJPO BOE UIF NPEVMVT PG FM
NBUFSJBM *U DBO CF DBMDVMBUFE CZ VTJOH UIF GPMMPXJOH TUFQT

Determine the velocity of the pressure wave

$$V_w = \sqrt{\frac{K}{\left(1 + \frac{K \; d}{e \; E}\right)}}$$

7X 7FMPDJUZ PG QSFTTVSF XBWF N T
, #VML NPEVMVT PG FMBTUJDJUZ PG ÍVJE 1B
U 'MVJE EFOTJUZ LH NŽ
& .PEVMVT PG FMBTUJDJUZ PG QJQF XBMM 1B
d_i Inner diameter of pipe (mm)
F 1JQF XBMM UIJDLOFTT NN

5IF NPEVMVT PG FMBTUJDJUZ PG QJQF NBEF PG UIFSNPQMBTUJD QPMZNFST WBSJ
EVSBUJPO BOE UFNQFSBUVSF)FODF PQFSBUJOH EVSBUJPO BOE UFNQFSBUVSF
QSFDJTF DBMDVMBUJPO PG XBUFS IBNNFST

Calculate maximum pressure change due to water hammers

$$p = V_w \quad v \quad / 10000$$

—Q .BYJNVN QSFTTVSF DIBOHF CBS
7X 1SFTTVSF XBWF WFMPDJUZ N T TFF TUFQ
—W $IBOHF JO ÍVJE WFMPDJUZ N T W W
W 7FMPDJUZ PG ÍVJE CFGPSF DIBOHF N T
W 7FMPDJUZ PG ÍVJE BGUFS DIBOHF N T
U 'MVJE EFOTJUZ LH NŽ

"MM QSFTTVSF JODSFBTFT JOEVDFE CZ B ÍPX SFEVDUJPO XJMM IBWF B DPSSFTQP
PO UIF PUIFS TJEF WBDVVN *G UIJT FYDFFET UIF FYQFDUFE TUBUJD NJOJNVN P
UIF DBMDVMBUFE QSFTTVSF NVTU CF DPNQBSFE UP UIF QSFTTVSF BU XIJDI UIF Q
PSEFS UP FWBMVBUF UIF TBGFUZ GBDUPS JO TUFQ

Calculate the maximum and minimum total pressures

$$p_{max} = p + p$$

$$p_{min} = p - p$$

p_{NBY} .BYJNVN UPUBM QSFTTVSF CBS
p_{min} Minimum total pressure (bar)
Q &YQFDUFE PQFSBUJOH QSFTTVSF CBS
—Q $IBOHF EVF UP XBUFS IBNNFS DBMDVMBUFE JO TUFQ

Calculate the e ective safety factor

$$C_{max} = \frac{20 \quad e}{p_{max} \quad (d - e)}$$

$\$_{NBY}$ Safety factor (dimensionless)
V $JSDVNGFSFOUJBM TUSFTT / NN•
U 1JQF UIJDLOFTT NN
E 0VUTJEF EJBNFUFS PG QJQF NN
p_{NBY} .BYJNVN UPUBM QSFTTVSF CBS DBMDVMBUFE JO TUFQ

5IF WBMVF GPS UIF DJSDVNGFSFOUJBM TUSFTT DBO CF GPVOE JO UIF DSFFQ DVS
IBNNFST MBTU GPS B NBUUFS PG TFDPOET UIF WBMVF GPS B MPBE EVSBUJPO PG
5IF{FYDFQUJPO UP UIJT SVMF JT XIFO UIF XBUFS IBNNFST BSF PTDJMMBUJOH F
EJTQMBDFNFOU QVNQ *O UIJT DBTF UIF TZTUFN NVTU CF USFBUFE BT JG B MPBE
NBYJNVN UPUBM QSFTTVSF QNBY FYJTUFE UISPVHIPVU UIF FOUJSF TFSWJDF MJ

Safety factors

'P S J O G S F R V F O U X B U F S I B N N F S T U I F D P N N P O N J O J N V N W B M V F T D B O C F V T F E B T
'P S Q F S J P E J D X B U F S I B N N F S T U I F G B D U P S T I P V M E C F B U M F B T U
*G U I F T B G F U Z G B D U P S G P V O E J O T U F Q E P F T O P U N F F U U I F T F D S J U F S J B G P S T E
J Q J E F B N F U P S V M E P O T J E F S F B T V S I P V M E B L E F E V D P D D V S S F O D F
P G X B U F S I B N N F S F H Q P X F S F E W B M W F T T V S H F U B O L T T M P X T U B S U V Q Q V N Q
8 I F O V S J O H Q P X F S F E W B M W F T W B M W F T B S F D P N N P O M Z E F T J H O E D X J U I D M P T V S F
U I F D S J U J D B M Q F S J P E 5D U P S F E V D F X B U F S I B N N F S 5 I F D S J U J D B M Q F S J P E J T U I
needs to complete one cycle in the pipeline.

$$T_c = \frac{2\ L}{V_w}$$

5 $ S J U J D B M Q F S J P E T
L Pipe length (m)
7 1 S F T T V S F X B W F W F M P D J U Z N T T F F T U F Q

Example

" X B U F S Q J Q F M J O F G S P N B T U P S B H F U B O L J T D P O O F D U F E U P B N B J O W B M W F
B D U J W B U F E X J U I B O F M F D U S J D B M S F N P U F D P O U S P M 5 I F W B M W F D M P T J O H U J N
Í P X S B U F J T 2 N Ž I

Material	PP-H
0 V U T J E F E J B N F U F S	110 mm
8 B M M U I J D L O F T T	10 mm
Pipeline length	500 m
0 Q F S B U I N Q F S B U V S F	‹ $
Modulus of elasticity	& / N N • Pa
8 B U F S E F O T J U Z	U Ž L H N Ž
# V M L N P E V M V T P G F M B T , U J D J U Z	(1 B G X B U F S

Calculating the velocity of the pressure wave

$$V_w = \sqrt{\frac{2.05\ \ 10^9}{10^3\ \left(1 + \frac{90\ \ 2.05\ \ 10^9}{10\ \ 800\ \ 10^6}\right)}} = 292 \text{ m/s}$$

Calculating the uid velocity before the change

$$v_1 = \frac{\text{Volume ow}}{\text{cross-sectional area}}$$

$$v_1 = \frac{35/3600 \text{ m}^3/\text{s}}{(0.09/2)^2 \text{ m}^2} = 1.53 \text{ m/s}$$

"TTVNF XBUFS WFMPDJUZ HPFT UP [FSP BGUFS UIF WBMWF JT DMPTFE J F —W

Pressure change

p = 292 (1.53) 1000/10000= 4.47 bar

Calculating the maximum pressure

p_{max} = 10 + 4.47 = 14.47 ba

— Q JT MFTT UIBO Q)FODF UIF NJOJNVN QSFTTVSF EPFT OPU IBWF UP CF UBLFO

Calculating the circumferential stress

'JOE UIF DJSDVNGFSFOUJBM TUSFTT JO UIF 11) MPOH UFSN CFIBWJPS 5BLF UIF EVSBUJPO PG I BT GPS OPO PTDJMMBUJOH XBUFS IBNNFST UIF QJQF OFFET U pressure for only a matter of seconds.

V / ₪N N

$$C = \frac{20 \quad e}{p_{max} \quad (d - e)}$$

$$C = \frac{20 \quad 17.5 \quad 10}{14.47 \quad (110 - 10)} = 2.42$$

Calculating the maximum safety factor

5IF NJOJNVN TBGFUZ GBDUPS GPS 11) DBO CF TFU UP)FSF $ TP U TVJUBCMF GPS JOGSFRVFOU XBUFS IBNNFST)PXFWFS JU XPVME OPU CF TVJUBC IBNNFST PDDVSSFE CFDBVTF JO UIBU DBTF XF XPVME OFFE $ 1JQF EJNFOTJP DMPTJOH UJNF XPVME OFFE UP CF BEKVTUFE JO PSEFS UP SFEVDF XBUFS IBNNFS

Calculating the critical period

$$T_c = \frac{2 \quad L}{V_w} = \frac{2 \quad 500\ m}{292\ m/s} = 3.4\,s$$

*O UIJT FYBNQMF UIF WBMWF DMPTJOH UJNF JT MFTT UIBO UIF WBMVF PG UIF DS JODSFBTJOH UIF DMPTJOH UJNF BCPWF UIJT DSJUJDBM QFSJPE XBUFS IBNNFS XI QJQJOH XPVME UIFO CF TVJUBCMF GPS BMM TJUVBUJPOT JOWPMWJOH QFSJPEJD

2.5 Piping systems in highly combustible locations/ transport of explosive media

*O UIFJS OPSNBM GPSN UIF UIFSNPQMBTUJDT VTVBMMZ VTFE GPS QJQJOH TZTUF
17$ $ 11 1& BOE 17%' BSF OPO DPOEVDUJWF NBUFSJBMT 5IFJS TQFDJÌD SFTJTU
10 {˜DN 5IF DSFBUJPO PG BO FMFDUSJDBM DIBSHF DBOOPU CF SVMFE PVU 5IJT N
XIFO EFTJHOJOH BOE PQFSBUJOH B QJQJOH TZTUFN #VU CZ UBLJOH DFSUBJO QS
PG FMFDUSJDBM DIBSHFT XJUI TUBOEBSE NBUFSJBMT DBO CF QSFWFOUFE

5IF OPO DPOEVDUJWJUZ PG NPTU QMBTUJDT IBT MFE UP UIFJS XJEFTQSFBE VTF
FOHJOFFSJOH BOE FMFDUSPOJDT JOEVTUSZ #VU UIJT QSPQFSUZ DBO CF B EJTBI
DJSDVNTUBODFT JO PUIFS BQQMJDBUJPOT *O UIF DBTF PG QMBTUJD QJQJOH TZT
RVFTUJPO PG FMFDUSPTUBUJD DIBSHJOH PG UIF QJQFMJOF CFDPNFT JNQPSUBOU
OPO DPOEVDUJWF NFEJB BSF UP CF USBOTQPSUFE PS XIFO UIF QJQF BSF UP CF
combustible locations. In both of these cases electrostatic charging of the material is not only
B EJTBEWBOUBHF CVU DPVME FWFO CF EBOHFSPVT

"#4 17$ 6 17$ $ 1& 11 BOE 17%' CFMPOH UP UIF DMBTT PG FMFDUSJDBMMZ OPO
NBUFSJBMT &MFDUSJDBMMZ OPO DPOEVDUJWF NBUFSJBMT BSF UIPTF XIPTF TQF
˜DN 5IF WBMVFT GPS UIF NBUFSJBMT MJTUFE BCPWF BSF PO UIF PSEFS PG
TQFDJÌD SFTJTUBODF JO UIF NBUFSJBM EFTJ EFFNFE UP CF TVCKFDU UP
electrostatic charging.

'PS FYBNQMF JO UIF NJOJOH JOEVTUSZ TBGFUZ EJDUBUFT UIBU QMBTUJDT CF VT
SFTJTUBODF EPFT ˜DPU NFFU SFE BU ‹$ BOE SFMBUJWF IVNJEJUZ

4JNJMBS SFTUSJDUJPOT BQQMZ UP UIF JOTUBMMBUJPO PG QMBTUJD QJQF XIFSFW
DPVME PDDVS /P EBOHFS BSJTFT GSPN UIF VTF PG QMBTUJD QJQF UP USBOTQPS
ÍVJET BT MPOH BT UIJT JT B DMPTFE TZTUFN 4MPXFS ÍPX SBUFT BMTP SFEVDF U
FMFDUSPTUBUJD DIBSHFT *U JT QPTTJCMF JO QSJODJQMF UP NBLF OPO DPOEVD
NFBOT PG TQFDJBM NFBTVSFT F H BEEJOH DBSCPO #VU TVDI BEEJUJWFT DPVM
PUIFS EFTJSBCMF QSPQFSUJFT *U JT UIFSFGPSF JNQFSBUJWF UP FWBMVBUF FBD
EFDJEF XIJDI NBUFSJBM PËFST UIF CFTU TPMVUJPO

8IFOFWFS QMBTUJD QJQJOH JT UP CF JOTUBMMFE JO SPPNT XIFSF FYQMPTJWF H
BSJTF BOE XIFOFWFS QMBTUJD QJQF BSF VTFE GPS UIF USBOTQPSU PG FMFDUS
NFEJB UIF GPMMPXJOH NVTU CF DPOTJEFSFE EVSJOH QMBOOJOH

Installation of pipe in rooms where explosive gas-air mixtures can occur:

- "WPJE UIF BDDVNVMBUJPO PG FYQMPTJWF NJYUVSFT CZ QSPWJEJOH GPS F H H FYUSBDUJPO
- "WPJE UIF BDDVNVMBUJPO PG FMFDUSJDBM DIBSHF CZ JPOJ[JOH UIF BUNPTQIFS
- %JTDIBSHF TUBUJD FMFDUSJDJUZ F H CZ DPBUJOH UIF QJQF TVSGBDF XJUI BO TPMWFOU GSFF QBJOU DPOUBJOJOH NFUBMMJD QPXEFS PS CZ XSBQQJOH UIF Q

  It is essential that the pipe be grounded.
- "WPJE UIF BDDVNVMBUJPO PG FMFDUSJDBM DIBSHFT CZ JODSFBTJOH UIF SFMBU " DPOEVDUJWF ÌMN PG XBUFS PO UIF TVSGBDF PG UIF QJQF JNQSPWFT DPOEVD BOZ BDDVNVMBUJPO PG FMFDUSPTUBUJD DIBSHFT XIFO SFMBUJWF IVNJEJUZ FY
- 8F BEWJTF TUSPOHMZ BHBJOTU SFMZJOH TPMFMZ PO USFBUJOH UIF QJQFMJOF IZHSPTDPQJD TPMVUJPO UP JNQSPWF JUT DPOEVDUJWJUZ CFDBVTF UIJT NFBTV FËFDUJWF GPS B MJNJUFE QFSJPE BOE BDDJEFOUBM QBSUJBM SFNPWBM PG UIF

  ruled out.

Transport of electrically non-conductive media:

"T B SVMF QMBTUJD QJQF BSF OPU UP CF SFDPNNFOEFE GPS UIF USBOTQPSU PG
FMFDUSJDBMMZ OPO DPOEVDUJWF EVF UP UIF FËFDUT PG BDDVNVMBUJOH FMFDU
FYUFOTJWF XFBS PO UIF NBUFSJBM &MFDUSJDBMMZ OPO DPOEVDUJWF DPNCVTU
only be transported in closed pipeline systems.

2.6 Piping systems for transporting compressed air

Introduction

1MBTUJD QJQJOH TZTUFN IBWF CFFO VTFE UP USBOTQPSU DPNQSFTTFE BJS GPS &YQFSJFODF IBT TIPXO UIBU PJM PSJHJOBUJOH GSPN DPNQSFTTPST DBO CF GPV MFTTFS FYUFOU JO UIF DPNQSFTTFE BJS 5IJT DBO POMZ CF BWPJEFE CZ JOTUBM TFSWJDJOH B TFQBSBUJPO ÌMUFS JOTUBMMFE BGUFS UIF DPNQSFTTPS 5IF DPNQ WBSJFT DPOTJEFSBCMZ BOE UIF PJMT NBZ BMTP DPOUBJO BSPNBUJD TVCTUBODF FËFDU UIBU UIF DPNQSFTTPS PJMT NBZ IBWF PO UIF NBUFSJBM VTFE GPS UIF QJQ UBLF JOUP BDDPVOU UIF GSBDUVSF DIBSBDUFSJTUJDT PG UIF NBUFSJBM

Recommended material for compressed air piping systems

PE (polyethylene) or PB (polybutene)

#PUI NBUFSJBMT BSF MJHIUXFJHIU FBTZ UP JOTUBMM BOE DPSSPTJPO GSFF QSP BEWBOUBHF PG IJHI UFOTJMF TUSFOHUI 5IFSFGPSF ('{1JQJOH 4ZTUFNT SFDPNN VQ UP B NJOJNVN UFNQFSBUVSF PG ‹$ F H PVUEPPS BQQMJDBUJPOT QPMZC NJOJNVN UFNQFSBUVSF PG ‹$ F H JOEPPS JOTUBMMBUJPO &YQMPTJWF GSBD PQFSBUJOH JOTUSVDUJPOT BSF GPMMPXFE

1& BOE 1# BSF HFOFSBMMZ DIFNJDBMMZ SFTJTUBOU UP DPNQSFTTPS PJMT 0OMZ FTUFST PS BSPNBUJDT TIPVME OPU CF VTFE 4FBMJOH NBUFSJBMT TVDI BT /#3 SFHVMBSMZ VTFE GPS DPNQSFTTFE BJS OFUXPSLT BSF JO EBOHFS JO TVDI DBTF

In order to simplify the selection of a compressor oil by the operator of a compressed air

TZTUFN XF IBWF TVNNBSJ[FE NBOZ PG UIF PJMT PËFSFE PO UIF NBSLFU BOE IBW JOUP TFDUJPOT BDDPSEJOH UP UIFJS DIFNJDBM TUSVDUVSF "GUFS DPOTVMUJOH QPTTJCMF UP DIPPTF BO PJM UIBU JT OPU PO UIF MJTU TJODF XF EP OPU DMBJN 5IF UZQF PG PJM VTFE NVTU CF JODMVEFE JO POF PG UIF DBUFHPSJFT EFFNFE T ('{1JQJOH 4ZTUFNT SFDPNNFOET UIBU ZPV DPPSEJOBUF UIF TFMFDUJPO PG UIF P manufacturer of the compressor.

Suitability of air compressor oils for compressed air lines made of polyethylene

Re ned petroleum products (mineral oils)	Recommended
1BSBÎOJD PJMT BMJQIBUJD IZESPDBSCPOT	9
/BQIUIFOJD PJMT BMJDZDMJD IZESPDBSCPOT	9
"SPNBUJD PJMT	

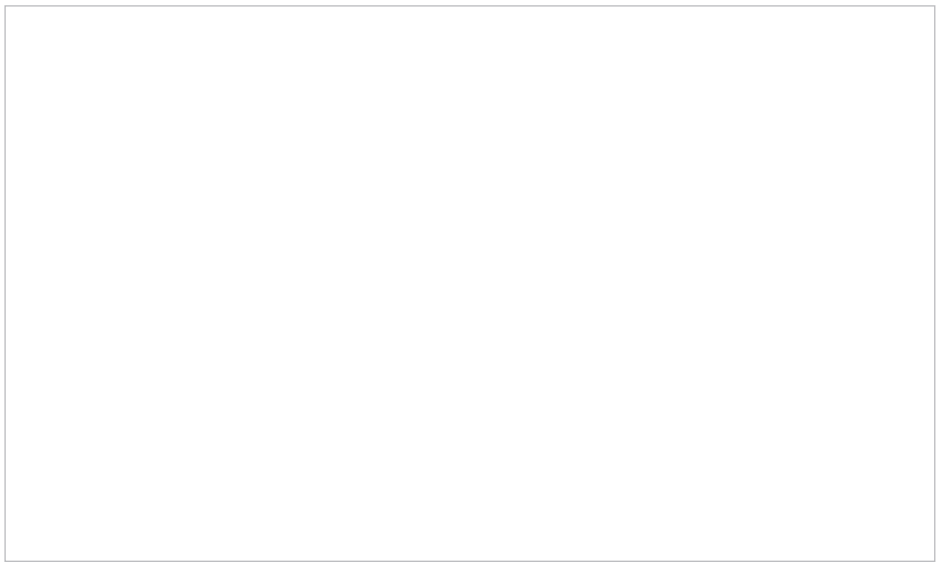
Synthetic oils (with O as an additional element of molecular structure)	Recommended
1PMZBMHXMZEPMT	9
Poly-DPMFÌOT	9
Polyesters	
Di-esters	

Synthetic oils (with Si, P, N or F as an additional element of molecular structure)	Recommended
Silicone oils	9
Phosphoric esters	
"SPNBUJD BNJOFT	
Fluorine esters	
Poly-DPMFÌOT QPMZPM FTUFST	

Maximum allowable operating pressure for PE compressed air lines

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN 1& BOE 1& GPS DPNQSFT
TZTUFNT NBEF PG QPMZFUIZMFOF TIPVME CF UBLFO JOUP BDDPVOU 5IJT EJBHSB
TFSWJDF MJGF PG ZFBST BOE B EFTJHO GBDUPS PG 5IF BNCJFOU UFNQFSBU
JOUP BDDPVOU GPS{FYBNQMF GPS BO JOTUBMMBUJPO VOEFS B TVOOZ SPPG PS J
DPNQSFTTPST SVOOJOH 'PS {TBGFUZ SFBTPOT ('{1JQJOH 4ZTUFNT SFDPNNFOET
4%3 GPS DPNQSFTTFE BJS QJQJOH TZTUFNT

⚠ In case of long-term operating pressures at temperatures above +40 °C, please contact your authorized GF Piping Systems representative.

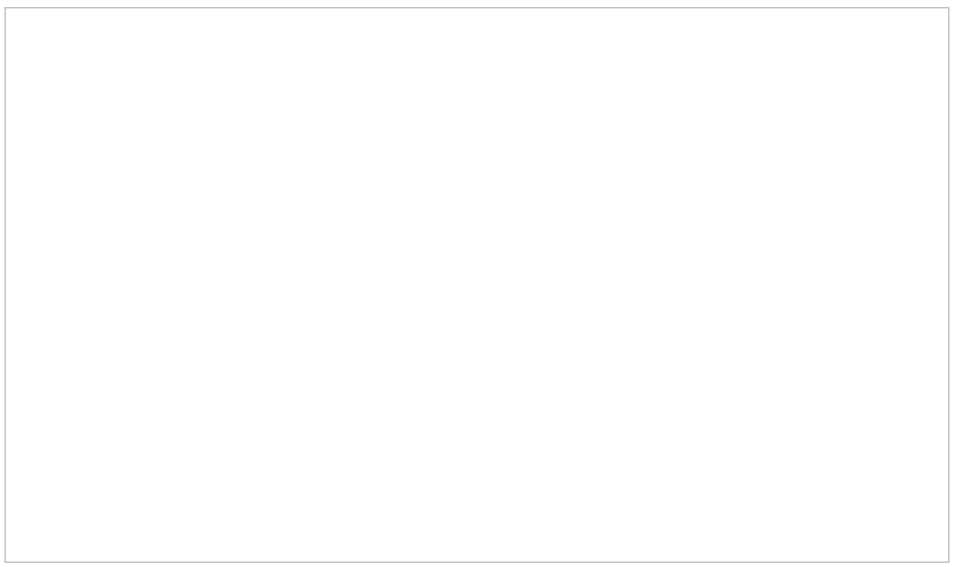


P Permissible pressure
CBS QTJ
5 "NCJFOU UFNQFSBUVS
‹$ ‹'

Maximum allowable operating pressure for PB compressed air lines

5IF GPMMPXJOH QSFTTVSF UFNQFSBUVSF EJBHSBN GPS DPNQSFTTFE BJS QJQJOH
QPMZCVUZMFOF 1# TIPVME CF UBLFO JOUP BDDPVOU 5IJT EJBHSBN JT CBTFE P
{ZFBST BOE B EFTJHO GBDUPS PG 5IF BNCJFOU UFNQFSBUVSF IBT UP CF UBI
GPS{FYBNQMF GPS BO JOTUBMMBUJPO VOEFS B TVOOZ SPPG PS JO B SPPN XJUI D
TBGFUZ SFBTPOT ('{1JQJOH 4ZTUFNT SFDPNNFOET VTJOH 4%3 GPS DPNQSFTTFE
systems from PB.

⚠ In case of long-term operating pressures at temperatures above +70 °C, please contact your authorized GF Piping Systems representative. Don’t use PB lines for compressed air below 0°C!



P Permissible pressure
CBS QTJ
5 "NCJFOU UFNQFSBUVS
‹$ ‹'

2.7 Piping systems under vacuum

5IF NFDIBOJDBM MPBE BU BCTPMVUF WBDVVN DPSSFTQPOET UP B EJËFSFOUJBM C
J F UIF FËFDUJWF QSFTTVSF PO UIF QJQF T JOOFS XBMM JT CBS MFTT UIBO UIF
XBMM BU TUBOEBSE BUNPTQIFSJD QSFTTVSF

*O DBTF PG B EJËFSFOUJBM QBSUJBM WBDVVN TQFDJBM BUUFOUJPO NVTU CF QBJ
TUBCJMJUZ PG UIF QJQF *U DBO CF DBMDVMBUFE XJUI UIF DMBTTJD CVDLMJOH C

$$P_k = \frac{E_c}{4\ (1-\ ^2)} \left(\frac{e}{r}\right)^3$$

1L $SJUJDBM CVDLMJOH QSFTTVSF / NN• / NN• CBS
&D -POH UFSN DSFFQ NPEVMVT / NN•
µ Poisson's ratio
F 1JQF XBMM UIJDLOFTT NN
r Mean pipe radius (mm)

" QJQF BU BCTPMVUF WBDVVN EJËFSFOUJBM QBSUJBM WBDVVN CBS JT BEFRVB
BHBJOTU CVDLMJOH XIFO UIF DSJUJDBM CVDLMJOH QSFTTVSF JT FYDFFEFE
GBDUPS PG JT VTFE GPS DBMDVMBUJPO "OZ JOÍVFODF DBVTFE CZ PVU PG SPVC
NVTU CF UBLFO JOUP BDDPVOU TFQBSBUFMZ 6OEFS UIFTF BTTVNQUJPOT UIF GP
BQQMJDBUJPO UFNQFSBUVSFT BSJTF GPS UIF WBSJPVT QJQF NBUFSJBMT UBLJOH
BQQMJDBUJPO UFNQFSBUVSF MJNJUT GPS UIF TQFDJÌD NBUFSJBM TFF UIF UBCM
pipe series are unsuitable for these conditions.

ZFBS WBMVFT µ1PJTTPOT SBUJP GPS UIF BQQMJDBUJPO

2.7.1 Pipe

Maximum application temperatures under vacuum
(1 bar di erential partial vacuum)

Material	PN (bar)	SDR	Temperature (°C)
" # 4	10		
		11	
17$ 6	10	21	
17$ $	10	21	
			80
PE80	10	11	50
PE100		11	
PP	10	11	80

Maximum application temperatures under vacuum (1 bar di erential partial vacuum) or under 0.4 bar di erential partial vacuum for PVDF PN10 system

Material	PN (bar)	SDR	Max. temperature (°C)
17%' GPS —Q 10 CBS		33	20
17%' GPS —Q CBS		21	

2.7.2 Fittings

4JODF ('{1JQJOH 4ZTUFNT ÌUUJOHT IBWF B UZQJDJBMMZ HSFBUFS XBMM UIJDLOFT
UIFZ BSF OPU DSJUJDBM JO WBDVVN BQQMJDBUJPOT BOE EP OPU IBWF UP CF UBL
determining the application temperatures.

2.7.3 Mechanical connections

4JNJMBS UP ÌUUJOHT NFDIBOJDBM DPOOFDUJPOT GFBUVSF B UZQJDJBMMZ HSFBU
DPNQBSFE UP QJQF)PXFWFS UIF WBDVVN SFTJTUBODF PG UIF HBTLFUT NVTU CF
QFSNJTTJCMF WBDVVN GPS NFDIBOJDBM DPOOFDUJPOT JT MJTUFE JO UIF GPMMP

Connection type	Permissible vacuum (di erential partial vacuum) (bar)
6OJPO	1
5ISFBEDPPLEOOFDUJPO	1
'MBOHF DPOOFDUJPO ÍBU HBTLFU	Not possible
'MBOHF DPOOFDUJPO QSPÌMF TF	1 BM
'MBOHF DPOOFDUJPO 0 SJOH TF	1 BM

2.7.4 Valves

#BMM WBMWFT BSF UIF QSFGFSSFE WBMWFT GPS WBDVVN BQQMJDBUJPOT 5IF QF
WBMWFT JT MJTUFE JO UIF GPMMPXJOH UBCMF

Valve type	DN (mm)	Permissible vacuum (di erential partial vacuum) up to a maximum temperature of 50 °C (bar)
#BMM WBMWF UZQF	10 - 100	1
#BMM WBMWF UZQF	10 - 100	0.8
%JBQISBHN WBMWF UZQF	15 - 50	0.5
#VUUFSÍZ WBMWF UZQFT		1

2.8 Piping systems for surface nishing and varnishing technology

2.8.1 Silicone-free/cleaned

(SPXJOH FOWJSPONFOUBM BXBSFOFTT DPOUJOVPVTMZ JODSFBTJOH SFRVJSFNFO
UIF ÌFME PG UPYJD TVCTUBODFT FNJTTJPO 5" BJS IBWF MFE UP UIF EFWFMPQNF
QBJOUT BOE WBSOJTIFT 8JUI OFX WBSOJTIJOH UFDIOPMPHJFT VQ UP PG UIF
can be reduced.

'PS UIF QSPEVDUJPO USBOTQPSU BOE QSPDFTTJOH PG XBUFS TPMVCMF QBJOUT
QJQFMJOF DPNQPOFOUT UIBU EP OPU DPOUBJO TVCTUBODFT XIJDI JOUFSGFSF XJ
QSPDFTT TVDI BT TJMJDPOFT DFSUBJO HSFBTFT PJMT BOE XBYFT NBZ CF VTFE

GF Piping Systems – An experienced partner

('{1JQJOH 4ZTUFNT IBT XPSLFE DMPTFMZ GSPN UIF CFHJOOJOH XJUI NBOVGBDUVS
DPOTUSVDUPST BOE PQFSBUPST JO UIJT TQFDJBM TFDUPS PG TVSGBDF ÌOJTIJOH
UFDIOPMPHZ ('{1JQJOH 4ZTUFNT IBT TVDDFTTGVMMZ TVQQMJFE QMBOU DPOTUSV
WBSOJTIJOH QSPDFTTFT GPS ZFBST F H UIF BVUPNPUJWF JOEVTUSZ

1SPEVDUJPO NFFUT UIF NPTU SJHPSPVT EFNBOET

- Silicone-free separating agents in the paint shop
- "CTPMVUF DBSF JO DMFBOJOH JOTUBMMBUJPO BOE QBDLJOH
- 6ODPNQSPNJTFE [PPHDZUSPM
- 2VBMJUZ BTTVSBODF TZTUFN DFSUJÌFE BDDPSEJOH UP *40

2.8.2 Fittings

5IF DPNQPTJUJPO PG UIF SBX NBUFSJBM HSBOVMBUF JT TJMJDPOF GSFF "MM T
TQBSZFE XJUI TJMJDPOF GSFF TFQBSBUJOH BHFOUT 'PMMPXJOH JOKFDUJPO NPM
DMFBOFE BOE EJSFDUMZ QBDLFE ('{1JQJOH 4ZTUFNT SFDPNNFOET TFMFDUJOH B
4UBOEBSE 1BDL PS (1 (SBOE 1BDL XIFO PSEFSJOH ÌUUJOHT UP QSFWFOU DPO
UP UIF ÌOBM DPOTVNFS

2.8.3 Valves andunions

5IF JOEJWJEVBM DPNQPOFOUT PG UIF WBMWFT BOE VOJPOT BSF DMFBOFE XJUI E
B TQFDJBM DMFBOJOH QSPDFTT 5IFZ BSF BTTFNCMFE JO B TQFDJBM XPSLJOH BS
QSPUFDUJWF

4MJEJOH DPNQPOFOUT BSF MVCSJDBUFE TMJHIUMZ XJUI TQFDJBM MVCSJDBOUT U
4ZOUIFTJT 130 "" CBTFE PO SFRVJSFNFOUT 7BMWFT BOE VOJPOT BSF JOEJWJEV
sealed bag.

2.9 Gaskets

(BTLFUT VOEFSHP UIF TBNF QSPEVDUJPO DMFBOJOH BOE QBDLJOH QSPDFTTFT B

i Maintenance

For safety reasons we recommend replacing the entire body when disassembling the valve.

3 Hydraulic Calculation and Pressure Losses

3.1 Hydraulic calculation

3.1.1 Required pipe diameter

Formulas

5IF GPMMPXJOH GPSNVMB DBO CF VTFE GPS B ÌSTU BQQSPYJNBUJPO PG UIF QJQF B HJWFO ÍPX SBUF

$$d_i = 18.8 \sqrt{\frac{Q_1}{v}} \quad \text{or} \quad d_i = 35.7 \sqrt{\frac{Q_2}{v}}$$

W 'MPX WFMPDJUZ N T
d_i Pipe inner diameter (mm)
Q_1 'MPX SBUF NŽ I
Q_2 'MPX SBUF M T
$POWFSTJPO GBDUPS GPS VOJUT 2 N I
$POWFSTJPO GBDUPS GPS VOJUT 2 M T

5IF ÍPX WFMPDJUZ NVTU CF BQQSPYJNBUFE BDDPSEJOH UP UIF JOUFOEFE VTF PG 4UBOEBSE WBMVFT GPS UIF ÍPX WFMPDJUZ BSF

Liquids

W r N T T GPS UIF TVDUJPO TJEF

W r N T GPS UIF QSFTTVSF TJEF

Gases

W r N T

5IF DBMDVMBUJPOT PG QJQF EJBNFUFS IBWF OPU UBLFO JOUP BDDPVOU IZESBVM CF DBMDVMBUFE TFQBSBUFMZ BT EFTDSJCFE JO UIF GPMMPXJOH TFDUJPOT

(m^3/h)	(l/min)	(l/s)	(m^3/s)
1.0			Y
	1.0		Y^{-5}
		1.0	Y^{-3}
		1000	1.0

Conversion table with units for ow rate

Example for calculating the inner diameter d_i

PP pipe SDR11
'MPX WP2MVNF 2 M T
'MPX WFMPDJUZ W N T

$$d_i = 35.7 \sqrt{\frac{8}{1.5}} = 82.4 \text{ mm}$$

" QJQF XJUI %/ p JODI JT VTFE "GUFS EFÌOJOH UIF JOOFS EJBNFUFS UIF S
WFMPDJUZ DBO CF DBMDVMBUFE XJUI UIF GPMMPXJOH GPSNVMB

$$v = 354 \frac{Q_1}{d_i^2} = 1.9 \frac{m}{s} \quad \text{or} \quad v = 1275 \frac{Q_2}{d_i^2} = 1.9 \frac{m}{s}$$

W 'MPX WFMPDJUZ N T
d_i Pipe inner diameter (mm)
21 'MPX SBUF NŽ I
22 'MPX SBUF M T
$POWFSTJPO GBDUPS GPS VOJUT 2 N
$POWFSTJPO GB2DUPS GPS VOJUT 2

Correlation of outer diameter – Inner diameter

5P ÌOE UIF PVUTJEF EJBNFUFS VTJOH UIF JOTJEF EJBNFUFS BOE UIF BQQMJDBCM
GPMMPXJOH GPSNVMB

$$d = d_i \frac{SDR}{SDR - 2}$$

3.1.2 Correlation of outside diameter to inside diameter

Correlation of outside diameter to inside diameter for SDR13.6, SDR21 and SDR33

d_i (mm)	SDR33 PVDF d (mm)	d_i (mm)	SDR13.6 PVC-U, PVC-C d (mm)	d_i (mm)	SDR21 PVC-U, PVDF d (mm)
85	90		20		20
103	110	21	25	21	25
	125		32	28	32
132					
150			50		50
	180				
188	200				
211	225		90	81	90
235	250		110	100	110
	280		125	113	125
	315	119			
333	355				
		-	-		180
		-	-	181	200
-	-	-	-		225
-	-	-	-		250
-	-	-	-	253	280
-	-	-	-	285	315
-	-	-	-		

Correlation of outside diameter to inside diameter for SDR11 and SDR17

d_i (mm)	SDR11 PE, PP d (mm)	d_i (mm)	SDR17, SDR17.6 ABS, PE, PP d (mm)
	20		20
20	25	21	25
	32	28	32
33		35	
	50		50
52			
	90		90
90	110		110
102	125	110	125
115			
131			
	180	159	180
	200		200
	225	199	225
205	250	221	250
229	280		280
258	315		315
290	355	313	355
		353	
	500		500
515			
581			
	800		800

3.1.3 Nomogram for easy determination of diameter and pressure loss

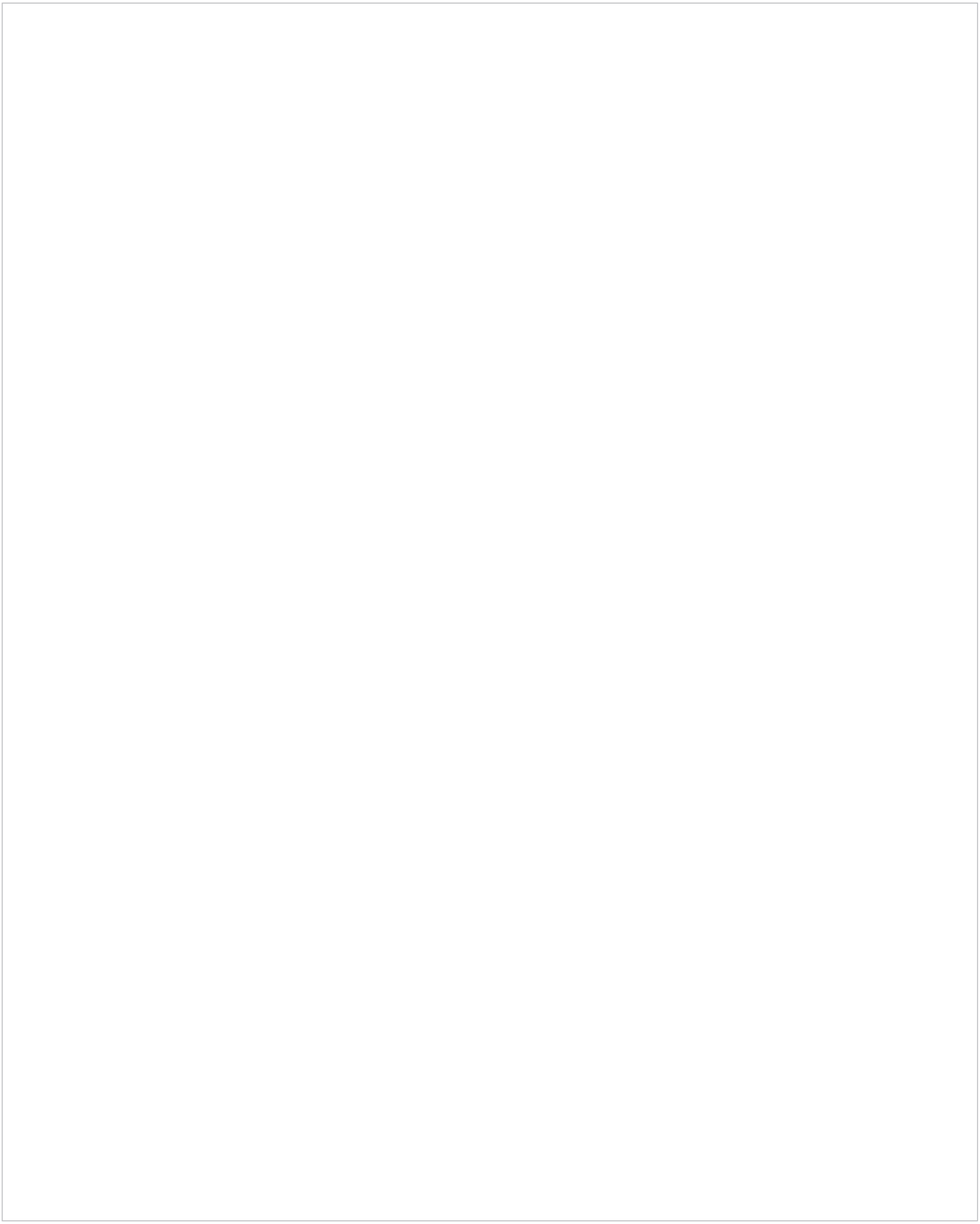
5IF GPMMPXJOH OPNPHSBN TJNQMJÌFT UIF EFUFSNJOBUJPO PG UIF SFRVJSFE EJB
UIF QSFTTVSF MPTT PG UIF QJQF QFS NFUFS QJQF MFOHUI DBO CF SFBE PË

⚠ The determined pressure loss from the nomogram applies only to a density of the ow medium of 1,000 kg/m³, e.g. for water. Further pressure losses of ttings, valves, etc. have to be considered as shown in the following.

3.1.4 Using the nomogram

#BTFE PO B ÍPX WFMPDJUZ PG N T B MJOF JT ESBXO UISPVHI UIF EFTJSFE ÍPX
UP UIF BYJT XJUI BO JOOFS EJBNFUFS PG EJ Å NN 5IFO TFMFDU B EJBNFUFS
4%3 BOE ESBX B OE MJOF UISPVHI UIF EFTJSFE ÍPX SBUF VQ UP UIF QSFTTVSF
(5 mbar per meter pipe).

Nomogram for pipe SDR13.6, SDR21, SDR33 using the metric system



Nomogram for pipe SDR21, SDR17, SDR33 using the metric system

Nomogram for inch pipe

3.2 Pressure loss

3.2.1 Pressure loss in straight pipe

8IFO DBMDVMBUJOH UIF QSFTTVSF MPTT JO TUSBJHIU QJQF MFOHUIT UIFSF JT B MBNJOBS BOE UVSCVMFOU ÍPX 5IF JNQPSUBOU VOJU PG NFBTVSFNFOU JT UIF 3F 5IF DIBOHFPWFS GSPN MBNJOBS UP UVSCVMFOU ÍPX PDDVST BU UIF DSJUJDBM W Re_{crit} { {

-BNJOBS ÍPX PDDVST JO QSBDUJDF QBSUJDVMBSMZ JO UIF USBOTQPSU PG WJTD MVCSJDBUJOH PJMT *O UIF NBKPSJUZ PG BQQMJDBUJPOT JODMVEJOH NFEJB TJN ÍPX IBWJOH BO FTTFOUJBMMZ TUFBEJFS WFMPDJUZ UIBO MBNJOBS ÍPX JO B DSPT occurs.

5IF QSFTTVSF MPTT JO B TUSBJHIU MFOHUI PG QJQF JT JOWFSTFMZ QSPQPSUJPO BOE JT DBMDVMBUFE CZ UIF GPMMPXJOH GPSNVMB

$$p_R = \frac{L}{d_i} \frac{}{2\ 10^2} v^2$$

—RQ	Pressure loss in a straight length of pipe (bar)
O	Pipe friction factor
L	Length of the straight length of pipe (m)
d_i	Pipe inner diameter (mm)
U	%FOTJUZ PG ÍPX NFEJB N³) LH N
W	'MPX WFMPDJUZ N T

! In practice, when making a rough calculation (i.e. smooth plastic pipe and turbulent ow) it is enough to use the value O= 0.02 to represent the hydraulic pressure loss.

3.2.2 Pressure loss in ttings

Coe cient of resistance

5IF QSFTTVSF MPTTFT EFQFOE VQPO UIF UZQF PG ÌUUJOH BT XFMM BT PO UIF ÍPX TP DBMMFE DPFÎDJFOU 8FSG SJFTJTUBODF DPFFÎDJFOUT

Fitting type	Coe cient of resistance bending radius R	-value
90° bend	q E	0.51
	q E	
	q E	
	q E	0.23
‹ CFOE	q E	
	q E	
	q E	0.20
	q E	0.15
‹FMCPX		1.2
‹ FMCPX		0.3
5FF		1.3
Reduction (contraction)		0.5
3FEVDUJPO		1.0
$POOFDUJPOT ÍBOHFT NWOJPOT GVTJPOJOH CFUXFFOÇ UEXÇ QJNF	E	E
	E	E
	E	E
	E	E

[1] 'PS B NPSF EFUBJMFE EJËFSFOUJBUF CFUXFF coalescence and separa UJPO 7BMVFT GPS [V NBYJNVN PG DBO CF GPVOE JO UIF SFTQFD MJUFSBUVSF 6TVBMMZ PG B UFF JO UIF PWFS QSFTTVSF MPTT JT WF therefore in most cases]{ { DBO CF VTFE

Calculation of pressure loss

5P DBMDVMBUF UIF UPUBM QSFTTVSF MPTT JO BMM ÌUUJOHT JO B QJQFMJOF UBL
MPTTFT J F UIF TVN PG BMM TJOHMF QSFTTVSF MPTT DBO UIFO CF DBMDVMBUFE BDDPS
UIF GPMMPXJOH GPSNVMB

$$p_{Fi} = \frac{v^2}{2 \cdot 10^5}$$

—Fi Q 1SFTTVSF MPTT PG ÌUUJOHT CBS
6] 4VN PG UIF JOEJWJEVBM MPTTFT
W 'MPX WFMPDJUZ N T
U %FOTJUZ PG UIF NFEJVN USBOTQPSUFE JO LH NŽ H DNŽ LH NŽ

3.2.3 Pressure loss in valves

5IF WLG BDUPS JT B DPOWFOJFOU NFBOT PG DBMDVMBUJOH UIF IZESBVMJD ÍPX SBU
GPS BMM JOUFSOBM SFTJTUBODFT BOE GPS QSBDUJDBM QVSQPTFT JT SFHBSEFE
UIF ÍPX SBUF PG XBUFS JO MJUFST QFS NJOVUF XJUI B QSFTTVSF ESPQ PG CBS
UFDIOJDBM EBUB PG UIF ('{1JQJOH W4WBUFNFT WB MXFMMT DPOQSEFOTVSF MPTT
DIBSUT 5IF MBUUFS NBLF JU QPTTJCMF UP SFBE PË UIF QSFTTVSF MPTT EJSFDU
DBO BMTP CF DBMDVMBUFE GSPN UIF W LG W BOE UIF EFTJSFE ÍPX SBUF UP UIF GPMMPXJOH GPSNVMB

$$p_{Ar} = \left(\frac{Q}{k_v}\right)^2 \frac{}{1000}$$

—"Q 1SFTTVSF MPTT PG WBMWF CBS
2 'MPX SBUF NŽ I
U %FOTJUZ PG UIF NFEJVN USBOTQPSUFE LH NŽ H DNŽ LH NŽ
LW 7BMWF ÍPX DIBSBDUFSJTUJD NŽ I

3.2.4 Pressure di erence from static pressure

*G UIF QJQFMJOF JT MBJE WFSUJDBMMZ B HFPEFUJD QSFTTVSF EJËFSFODF NVTU
QSFTTVSF EJËFSFODF JT DBMDVMBUFE BT GPMMPXT

$$p_{geod} = H_{geod} \quad 10^{-4}$$

—geod (FPEFUJD QSFTTVSF EJËFSFODF CBS
—)geod %JËFSFODF JO FMFWBUJPO PG UIF QJQFMJOF N
U %FOTJUZ PG NFEJB LH NŽ H DNŽ LH NŽ

3.2.5 Sum of pressure losses

5IF TVN PG BMM UIF QSFTTVSF MPTTFT JO UIF QJQFMJOF JT HJWFO CZ

$$p = p_R + p_{Fi} + p_{Ar} + p_{geo}$$

Example of a pressure loss calculation

5IF GPMMPXJOH FYBNQMF TIPXT UIF DBMDVMBUJPO UP EFUFSNJOF UIF QSFTTV
QJQFMJOF

		Number of ttings
17%' QJQF	E NN	Y FMCPX ‹
4%3 ÍPX SBUF	M T	Y FMCPX ‹
Medium	Zinn (II)-chlorid	Y UFFT
Density of medium	H 3D N	Y VOJPOT
Length of straight pipe sections	15 m	Y ÍBOHF DPOOFDUJPOT Y EJBQISBHN WBMWF PQFOFE
&MFWBUJPOEJÏSPSFODF	2.0 m	

5IF XBMM UIJDLOFTT PG UIJT QJQFMJOF DBO CF DBMDVMBUFE BT GPMMPXT XJ

$$e = \frac{d}{SDR} = \frac{40\ mm}{21} = 1.9\ mm$$

5IF JOOFS EJBNFUFS PG UIF QJQFMJOF JT BT GPMMPXT

$$d_i = d - 2\ e = d - \frac{2\ d}{SDR} = 36.2\ mm$$

8JUI UIF SFRVJSFE ÍPX SBUF PG M T UIF ÍPX WFMPDJUZ JT BT GPMMPXT

$$v = 1275\ \frac{Q_2}{d_i^2} = 1275\ \frac{1.5}{36.2^2}\ \frac{m}{sec} = 1.46\ \frac{m}{sec}$$

Formulas for calculation of pressure losses

Pressure loss	Formula
Pressure loss of strait pipe	$p_r = 0.02\ \frac{15}{36.2}\ \frac{1900}{2\ 10^2}\ 1.46^2 = 0.17$ bar
1SFTTVSF MPTT PG connections	$\zeta = (12\ 1.2) + (4\ 0.3) + (3\ 1.3) + (5\ 0.7) =$
	$p_{Fi} = 23\ \frac{1.46^2}{2\ 10^5}\ 1900 = 0.47$ ba
1SFTTVSF MPTT PG characteristics diagram for EJBQISBHN WBMWF NFBOT NŽI ÍPX SBUF M TFD NŽI	$p_{Ar} = \left(\frac{5.4}{0.5\ \ 45.5}\right)^2\ \frac{1900}{1000} = 0.107$ bar
Pressure loss of height EJËFSFODF	$p_{geod} = 2.0\ \ 1900\ 10^{-4} = 0.38$ bar
5PUBM QSFTTVSF MPTT pipeline	$p = 0.17$ bar + 0.47 bar + 0.107 bar + 0.38 bar = 1.127 bar

4 Installation

4.1 z-dimension method

4.1.1 Overview

5IF QSFTTVSF PG DPNQFUJUJPO BOE IJHI DPTUT PO TJUF NBLFT JU FTTFOUJBM U
TZTUFNT FÎDJFOUMZ 5IF ('{1JQJOH 4ZTUFNT NFUIPE PG BTTFNCMZ JT IJHIMZ TVJ
*U{SFQMBDFT UIF UFEJPVT BOE UJNF DPOTVNJOH DVUUJOH UP TJ[F PG POF QJQF
QSFDJTF XBZ PG QSFQBSJOH XIPMF HSPVQT PG QJQF BDDPSEJOH UP QMBOT PS K
HSPVQ XJUI UIF DPSSFTQPOEJOH EFTJHO EJNFOTJPOT BOE DVU MFOHUIT DBO CF
JTPNFUSJD QBQFS PG ('{1JQJOH 4ZTUFNT

1MFBTF BEIFSF UP UIF GPMMPXJOH HVJEFMJOFT GPS ESBXJOH

Pipe running perpendicular to one another	Pipe running diagonally

)PSJ[POUBM
from left to right

7FSUJDBM

)PSJ[POUBM
to front and rear

5IF [EJNFOTJPOT PG UIF ÌUUJOHT BSF OFFEFE GPS EFUFSNJOJOH UIF BDUVBM DV
QJQF 5IF UBCMFT JO PVS QSPEVDU SBOHFT BOE JO UIF POMJOF DBUBMPHVFT DP
EBUB GPS UIF ÌUUJOHT 5IF MFOHUI PG QJQF UP CF DVU JT HJWFO BT JO UIF GPM
EJTUBODF CFUXFFO UIF DFOUFS PG BEKPJOJOH ÌUUJOHT MFTT UIF TVN PG UIF [E
ÌUUJOHT

4.1.2 Procedure

Socket fusion and socket adhesive ttings

Formula for determining the required pipe length

$L_0 = M – z1 – z$

L_o Length of pipe to be cut
. $ F O U F S U P D F O U F S E J T U B O D F P G ÌU U J O H$
[[E J N F O T J P O P G U I F ÌU U J O H

Example

Material 1 7 $ 6 E 1 /
$ F O U F S U P D F O U F S E 1 0 0 0 m m O D F .
[5 ‹ 33 mm
[B O H M F ‹ [33 mm

L_0 = 1000 mm – 33 mm – 33 mm = 934 m

Butt fusion ttings

Formula for determining the required pipe length:

$L_0 = M – L_{Fitt1} – L_{Fitt2} + L_{MatVerl}$

L_o $ V U M F O H U I P G Q J Q F$
$L_{ìUU}$ - F O H U I P G ÌU U J O H [E J N F O T J P O
. % J T U B O D F D F O U F S U P D F O U F S P G ÌU U J O H
$L_{MatLoss}$ Material loss through planning process and bead forming
* 3 J O G S B S F E Y N N N N N N
# $ ' C F B E B O E D S F W J D F G S F F Y

Example

Material 1 1) E 4 % 3 * 3 G V T F E
$ F O U F S D F O U F S E J T U 1 0 0 0 m m F .
L_{Fitt1} 5 ‹ F R V B M N N
L_{Fitt2} F M C P X ‹ N N
$L_{MatLoss}$ Y N N

1 J Q F B O E ÌU U J O H B S F G B D F E G P S F B D I G V T J P O 5 X P G V T J P O T S F T V M U J O Y
L_0 = 1000 mm – 66 mm – 66 mm + 2 5 mm = 878 m

4.1.3 Material losses for IR fusion procedure

Fusion machine IR-63 Plus

d (mm)	PP-natural (mm)	PE100 (SDR11) (mm)	PE100 (SDR17) (mm)	PP-H (SDR11) (mm)	PP-H (SDR17) (mm)	PVDF (mm)	ECTFE (mm)	PFA (mm)
20	5.0	5.5	-	5.0	-			
25	5.0	5.5	-	5.0	-			
32	5.0	5.5	-	5.0	-			
	5.0		-	5.0	-			
50	5.0		-	5.0	-			
	5.5		-	5.0	-			

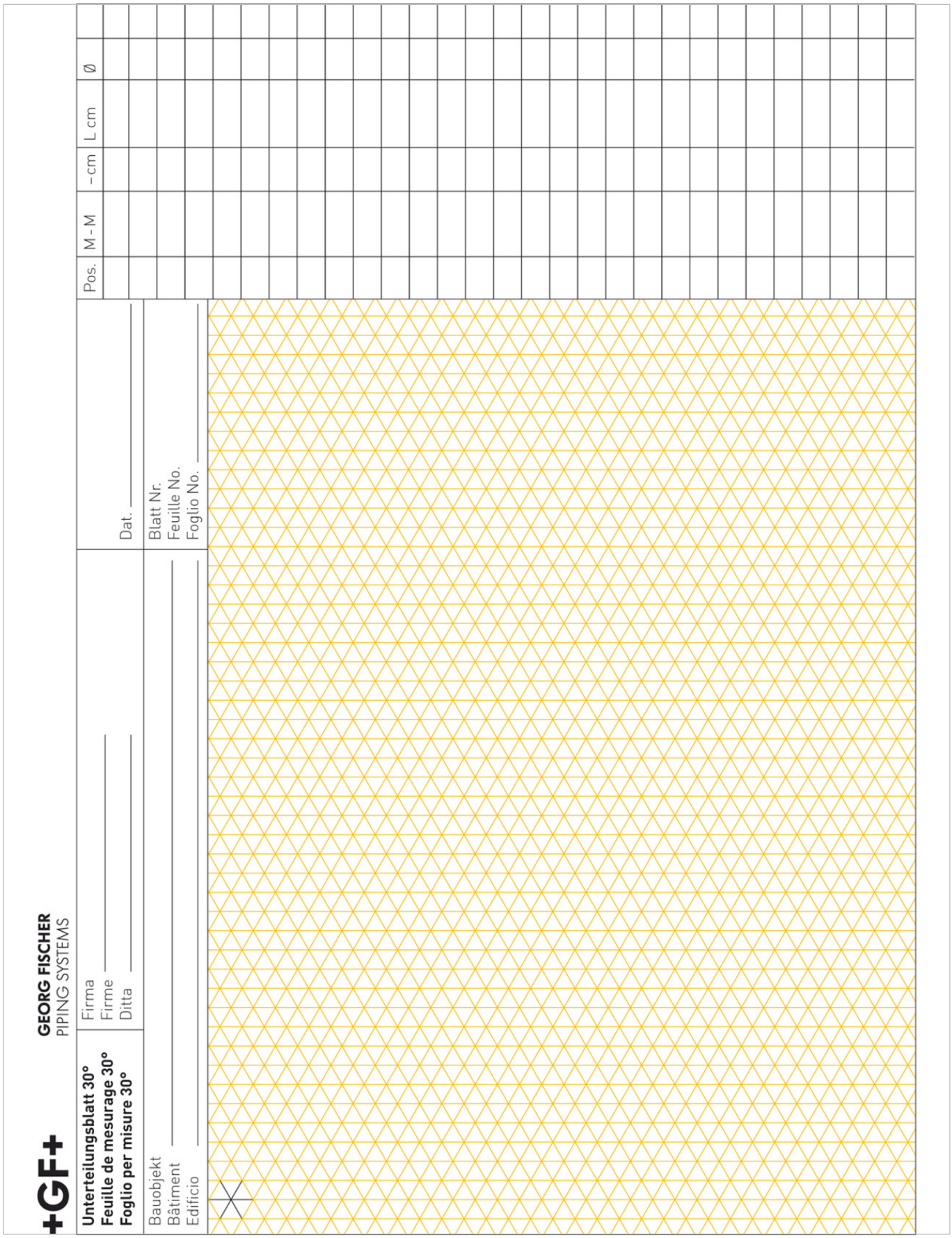
Fusion machine IR-110 A and IR-110 Plus

d (mm)	PP-natural (mm)	PE100 (SDR11) (mm)	PE100 (SDR17) (mm)	PP-H (SDR11) (mm)	PP-H (SDR17) (mm)	PVDF (mm)	ECTFE (mm)	PFA (mm)
20	5.0	5.5	-	5.0	-		5.0	
25	5.0	5.5	-	5.0	-		5.0	
32	5.0	5.5	-	5.0	-		5.0	
	5.0	5.5	-	5.0	-		5.0	
50	5.0	5.5	5.5	5.0	5.0	5.0	5.0	
	5.0	5.5	5.5	5.0	5.0	5.0	5.0	
	5.0	5.5	5.5	5.0	5.0	5.0	5.0	-
90	5.0	5.5	5.5	5.0	5.0	5.0	5.0	-
110	5.0	5.5	5.5	5.0	5.0	5.0	5.0	-

Fusion machine IR-315 A, IR-225 Plus and IR-315 Plus

d (mm)	PP-natural (mm)	PE100 (SDR11) (mm)	PE100 (SDR17) (mm)	PP-H (mm)	PVDF (mm)
	5.0				
	5.0				
90	5.0				5.0
110	5.5				5.0
125	-				5.0
	-				5.0
	-				5.0
180	-				-
200	-				5.0
225	-				5.0
250	-	-	-		5.5
280	-	-	-		5.5
315	-	-	-		5.5

Isometric paper



(ö đTemplate for isometric paper

4.2 Handling plastic pipeline systems

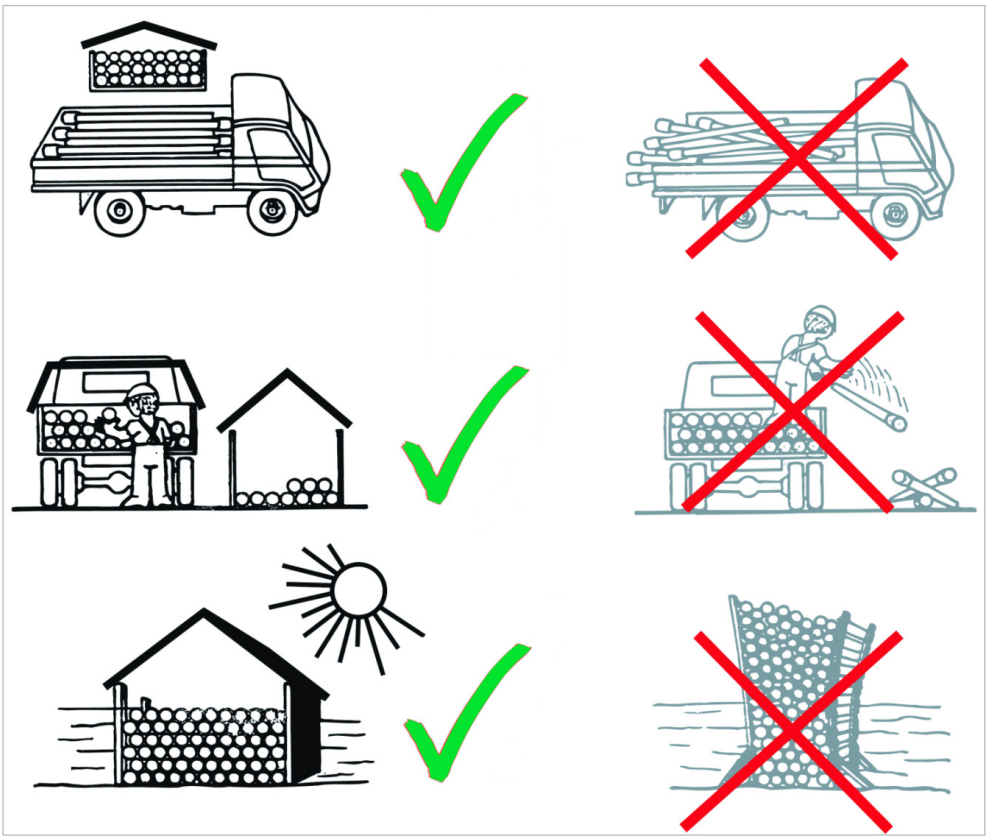
4.2.1 Transportation

7FIJDMFT VTFE UP USBOTQPSU QJQF NVTU CF DBQBCMF PG BDDPNNPEBUJOH UIF
QJQF NVTU CF TVQQPSUFE UP QSFWFOU UIFN CFOEJOH PS EFGPSNJOH 5IF BSFB
JODMVEJOH TJEF TVQQPSUT TIPVME CF MJOFE XJUI QBEEFE TIFFUJOH PS DPSSV
BWPJE EBNBHF CZ QSPUSVEJOH SJWFUT PS OBJMT 5P QSPUFDU BHBJOTU EBNBHI
OPU CF TMJE PWFS UIF USBOTQPSU WFIJDMFnT MPBEJOH BSFB OPS TIPVME UIFZ
ground to their place of storage.

%VF DBSF NVTU CF UBLFO XJUI MPBEJOH BOE VOMPBEJOH *G MJGUJOH HFBS JT
XJUI TQFDJBM QJQF HSJQT 5ISPXJOH QJQF BOE QBSUT EPXO GSPN UIF DBSHP TV
VOBDDFQUBCMF *NQBDUT NVTU CF BWPJEFE BU BMM DPTU FTQFDJBMMZ BU BNC
‹$ XIFSF NBOZ QMBTUJDT F H 17$ IBWF TJHOJÌDBOUMZ MPXFS JNQBDU SFTJTU

1JQF BOE ÌUUJOHT NVTU CF USBOTQPSUFE BOE TUPSFE TP UIBU UIFZ DBOOPU CF
EJSUZ XBUFS FUD 8F SFDPNNFOE TFBMJOH QJQF XJUI QSPUFDUJWF FOEDBQT UP
dirt.

8F SFDPNNFOE UIBU ('{1JQJOH 4ZTUFNT ÌUUJOHT BOE FRVJQNFOU BSF POMZ VOQ
immediately prior to use.



4.2.2 Storage

5IF QJQF TUPSBHF TVSGBDF NVTU CF MFWFM BOE GSFF PG TUPOFT 1JQF NVTU C
JO B XBZ UIBU BWPJET UIF SJTL PG EBNBHF PS QFSNBOFOU EFGPSNBUJPO -BSHF
XBMMFE QJQF NVTU CF ÌUUFE XJUI TUJËFOJOH SJOHT "WPJE TJOHMF QPJOU PS C
supports.

5IF GPMMPXJOH UBCMF HJWFT SFDPNNFOEFE NBYJNVN TUBDLJOH IFJHIUT GPS OP
TUPSBHF 1SPWJEFE QJQF BSF TUBDLFE PO QBMMFUT BOE QSPUFDUFE BHBJOTU T
OPNJOBM TUBDLJOH IFJHIUT TQFDJÌFE JO UIF UBCMF NBZ CF JODSFBTFE CZ

1JQF TUPSBHF BSFBT TIPVME CF BT XFMM QSPUFDUFE BT QPTTJCMF "CTPSQUJPO
PUIFS DIFNJDBMT NVTU CF BWPJEFE BU BMM DPTUT EVSJOH TUPSBHF

4UPSFE QJQF NVTU OPU CF FYQPTFE UP UIF FMFNFOUT NPSF UIBO BCTPMVUFMZ C
TIPVME CF LFQU JO B DPWFSFE XBSFIPVTF *G TUPSFE PVUEPPST F H PO B DPO
TIPVME CF DPWFSFE XJUI TIFFUJOH GPS QSPUFDUJPO BHBJOTU UIF XFBUIFS F H

0OF TJEFE XBSNJOH GSPN FYQPTVSF UP UIF TVO DPVME DBVTF EFGPSNBUJPOT

1JQF BOE QBSUT TIPVME CF VTFE JO UIF PSEFS PG NBOVGBDUVSF EFMJWFSZ UP
XBSFIPVTF UVSOPWFS PG UIF QMBTUJD NBUFSJBM

Material	Permissible stacking height (m)
" # 4	1.0
PE	1.0
PP	1.5
1 7 $ 6	1.5
1 7 $ $	1.5
1 7 % '	1.5

4.3 CAD library

Product library of GF Piping Systems

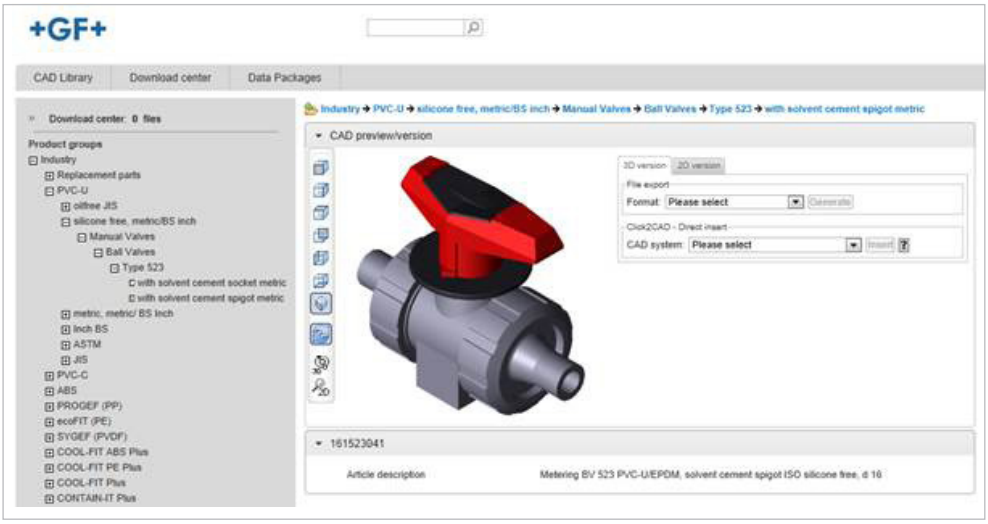
8JUI UIJT $"% MJCSBSZ ('{1JQJOH 4ZTUFNT BJNT UP QSPWJEF EFTJHOFST BOE FC
CFUUFS BOE NPSF FÎDJFOU TVQQPSU GPS UIF EFTJHO PG QJQJOH TZTUFNT

5ISFF EJNFOTJPOBM NPEFMT % NPEFMT PG BMM QJQJOH DPNQPOFOUT CZ ('{1J
BSFB PG JOEVTUSJBM BQQMJDBUJPOT DBO CF DBMMFE VQ WJB UIF EBUBCBTF 5II
EJNFOTJPOBM ESBXJOHT % ESBXJOHT PO IJT PXO JO UIF EFTJSFE WJFXT

5IF MJCSBSZ EPFT XPSL JOEFQFOEFOUMZ GSPN UIF VTFSnT $"% TZTUFN TVQQPSU
BOE JOUFSGBDFT 5IF EBUBCBTF DPNQSJTFT PWFS ESBXJOHT BOE UFDIOJDB
QJQF ÌUUJOHT NFBTVSFNFOU BOE DPOUSPM UFDIOPMPHZ BT XFMM BT NBOVBM B

The CAD library o ers:

- %BUB QBDLFUT XJUI BMM UIF ESBXJOHT PG B TZTUFN
- 0WFS ESBXJOHT
- 1JQF ÌUUJOHT WBMWFT NFBTVSFNFOU DPOUSPM
- Presentation in 2-D and in 3-D
- 0QUJNJ[FE VTFS JOUFSGBDF
- .VMUJGVODUJPOBM ESJWFST GPS UIF NPTU DPNNPO $"% TZTUFNT
- 2VJDL BDDFTT



Sample presentation of a CAD library

- Direct access to the online CAD library at http://cad.georg scher.com

4.4 Length changes and exible sections

4.4.1 Overview

5IFSNPQMBTUJDT BSF TVCKFDU UP HSFBUFS UIFSNBM FYQBOTJPO BOE DPOUSBDU
NBUFSJBMT 1JQF JOTUBMMFE BCPWF HSPVOE BHBJOTU XBMMT PS JO EVDUT SF
CF UBLFO VQ JO PSEFS UP QSFWFOU BOZ BEEJUJPOBM FYUSB TUSBJO PO UIF QJQ
UP QJQF FYQPTFE UP PQFSBUJOH UFNQFSBUVSF WBSJBUJPOT

-FOHUI DIBOHFT DBO CF UBLFO VQ CZ
- 'MFYJCMF TFDUJPOT
- $PNQFOTBUPST

'MFYJCMF TFDUJPOT BSF UIF NPTU DPNNPO UIF TJNQMFTU BOE UIF NPTU FDPOPN
DBMDVMBUJPOT GPS BOE UIF QPTJUJPOJOH PG ÍFYJCMF TFDUJPOT BSF UIFSFGPS

—- -FOHUI DIBOHF
LB 'MFYJCMF TFDUJPO

4.4.2 Fundamentals

5IF MPX FMBTUJDJUZ PG UIFSNPQMBTUJDT BMMPXT DIBOHFT JO MFOHUI UP CF UB
TFDUJPOT XIFSF QJQF TVQQPSUT BSF QPTJUJPOFE TP UIBU UIFZ DBO UBLF BEWE
ÍFYJCJMJUZ PG UIF NBUFSJBM 5IF MFOHUI PG TVDI TFDUJPOT JT EFUFSNJOFE CZ
QJQFMJOF BOE UIF FYUFOU PG UIF UIFSNBM FYQBOTJPO UP CF DPNQFOTBUFE

—- -FOHUI DIBOHF
LB 'MFYJCMF TFDUJPO

'MFYJCMF TFDUJPOT BSJTF OBUVSBMMZ BU BOZ CSBODIJOH PS DIBOHF JO EJSFDU
NPWFNFOU PG -UIF ÍFYJCMF TFDUJPO BT B SFTVMU PG B DIBOHF —- JO UIF MFOHUI N
SFTUSBJOFE CZ ÌYFE QJQF CSBDLFUT XBMM QSPUSVTJPOT HJSEFST PS UIF MJLF

4.4.3 Calculation of length changes

5IF DIBOHF JO MFOHUI DBVTFE CZ UFNQFSBUVSF DBO CF DBMDVMBUFE VTJOH UIF

L = L T
— - 5FNQFSBUVSF SFMBUFE MFOHUI DIBOHF NN
L Length of the pipe section (m)
— 5 %JËFSFODF PG UFNQFSBUVSF ,
D $PFÎDJFOU PG MJOFBS FYQBOTJPO NN N ,

Coe cients of linear expansion of polymers

Material	D= mm/m K
"#4	0.10
$00- '*5 "#4 1MVT	r
1"	0.10
PB	0.13
PE	0.15 – 0.20
PP	r
PPS	0.15
17$ 6	r
17$ $	r
17%'	0.12 – 0.18

&YBDU WBMVFT DBO CF
VTJOH ('{1JQJOH 4ZTUFN
UPPXMX DPPM ÌU HFPSHÌT
DPN PS SFRVFTUFE EJSF
UIF BVUIPSJ[FE ('{1JQJOH
4ZTUFNTQ SFTFOUBUJWF

⚠ If the operating temperature is higher than the installation temperature, then the pipe expands. If, on the other hand, the operating temperature is lower than the installation temperature, then the pipe contracts in length.

- The installation temperature must therefore be incorporated into the calculations as well as the maximum and minimum operating temperatures.
- It is preferable to use "+" to indicate expansion of the pipe and "-" to indicate contraction.
- The larger change in length is the one to be used for determining the required length of the exible section.

Boundary conditions for using the diagram

'PS FBTZ EFUFSNJOBUJPO PG UIF SFRVJSFE MFOHUI PG ÍFYJCMF TFDUJPO QMFBT
EJBHSBNT 5IF GPMMPXJOH CPVOEBSZ DPOEJUJPOT TIPVME CF UBLFO JOUP BDDP

- "TTFNCMZ UFNQFSBUVSF 5
- 0QFSBUJOH UFNQFSBUVSF 5

$$T = T_B - T_M$$

- "MMPXBCMF CFOEJOHWJTUSFTT GSPN
- 1/ UP 1/
- "TTVNFE DPFÎDJFOU PG GSJDUJPO PG UIF QJQF JO UIF MPPTF CSBDLFUT Ç

Information

5IF GPMMPXJOH EJBHSBNT TIPX UIF SFRVJSFE ÍFYJCMF TFDUJPOT GPS TUSBJHIU
PS N &YDFFEJOH UIF NBYJNBMMZ QFSNJTTJCMF TUSBJHIU QJQF EJTUBODF XPV
UIF QJQF EVF UP UPP HSFBU GSJDUJPO JO UIF QJQF DMBNQT 5IFSFGPSF UIF NB
MFOHUI NVTU CF DPOTJEFSFE EFQFOEJOH PO UIF QJQF EJBNFUFS WJTJCMF BCPW

Example: Determining the length of the required exible section

Calculating the relevant change in length

5IF FYBNQMF PG BO "#4 QSPDFTT QJQF TFSWFT UP JMMVTUSBUF UIF QSPDFEVS
QJQJOH GSPN UIF ÌYFE QPJOU UP UIF CSBODI QPJOU XIFSF UIF DIBOHF JO MFO
VQ

Length L 8 m

*OTUBMMBUJPO UFNQFSBUVSF 5

.BY PQFSBUJOH UFNQFSBUVSF 5

.JO PQFSBUJOH UFNQFSBUVSF 5

&YQBOTJPO PG UIF QJQF TFDUJPO EVSJOH IFBUJOH

$$+\Delta L_1 = L \quad T_1 = 8 \quad 15 \quad 0.10 = 12 \text{ mm}$$

$POUSBDUJPO EVSJOH DPPMJOH

$$-\Delta L_2 = L \quad T_2 = 8 \quad 40 \quad 0.10 = 32 \text{ mm}$$

5FNQFSBUVSF EJGGFSFODFT

$T_1 = T_1 \quad T_M = 15\ K \quad T_2 = T_2 - T_M = -40\ K$

.BYJNVN DIBOHF JO UFNQFSBUVSF TFMFDUFE

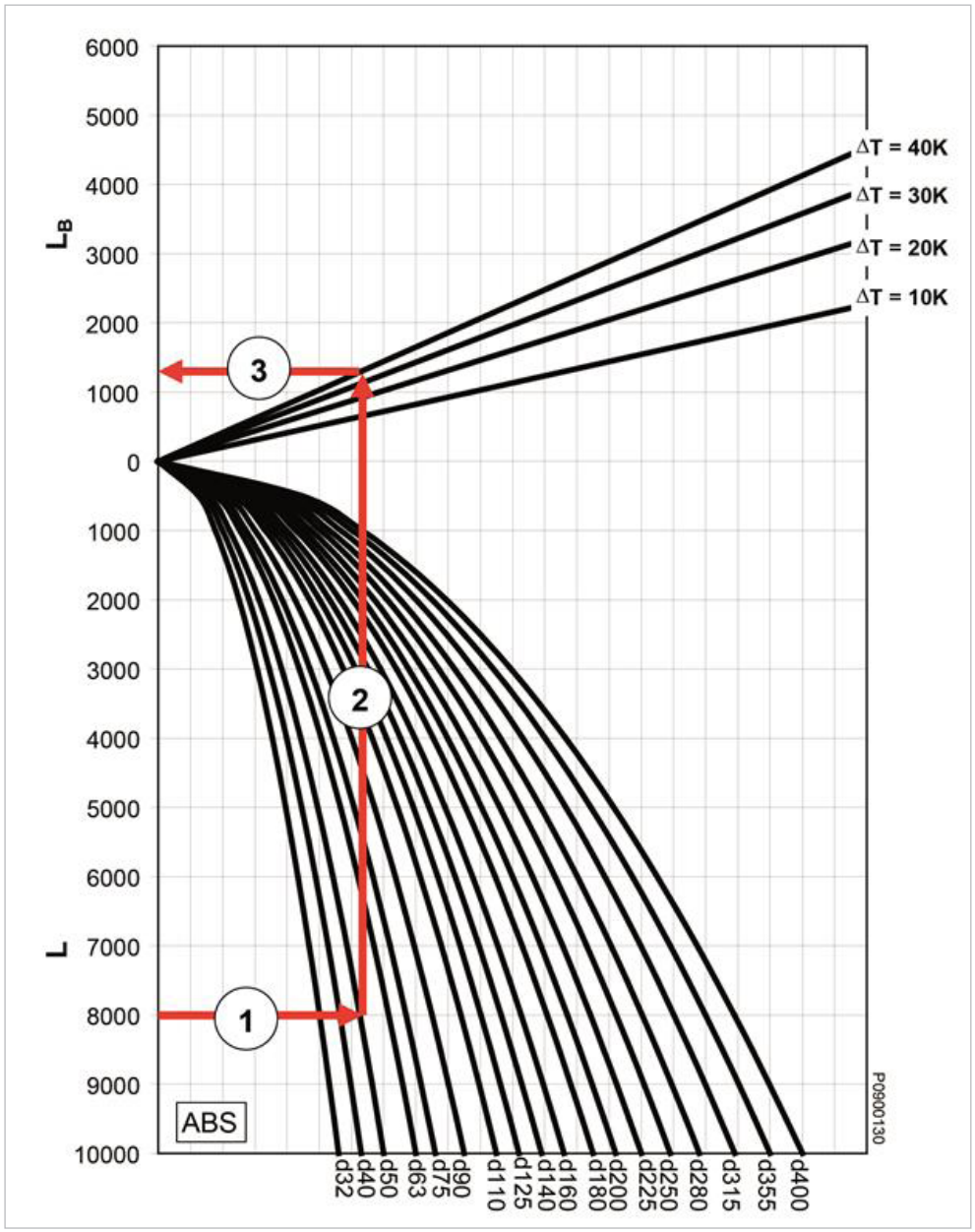
$T = 40\ °C$

Determining the length of the exible section for ABS

5IF WBMVFT OFFEFE UP EFUFSNJOF UIF OFDFTTBSZ MFOHUI BSF
- 5IF NBYJNVN DIBOHF JO UFNQFSBUVSF GSPN UIF QPTJUJPO J F GSPN UIF QP UIF QJQF XBT JOTUBMMFE #VU SFNFNCFS UIBU UIF QJQF DPVME DPOUSBDU KV
- Inner pipe diameter d
- Length of pipe section L

8JUI UIFTF WBMVFT UIF SFRVJSFE MFOHUI PG UIF ÍFYJCMF TFDUJPO DBO CF SFB "#4

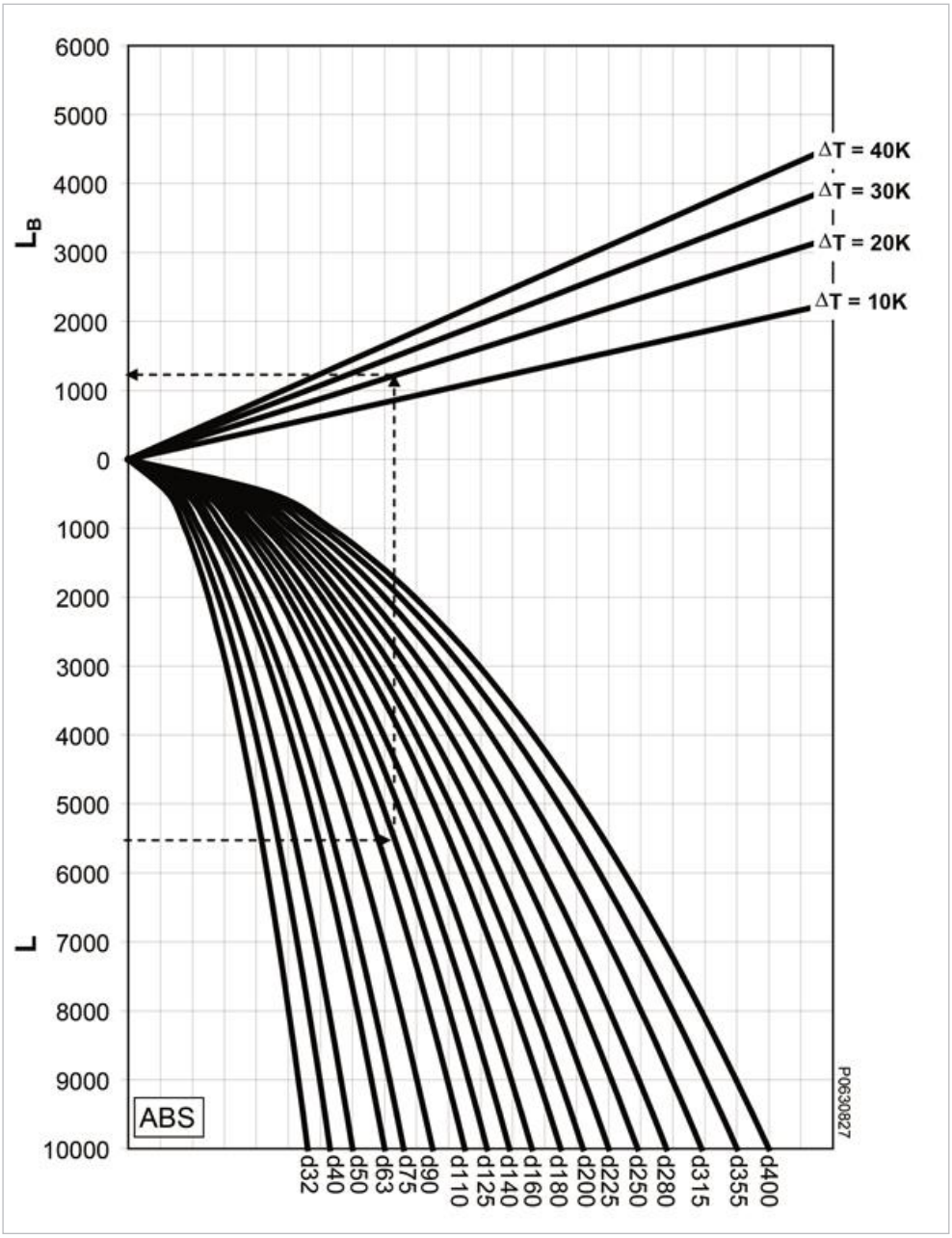
5IF GPMMPXJOH JOGPSNBUJPO DBO CF HBJOFE GSPN UIF DBMDVMBUJPO FYBNQMF
- *OTUBMMJOH B QJQF XJUI E NN
- .BYJNVN DIBOHF JO UFNQFSBUVSF —5 ,
- .BUFSJBM "#4
- -FOHUI PG SFRVJSFE ÍFYJCMF TFDUJPO



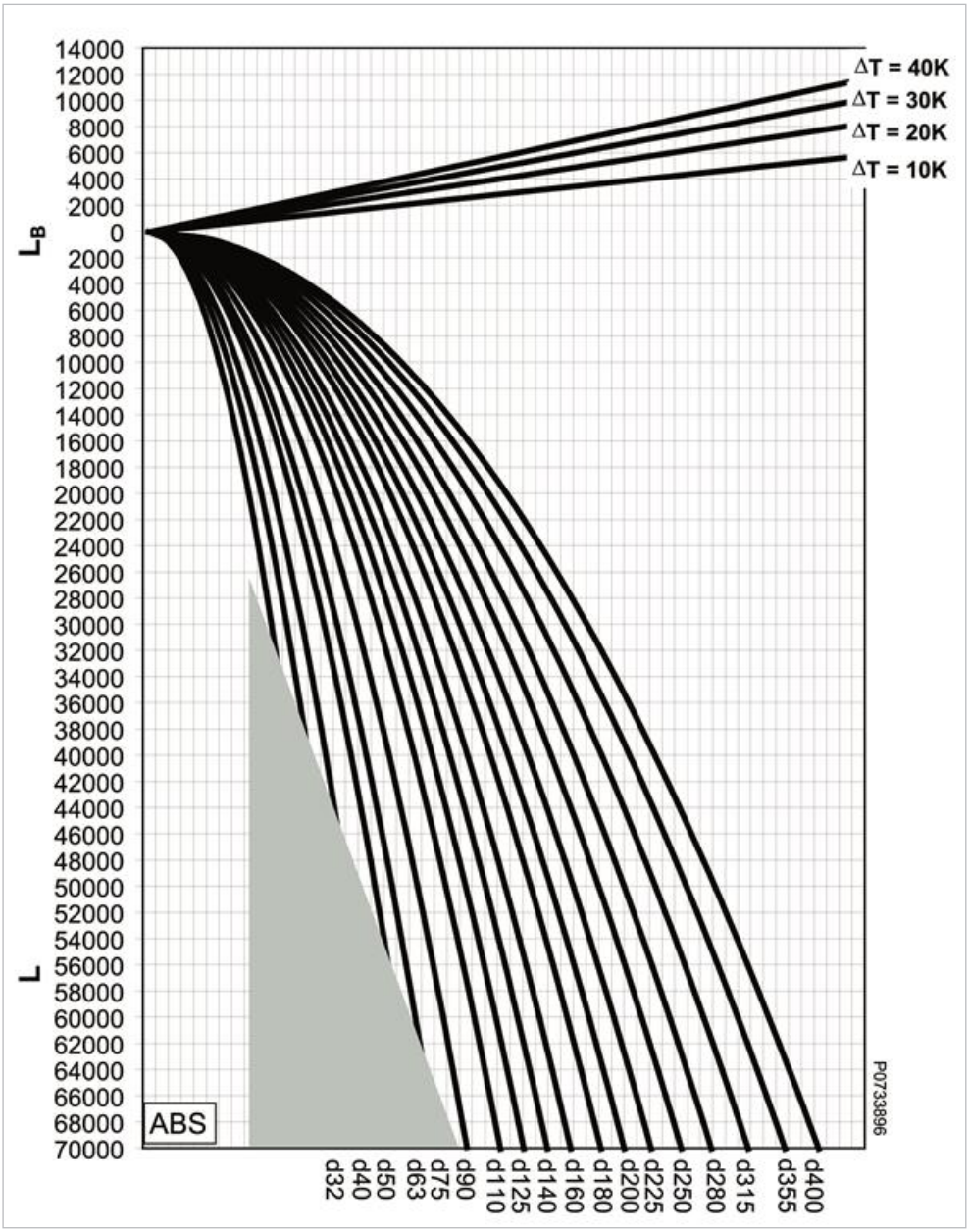
L Length of pipe section (mm)
L_B 3FRVJSFE MFOHUI PG section (mm)

The diagram can be used also the other way around, if a maximum exible section caused by the building construction is given. Then the maximum straight length of the pipe can be determined.

4.4.4 Flexible sections of ABS piping systems



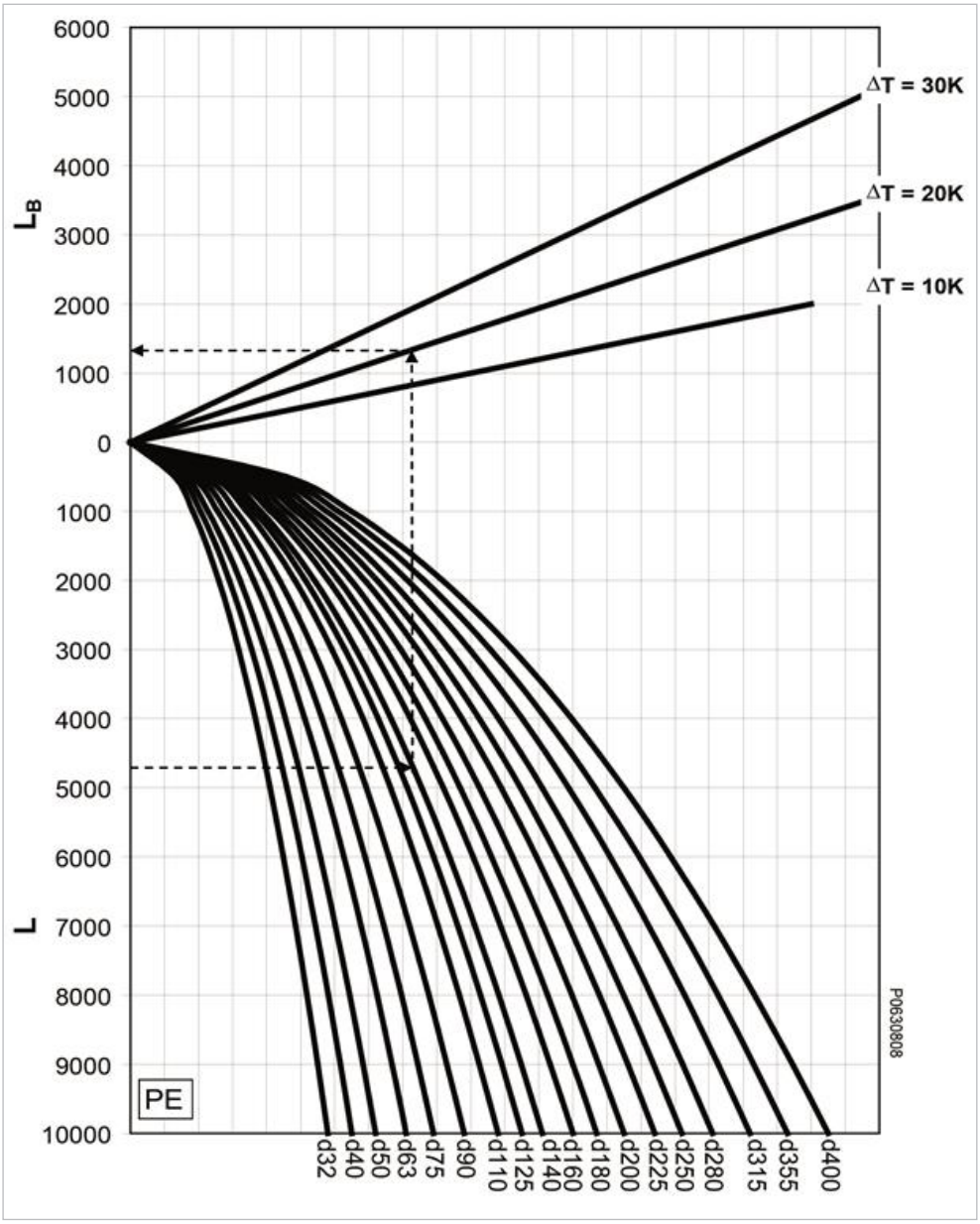
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)



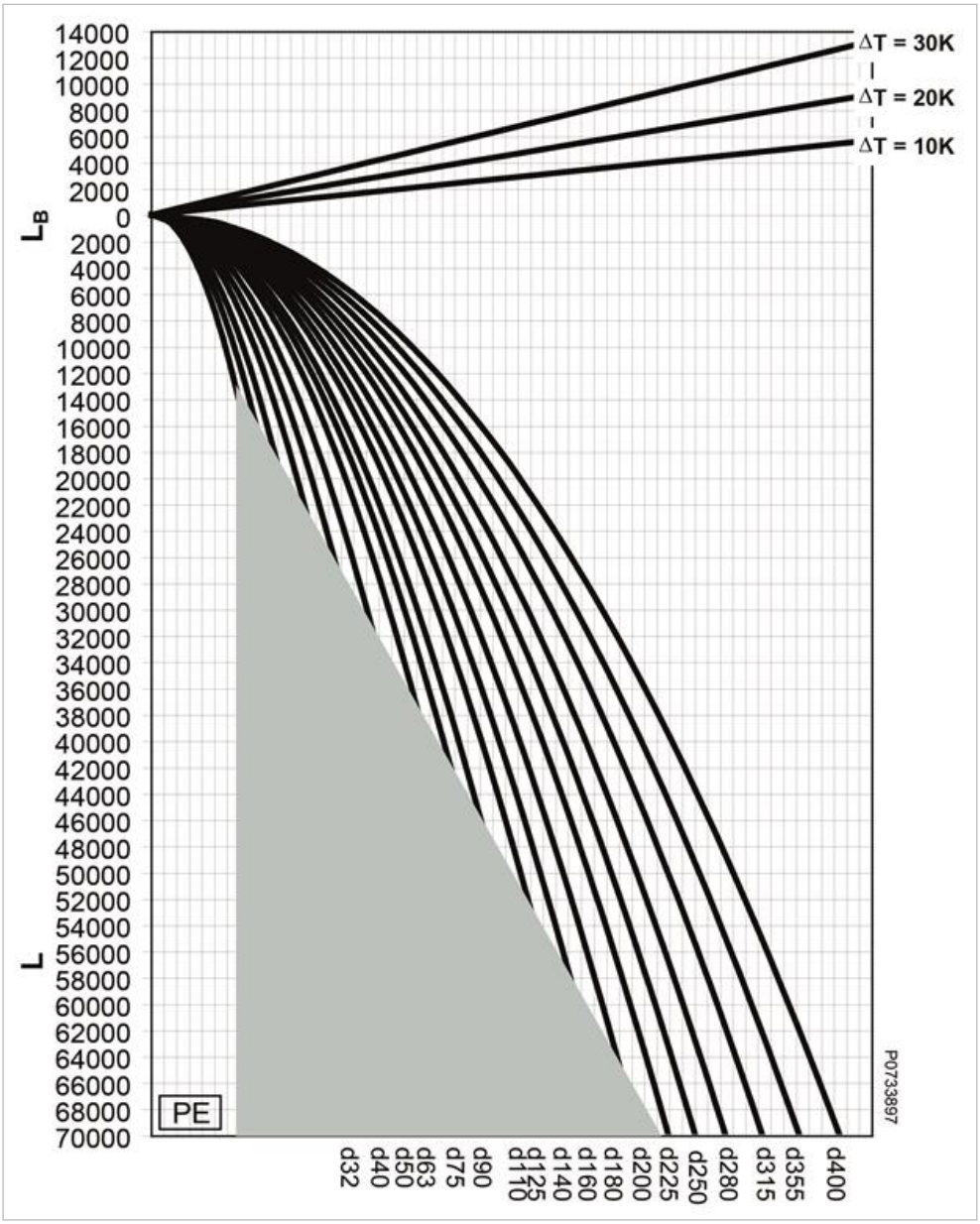
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

⚠ For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".

4.4.5 Flexible sections of PE (PE80, PE100) piping systems



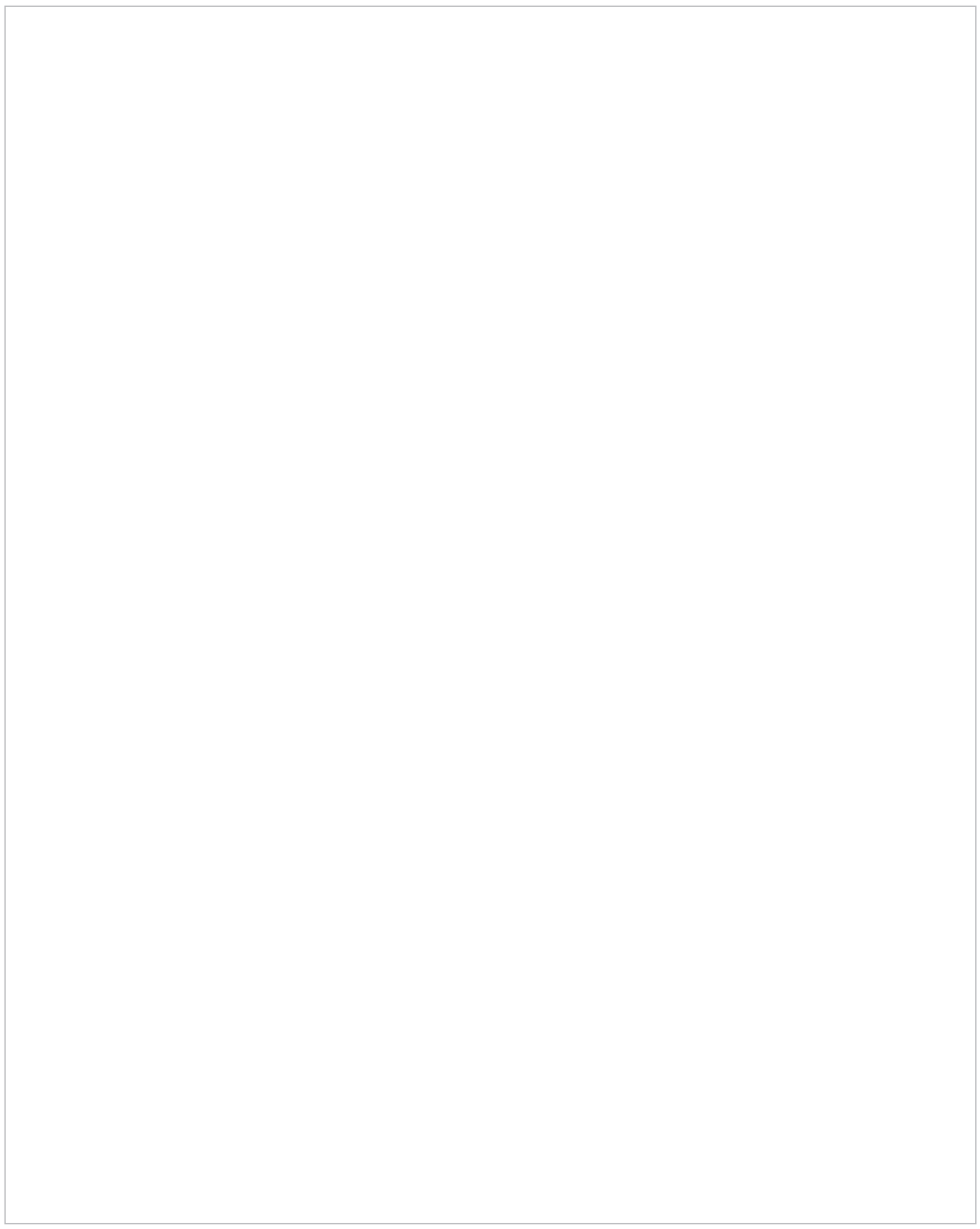
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)



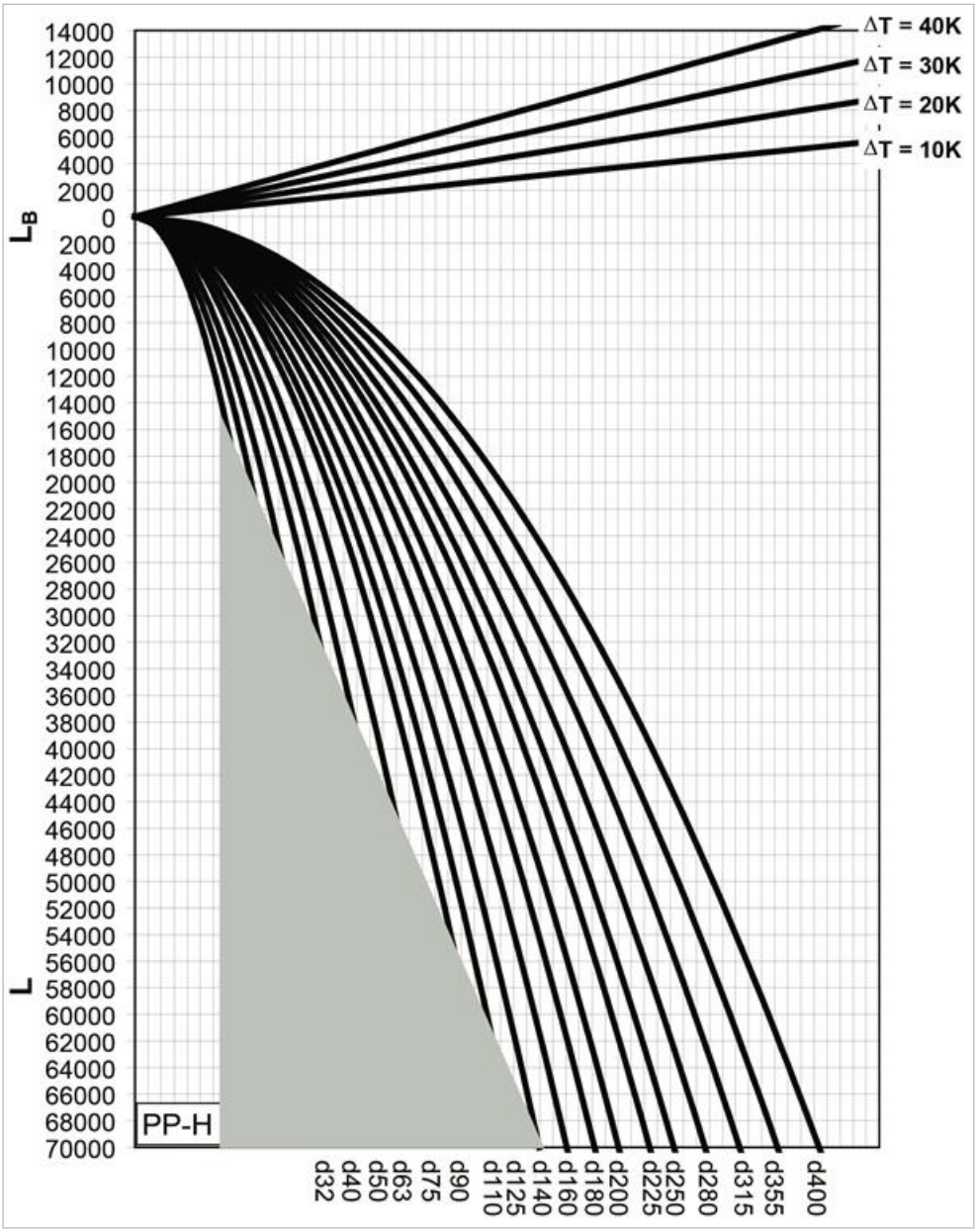
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

⚠ For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".

4.4.6 Flexible sections of PP piping systems

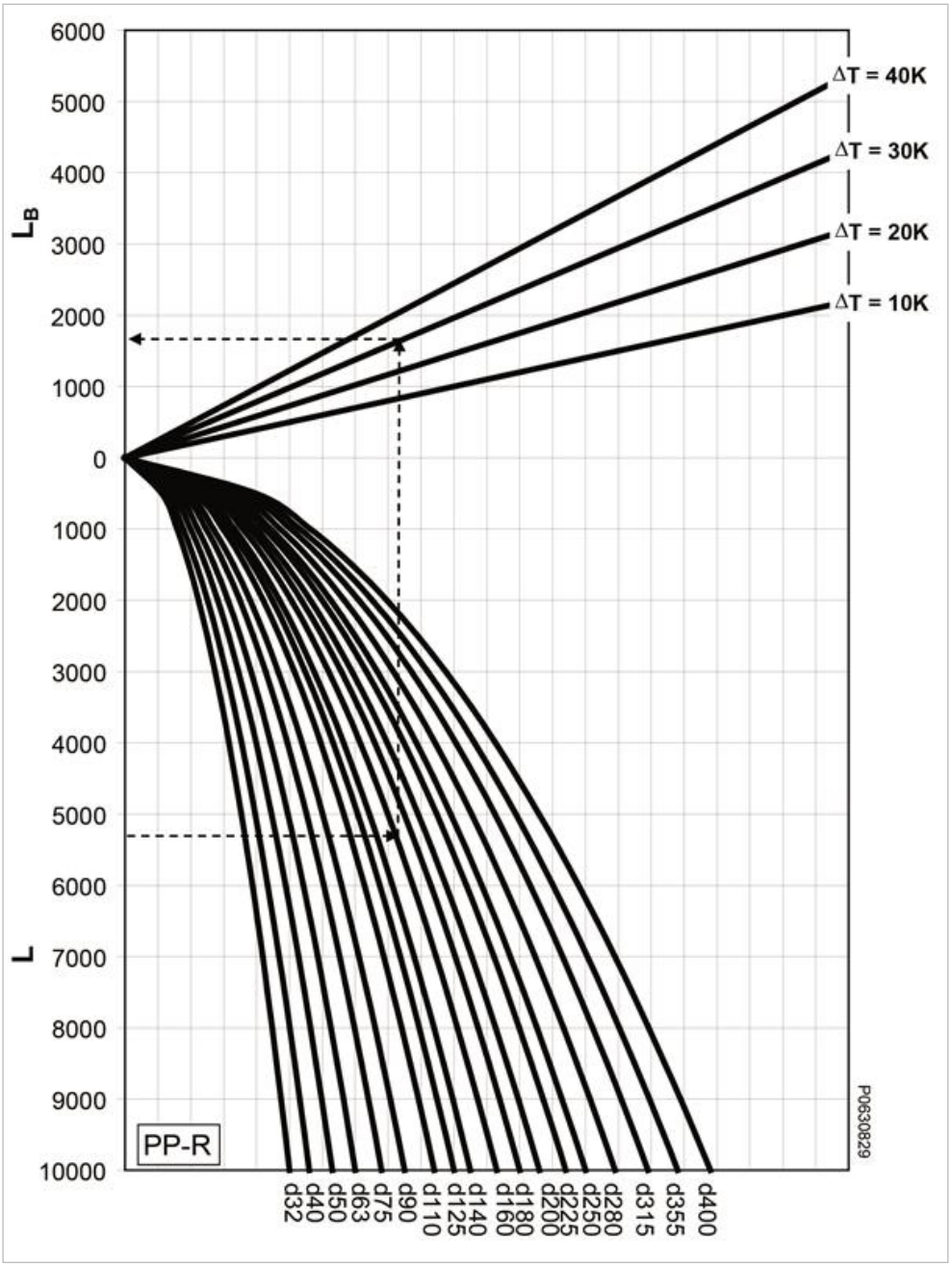


L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

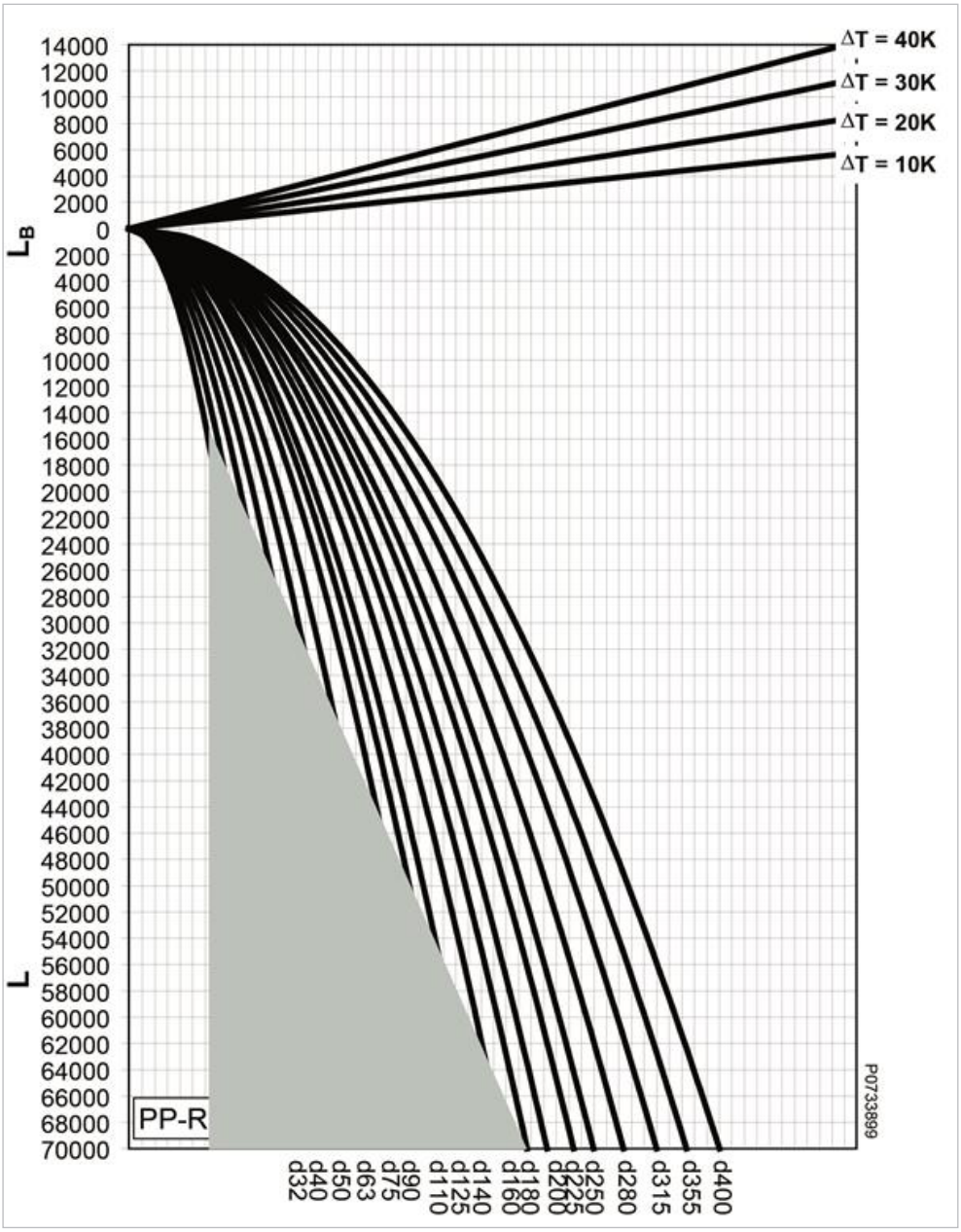


L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

⚠ For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".



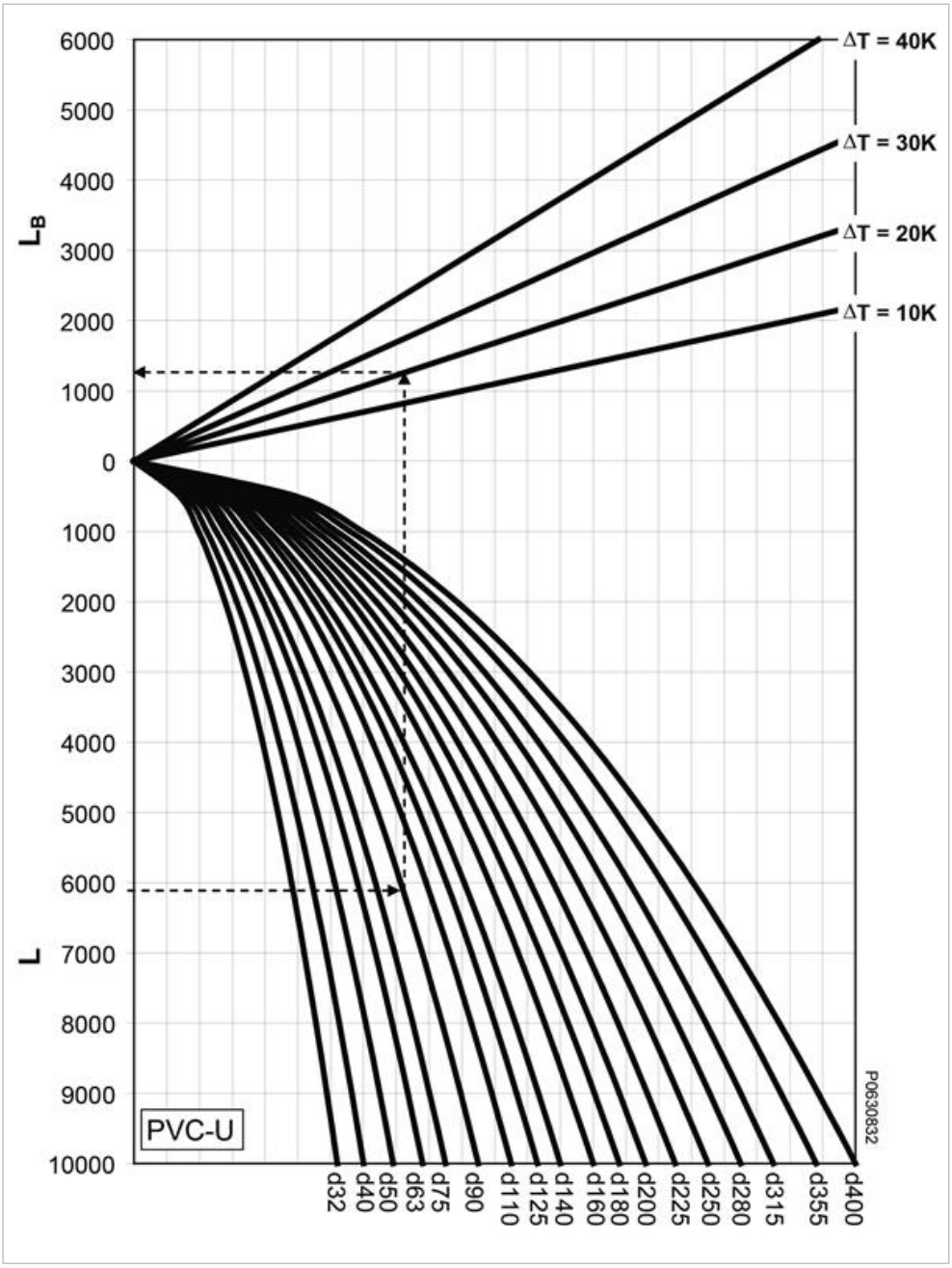
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)



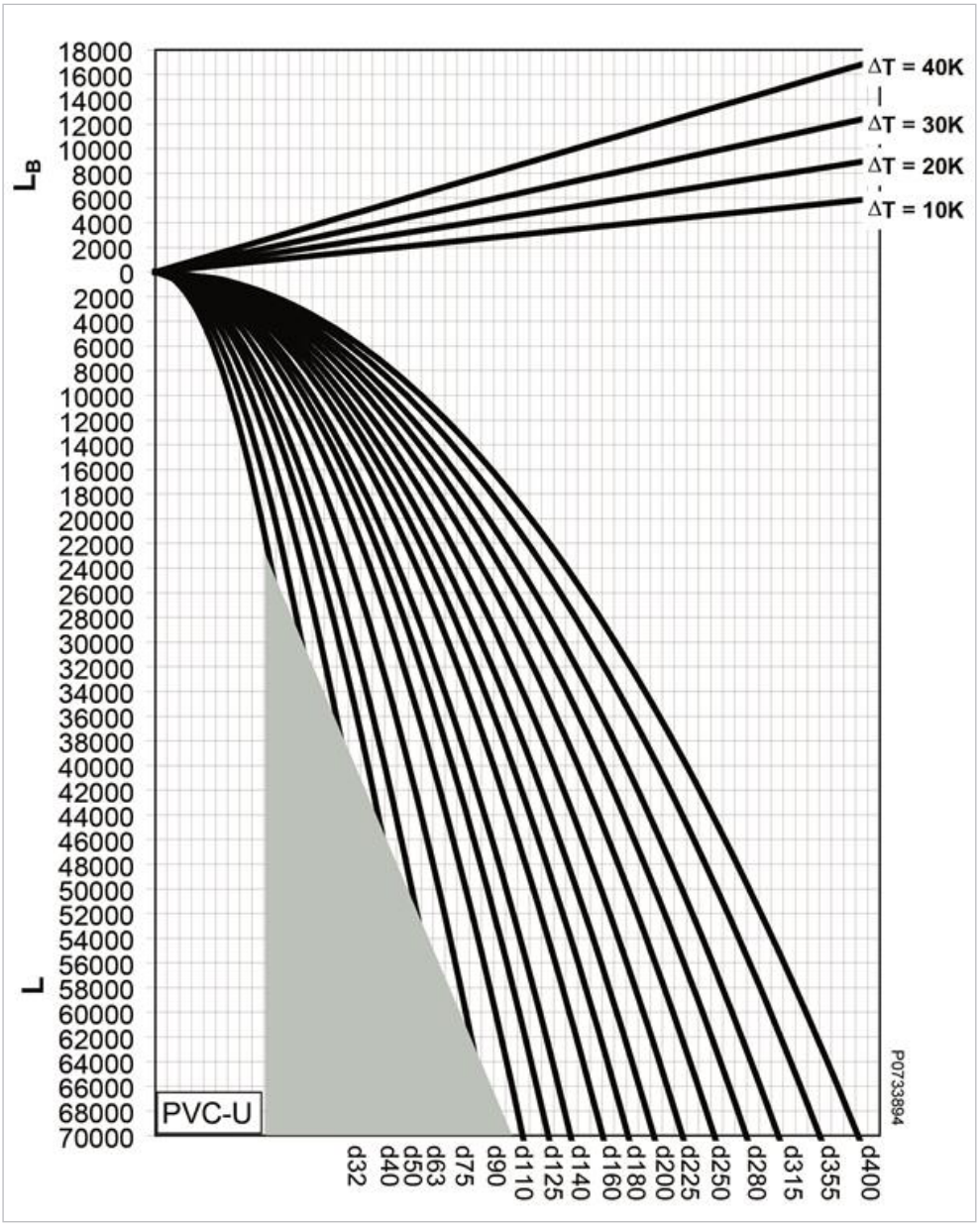
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

⚠ For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".

4.4.7 Flexible sections of PVC-U/PVC-C piping systems

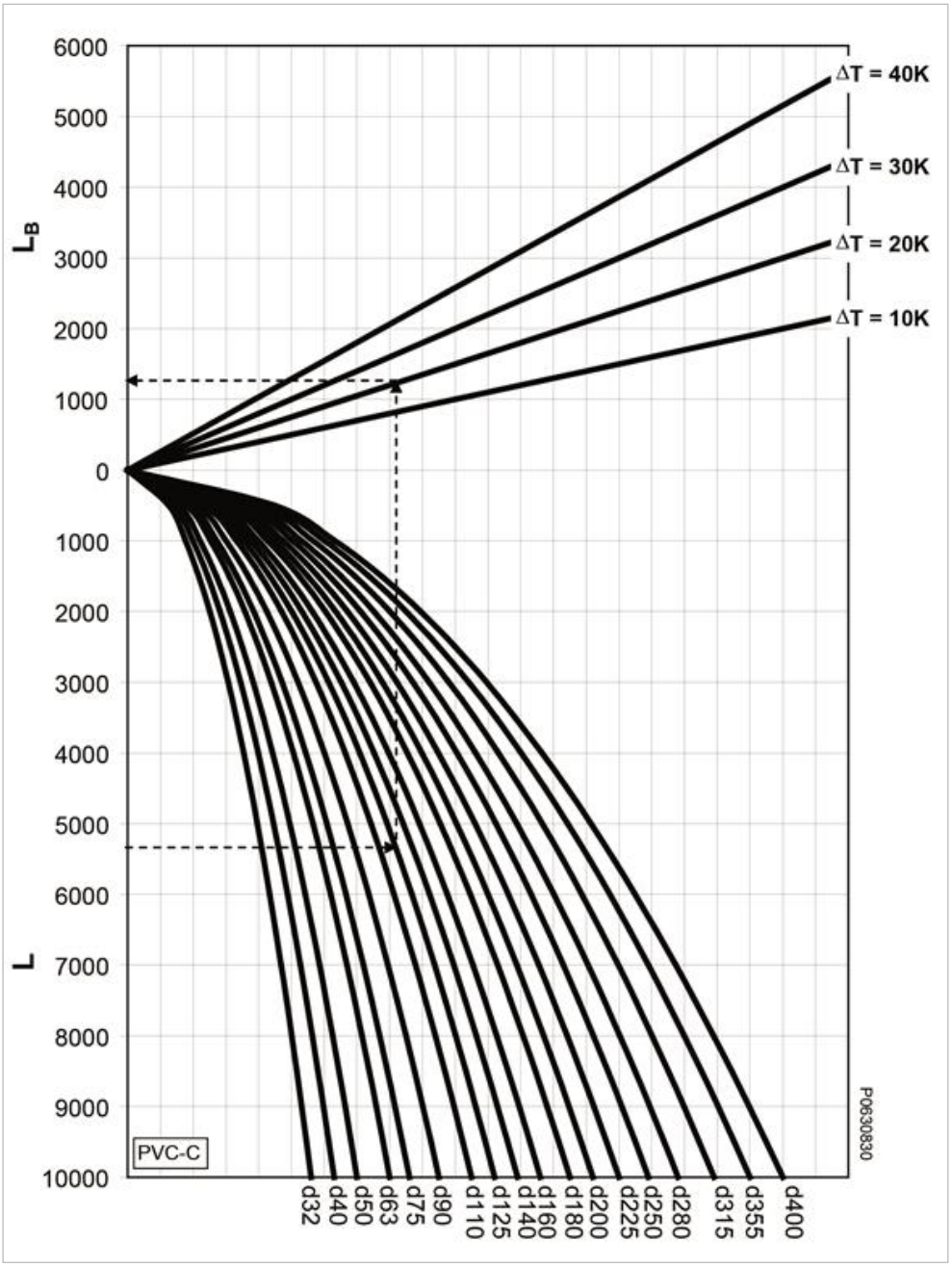


L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

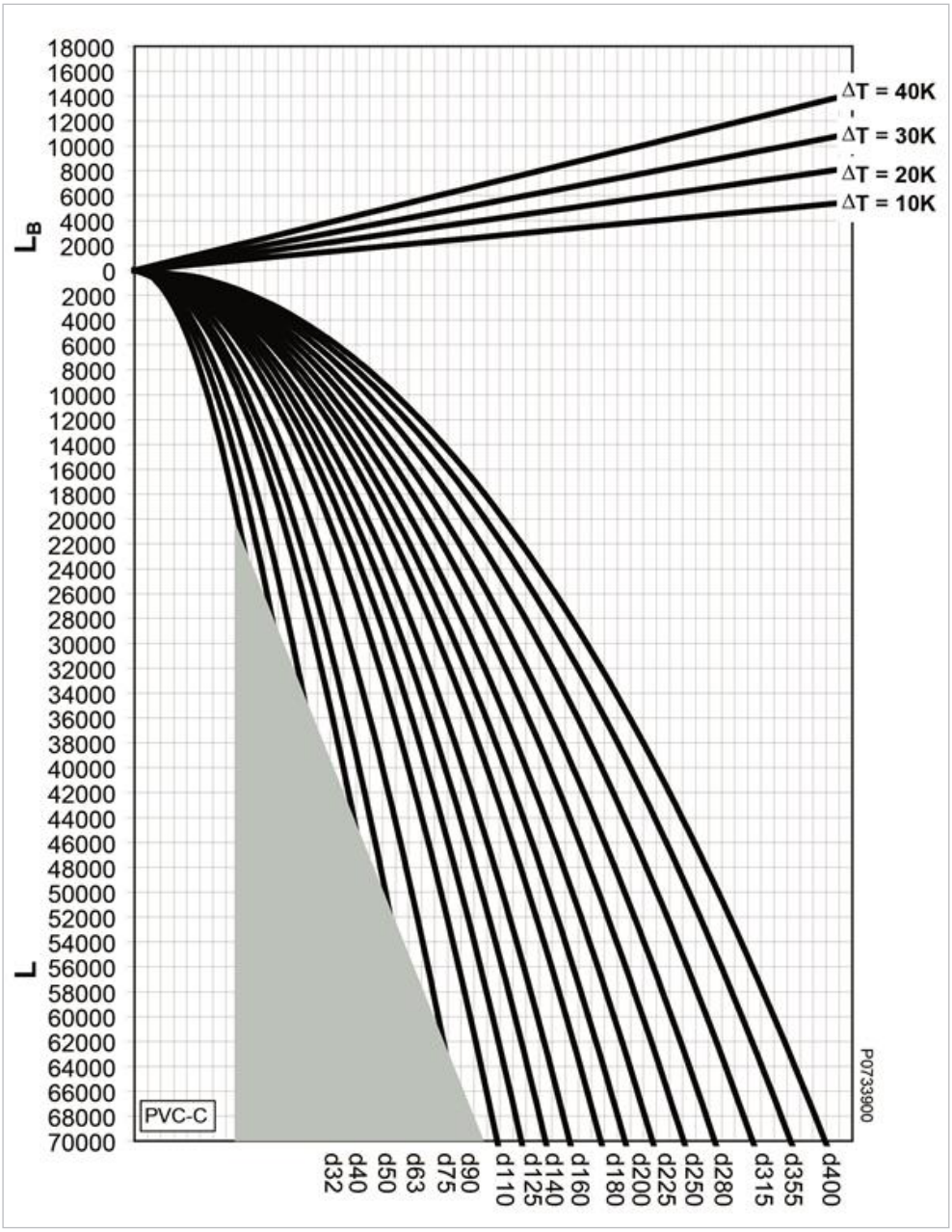


L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".



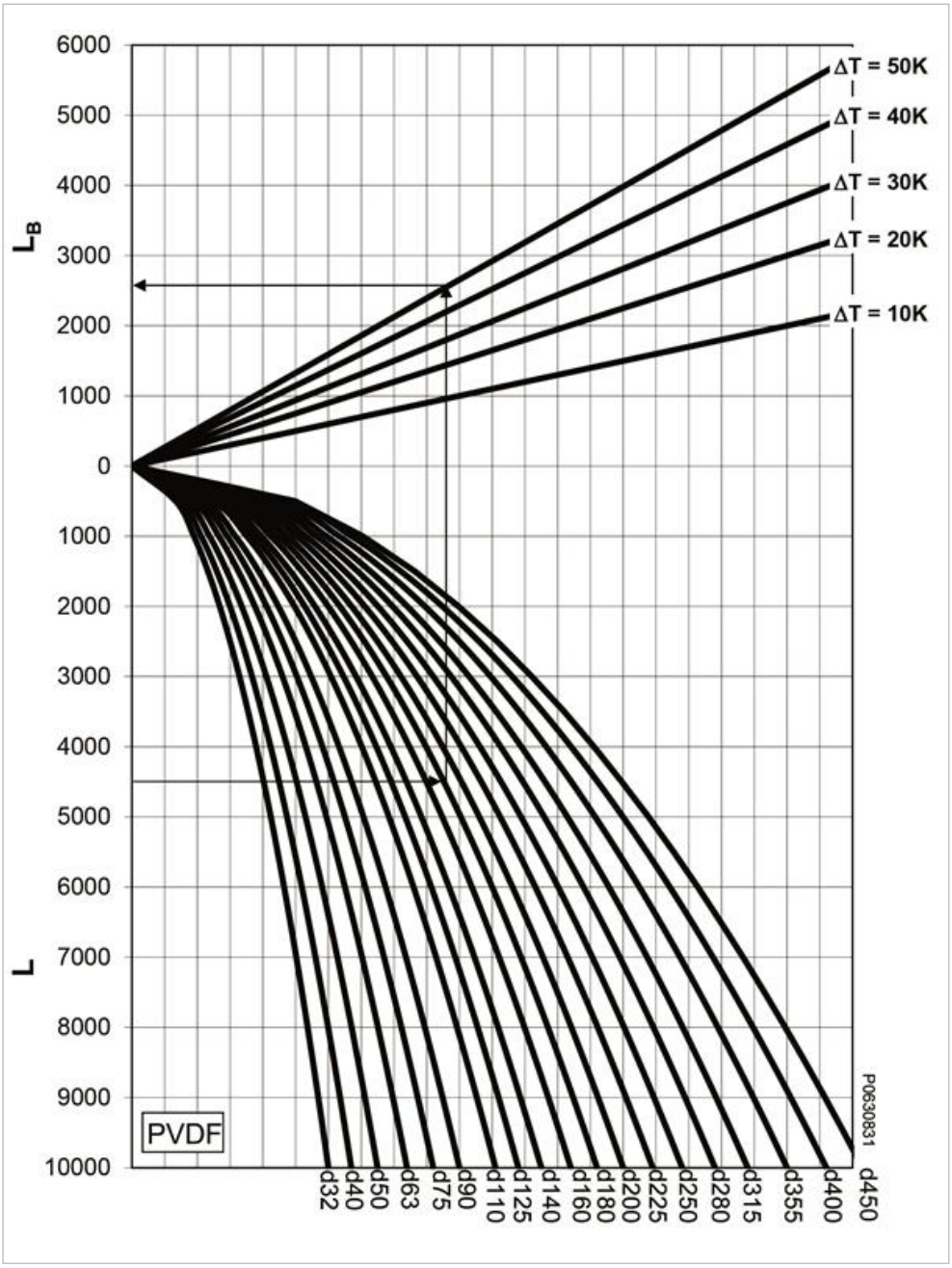
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)



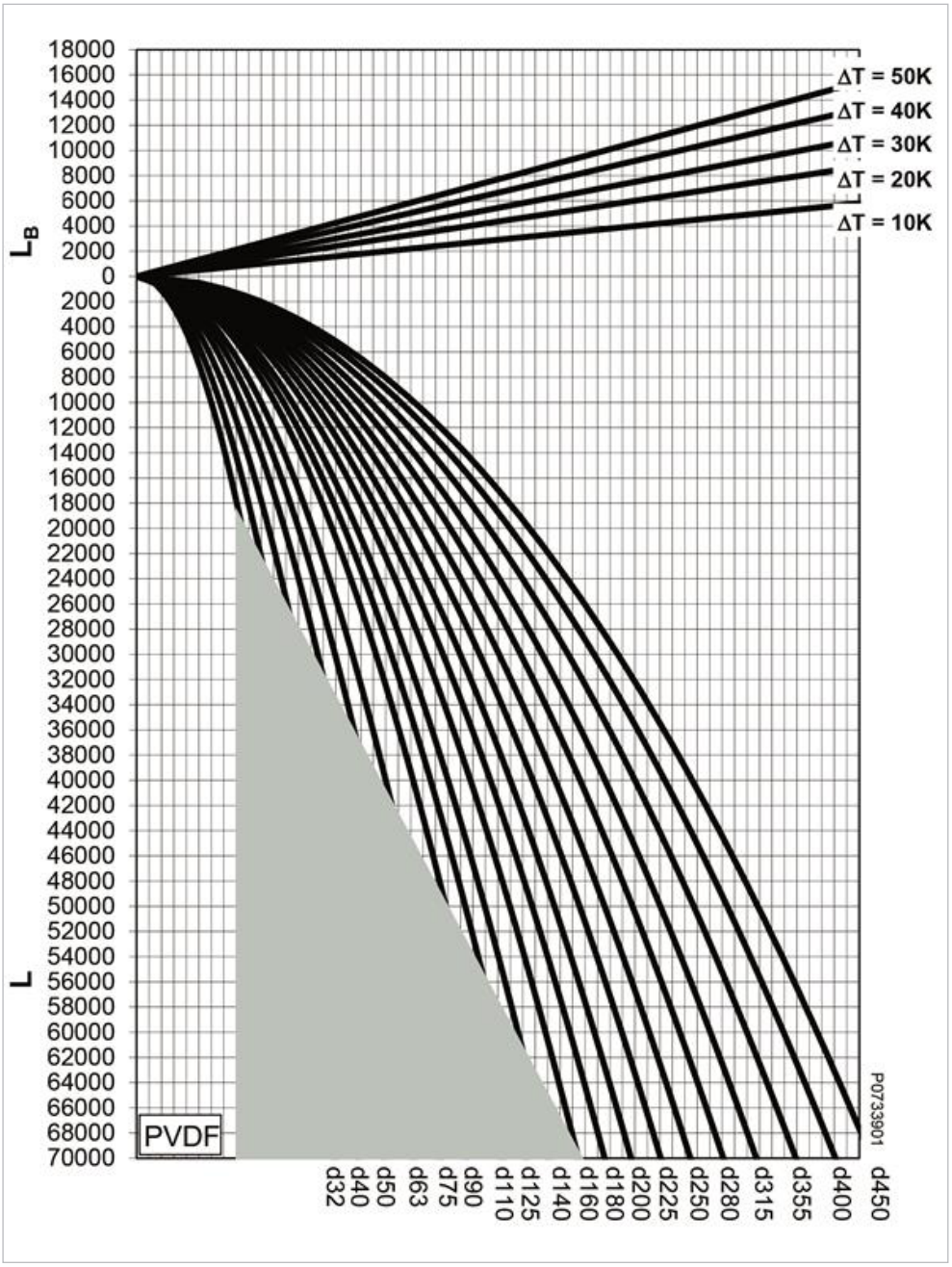
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".

4.4.8 Flexible sections of PVDF piping systems



L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)



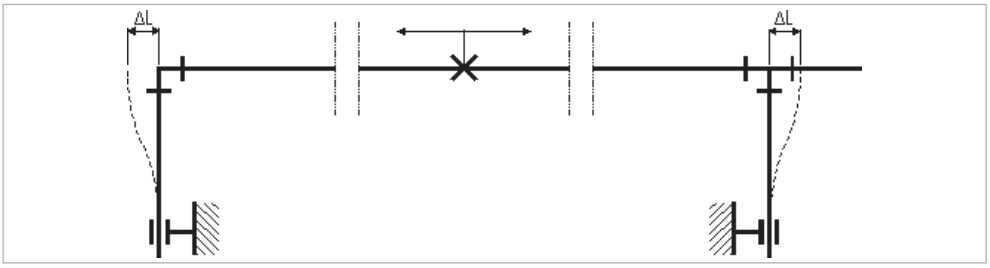
L Length of pipe section (mm)
L_B 3 F R V J S F E M F O H U I P G section (mm)

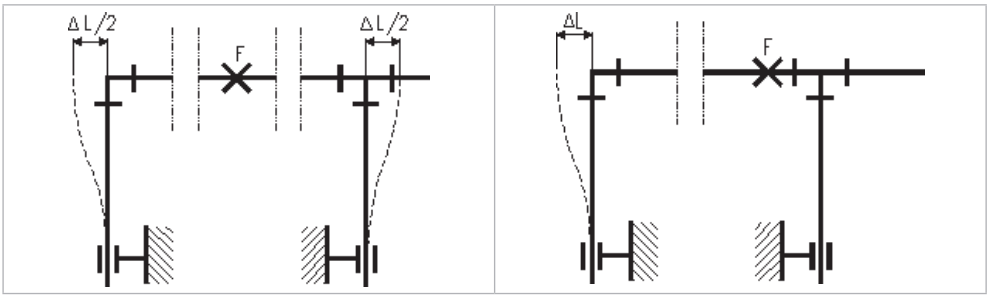
For explanations of the shaded area, see the introductory section "Boundary conditions for using the diagram".

4.5 Installation

4.5.1 Recommendations for installation

-FOHUI DIBOHFT JO QJQF TFDUJPOT TIPVME BMXBZT CF BDDPNNPEBUFE UISPVHI U
PG ÌYFE CSBDLFUT 5IF GPMMPXJOH FYBNQMFT TIPX IPX UIF DIBOHFT DBO CF EJT
TFDUJPOT CZ TVJUBCMF QPTJUJPOJOH PG ÌYFE CSBDLFUT





Recommended | Not recommended

&YQBOTJPO MPPQT DBO CF JOTUBMMFE UP UBLF VQ DIBOHFT JO MFOHUI XIFO ÍFY
be included at a change in direction or branch in the pipeline or if substantial changes in the
MFOHUI PG B TUSBJHIU TFDUJPO OFFE UP CF UBLFO VQ *O TVDI B DBTF UIF DPNC
JO MFOHUI JT EJTUSJCVUFE PWFS UXP ÍFYJCMF TFDUJPOT

⚠ Leaks caused by the bending load leakages can occur at mechanical joints.
Within the range of exible sections and expansion loops no threaded connections or ange connections shall be used.

Pre-stress

*O QBSUJDVMBSMZ EJÎDVMU TJUVBUJPOT XJUI MBSHF DIBOHFT JO POF EJSFDUJPO DPOUSBDUJPO JU JT QPTTJCMF UP QSF TUSFTT UIF ÍFYJCMF TFDUJPO EVSJOH J shorten its length L_B BT JMMVTUSBUFE JO UIF OFYU FYBNQMF

Example

Installation data L 10 m

0VUFS EJBNFUFS E NN

*OTUBMMBUJPO UFNQFSBUVSF ‹$

.BY PQFSBUJOH UFNQFSBUVSF ‹$

. B U F S J B M

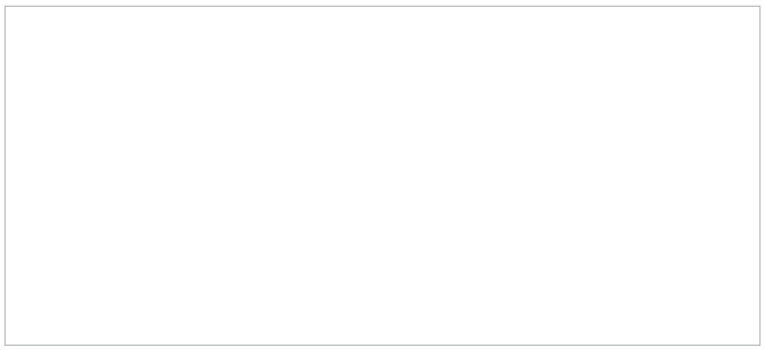
-FOHUI DIBOHF

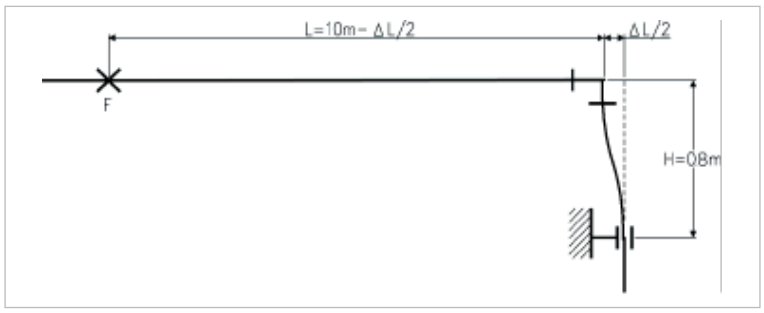
+ L = L T ABS = 10 m 25 K 0.10 mm/mK = 25 mm

" ÍFYJCMF TFDUJPO UP UBLF LV=Q25 mm Dneed to be L= dL E150 mm PG long according to the diagram.

*G UIF ÍFYJCMF TFDUJPO JT QSF TUSFTTFE UP —- UIFO UIF SFRVJSFE MFOHUI P SFEVDFE UP BCPVU NN 5IF WBSJBUJPO MFOHUI GSPN UIF QPTJUJPO JT UIFO ± L/2 = 25/2 = 12.5 mm .

1SF TUSFTTJOH UIF ÍFYJCMF TFDUJPO NBLFT JU QPTTJCMF UP SFEVDF JUT SFRVJ JOTUBMMBUJPOT XIFSF TQBDF JT SFTUSJDUFE 1SF TUSFTTJOH BMTP SFEVDFT UI TFDUJPO JO TFSWJDF JNQSPWJOH UIF BQQFBSBODF PG UIF QJQFMJOF



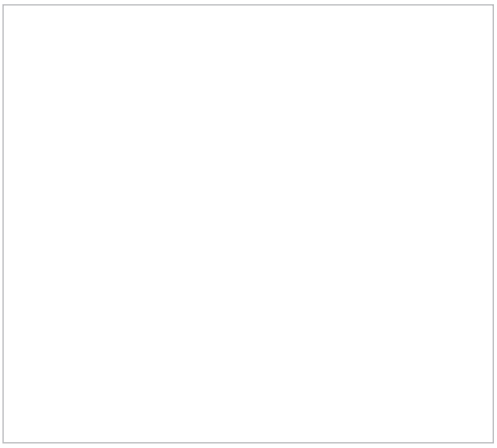


4.5.2 Installation of compensators

5IF MPX NPEVMVT PG FMBTUJDJUZ NFBOT UIBU UIF SFBDUJPO GPSDF PG QMBTUJD
JT MPX DPNQBSFE UP NFUBM QJQF 5IJT NBLFT OPSNBM DPNQFOTBUPST EFTJHOF
QJQF VOTVJUBCMF CFDBVTF PG UIFJS IJHI JOIFSFOU SFTJTUBODF 0OMZ GSFFMZ
NBZ CF VTFE JO QMBTUJD QJQF TZTUFNT J F UIPTF XJUI B MPX SFTJTUBODF 5I
DPNQFOTBUPST NBZ CF DPOTJEFSFE SVCCFS DPNQFOTBUPST 15'& DPSSVHBUFE
TVJUBCMZ TFMFDUFE NFUBM NVMUJ EJTL DPNQFOTBUPST

$BSFGVMMZ QMBDFE ÌYFE QPJOUT TIPVME CF TFMFDUFE XIFO ÌUUJOH DPNQFOTBU
of the pipe in order to ensure their unhindered operation.

⚠ When using compensators, additional longitudinal forces are implemented into the pipeline. These forces have to be carried by guiding the pipeline. For example, threaded rods are not suitable. To estimate the lateral forces it can be assumed that they can reach about 15 % of the axial forces. Please contact the manufacturers of compensators for further support designing such piping systems.

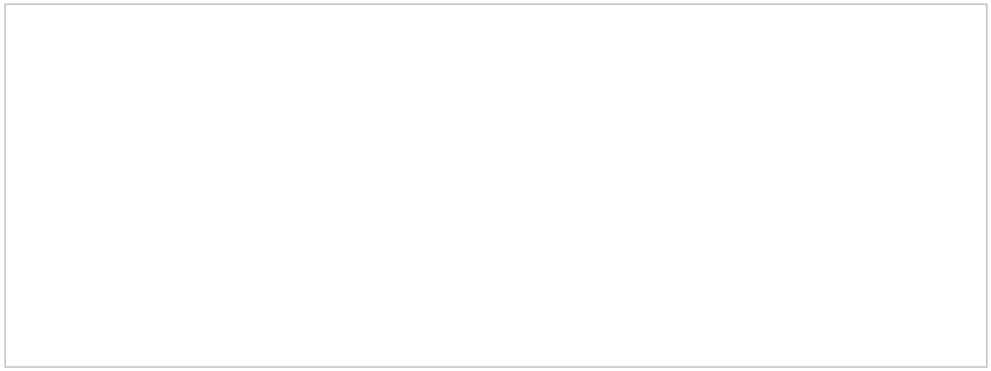


4.5.3 Installation of valves

7BMWFT TIPVME CF TFDVSFE BT EJSFDUMZ BT QPTTJCMF F H UP CSBDLFU PS XB
GPSDFT BSF USBOTNJUUFE EJSFDUMZ BOE OPU WJB UIF QJQFMJOF 7BMWF CSBDL
JOUFHSBUFE NPVOUJOH EFWJDF GSPN ('{1JQJOH 4ZTUFNT BSF VTFE GPS TFDVSFM
WBMWFT 5IF WBMWF CSBDLFUT BSF BMTP VTFE UP BDDFQU MPBET GSPN UIF WBM
QJQFMJOF "OZ DIBOHFT JO MFOHUI XIJDI BSJTF DBO CF LFQU GSPN UIF WBMWF X
ÌYFE QPJOUT CFGPSF PS BGUFS UIF WBMWF

Installing pipework under plaster or embedding it in concrete padded piping systems

8IFSF QJQJOH TZTUFNT BSF JOTUBMMFE VOEFS QMBTUFS PS FNCFEEFE JOUP DPO
TFDUJPOT BU CFOET BOE CSBODIFT NVTU CF QBEEFE GPS UIF DBMDVMBUFE EJTU
CSBODIFT BOE FMCPXT JODMVEFE JO UIF BËFDUFE TFDUJPO



5IF BTTJHOFE UFF PS FMCPX QJFDFT NVTU CF JODMVEFE JO UIF DVTIJPOJOH 0O
TVDI BT HMBTT XPPM SPDL XPPM GPBNFE QMBTUJD PS TJNJMBS NBZ CF VTFE GP

Non-padded pipe

1MBTUJD QJQF DBO BMTP CF QMBTUFSFE PS DPODSFUFE JO EJSFDUMZ 4JODF UIP
JOUFSOBM QSFTTVSF JT IBMG BT HSFBU BT UIF DJSDVNGFSFOUJBM TUSFTT QJQJ
MJNJUFE BEEJUJPOBM BYJBM TUSFTT XJUIPVU CFDPNJOH PWFSMPBEFE *O UIFTF
TUSFTT FYQFDUFE NVTU CF DBMDVMBUFE 5IF TBNF JT USVF PG BOZ TFDUJPO PG
QPJOUT XIFSF OP BMMPXBODF IBT CFFO NBEF GPS DIBOHFT JO MFOHUI 5IF MPBE
NVTU CF DBMDVMBUFE BOE DPOTJEFSFE XIFO QMBOOJOH UIF ÌYFE QPJOUT 5IF E
CSBDLFUT JO TVDI DBTFT NBZ IBWF UP CF SFEVDFE GSPN UIF OPSNBM WBMVFT JO
CPXJOH JO UIF QJQFMJOF

$BSF NVTU CF UBLFO UP BWPJE DSFBUJOH DBWJUJFT XIFO QMBTUFSJOH PS DPOD
CFDBVTF VOEFS VOGBWPSBCMF DPOEJUJPOT UIFTF DBO CFDPNF BSFBT PG TUSFT
QMBTUFS NJYUVSF UP TIPVME CF VTFE UP BMMPX UIF GPSDFT BSJTJOH GS
WBSJBUJPOT UP CF USBOTNJUUFE BXBZ XJUIPVU DBVTJOH UIF QMBTUFS UP DSBD

4.6 Pipe clamping distance and fastening of installation of pipe

4.6.1 Overview

Installation of plastic pipe

1MBTUJD QJQF TIPVME CF JOTUBMMFE VTJOH TVQQPSUT EFTJHOFE GPS VTF XJUI
CF JOTUBMMFE UBLJOH DBSF OPU UP EBNBHF PS PWFSTUSFTT UIF QJQF

Arranging loose brackets

" MPPTF CSBDLFU JT B QJQF CSBDLFU XIJDI BMMPXT BYJBM NPWFNFOU PG UIF QJ
stress-free compensation of temperature changes and compensation of any other operating condition changes.

.PWFNFOU PG UIF QJQF CSBDLFU	1JQF CSBDLFU JT NPVOUFE PO UIF QJQF CSBDLFU TVSGBDF	5IF QJQF JO UIF CSBDLFU TIPVME CF MBSHFS UIBO UIF PVUFS EJBNFU

5IF JOOFS EJBNFUFS PG UIF CSBDLFU TIPVME CF MBSHFS UIBO UIF PVUFS EJBNFU
BMMPX GSFF NPWFNFOU PG UIF QJQF 5IF JOOFS FEHFT PG UIF CSBDLFUT TIPVME
TIBSQ DPOUPVST UP BWPJE EBNBHJOH UIF QJQF TVSGBDF "OPUIFS NFUIPE JT UP
TQBDFST JO UIF CPMUT XIJDI BMTP BWPJET DMBNQJOH UIF CSBDLFU PO UIF QJQF

4QBDFST QSFWFOU DMBNQJOH UIF QJQF

5IF BYJBM NPWFNFOU PG UIF QJQJOH NBZ OPU CF IJOEFSFE CZ ÌUUJOHT BSSBOHI
CSBDLFU PS PUIFS EJBNFUFS DIBOHFT

4MJEJOH CSBDLFUT BOE IBOHJOH CSBDLFUT QFSNJU UIF QJQF UP NPWF JO EJËFS
"UUBDIJOH B TMJEJOH CMPDL UP UIF CBTF PG UIF QJQF CSBDLFU QFSNJUT GSFF
BMPOH B ÍBU TVQQPSUJOH TVSGBDF 4MJEJOH BOE IBOHJOH CSBDLFUT BSF OFFE
UIF QJQFMJOF DIBOHFT EJSFDUJPO BOE GSFF NPWFNFOU PG UIF QJQF NVTU CF B

Arranging xed points

" ÌYFE QJQF CSBDLFU JT B CSBDLFU XIJDI QSFWFOUT UIF QJQF GSPN NPWJOH JO
QVSQPTF PG B ÌYFE QPJOU JT UP DPOUSPM TZTUFN TUSFTTFT DBVTFE CZ UFNQFS

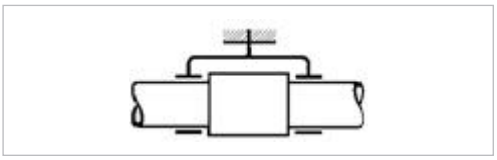
⚠ Fixed point design

5IF QJQF NVTU OPU CF ÌYFE CZ DMBNQJOH JU JO-UIF QJQF CSBDLFU 5IJT DBO
UJPO BOE QIZTJDBM EBNBHF UP UIF QJQF EBNBHF UIBU TPNFUJNFT EPFT OPU
WFSZ NVDI MBUFS

If it is necessary to restrict the length change of the pipe at both ends – as it is usually
UIF DBTF UIFO UIF QJQF CSBDLFU TIPVME CF BSSBOHFE CFUXFFO UXP ÌUUJO
BT B EPVCMF CSBDLFU UXP TJEFE ÌYFE QPJOU

1MBDJOH B QJQF CSBDLFU JNNFEJBUFMZ BEKBDFOU UP B ÌUUJOH SFTUSJDUT N
DIBOHFT JO MFOHUI UP POF EJSFDUJPO POF TJEFE ÌYFE QPJOU

One-sided xed point



Two-sided xed point

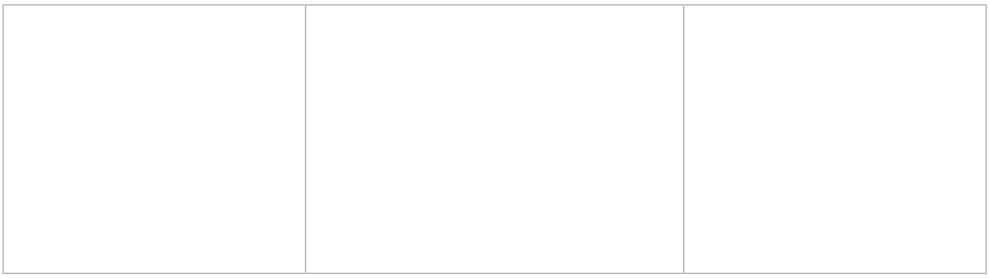
⚠ Pipe brackets must be robust and mounted rmly to be able to take up the forces arising from changes in length in the pipeline. Hanging brackets or KLIP-IT pipe brackets are unsuitable for use as xed points.

KLIP-IT pipe brackets

5IFTF SPCVTU QMBTUJD QJQF CSBDLFUT DBO CF VTFE OPU POMZ VOEFS SJHPSPV
CVU BMTP XIFSF UIF QJQFXPSL JT TVCKFDU UP BHHSFTTJWF NFEJB PS BUNPTQIFS
CSBDLFUT BOE QJQF DMBNQT GSPN ('{1JQJOH 4ZTUFNT BSF TVJUBCMF GPS BMM Q

%P OPU VTF ,-*1 *5 QJQF CSBDLFUT BT ÌYFE QPJOUT

4UBSUJOH GSPN UIF EJNFOTJPO E UIF ,-*1 *5 CSBDLFUT NVTU CF JOTUBMMFE T
JO UIF GPMMPXJOH BTTFNCMZ FYBNQMFT 5IF TVQQPSU EJTUBODFT MJTUFE JO TI
1JQF CSBDLFU TQBDJOH GPS "## QJQF ,-*1 *5 QJQF DMBNQT BQQMZ POMZ U
this mounting method.



Pipe brackets for post-insulated piping systems

4QFDJBM JOTVMBUJPO DMBNQT BSF PËFSFE GPS QJQJOH XIJDI JT JOTVMBUFE BG
DMBNQT TIBMM CF JOTUBMMFE BDDPSEJOH UP UIF DMBNQ NBOVGBDUVSFSnT JOTU

Using the tables for pipe bracket spacing

1MBTUJD QJQJOH TZTUFNT OFFE UP CF TVQQPSUFE BU DFSUBJO JOUFSWBMT EFQ
GBDUPST UIF NBUFSJBM UIF BWFSBHF QJQF XBMM UFNQFSBUVSF UIF EFOTJUZ
USBOTQPSUFE BOE UIF TJ[F BOE XBMM UIJDLOFTT PG UIF QJQF %FUFSNJOJOH UI
QJQF CSBDLFUT JT CBTFE PO UIF QFSNJTTJCMF EFÍFDUJPO PG UIF QJQF CFUXFFO
CSBDLFUT

1JQF XIJDI BSF ÌYFE JO UIF BYJBM EJSFDUJPO ÌYFE JOTUBMMBUJPO NVTU CF DI
NPTU DBTFT UIJT MFBET UP B SFEVDUJPO PG NBYJNVN JOOFS QSFTTVSF BT XFMI
CFUXFFO UIF TVQQPSU CSBDLFUT 'VSUIFSNPSF UIF GPSDFT XIJDI BDU PO UIF ÌY
UBLFO JOUP DPOTJEFSBUJPO

4.6.2 Pipe bracket spacing for ABS pipe

Liquids with a density of 1 g/cm³

d (mm)	DN (Inch)	Pipe bracket spacing L for pipe PN10 / SDR17 / S8 or Class C (mm)				
		20 °C	30 °C	40 °C	50 °C	60 °C
	1				550	
20	½	800				500
25	¾	850	800			
32	1	1000	900	850		
	1¼	1100	1000	950	850	
50	1½	1150	1100	1000	900	800
	2	1300	1200	1100	1000	850
	2½	1500	1350	1200	1100	950
90	3			1350	1200	1050
110		1800		1550	1350	1200
	5	2050	1800			1250
		2200	1850			1300
200		2300	2050	1850	1550	1350
225	8		2200	1900		
250	9	2500	2300	2000		1500
280	10			2100		
315	12	2800	2500	2200	1800	

'PS PUIFS 4%3 1/ WBMVFT PS DMBTTFT NVMUJQMZ UIF WBMVFT HJWFO JO UIF U
GBDUPS

- q 4%3 VOE 1/
- q ,MBTTF #
- q ,MBTTF %
- q ,MBTTF &

5IF QJQF CSBDLFU TQBDJOH HJWFO JO UIF UBCMF NBZ CF JODSFBTFE CZ JO U
QJQF SVOT J F NVMUJQMZ UIF WBMVFT HJWFO CZ

Liquids with a density other than 1 g/cm³

*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ PUIFS UIBO H DNŽ UIFO UIF UIF UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPX EJËFSFOU TVQQPSU TQBDJOHT

Density of medium (g/cm³)	Type of medium	Factors for bracket spacing
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	1.30

COOL-FIT ABS Plus pipe

d (mm)	Bracket spacing L (mm)
25	1550
32	1550
50	
	1900
90	2050
110	2200
	2550
200	3050
225	3300
250	3300
280	
315	3800

4.6.3 Bracket spacing for PE pipe

Liquids with a density of 1 g/cm³

d (mm)	Bracket spacing L for SDR11 pipe (mm)				
	20 °C	30 °C	40 °C	50 °C	60 °C
	500				350
20		550	500		
25			550	550	500
32					550
	900	850			
50	1050	1000	900	850	
	1200	1150	1050	1000	900
	1350	1300	1200	1100	1000
90	1500		1350	1250	1150
110			1500		1300
125				1550	
	1900	1850			1500
	2050	1950	1850		
180	2150	2050	1950	1850	
200	2300	2200	2100	2000	1900
225		2350	2250	2150	2050
250		2500		2300	2100
280			2550		2200
315	2900	2800		2550	2350
355	3100	3000	2900		2550
	3300	3150	3050	2900	
	3550		3300	3100	2900
500	3900		3500	3350	3100

'PS PUIFS 4%3 WBMVFT NVMUJQMZ UIF WBMVFT CZ UIF GPMMPXJOH GBDUPST

- q 4%3 VOE 4%3
- q 4%3

5IF QJQF CSBDLFU TQBDJOH HJWFO JO UIF UBCMF NBZ CF JODSFBTFE CZ JO U QJQF SVOT J F NVMUJQMZ UIF WBMVFT HJWFO CZ

Liquids with a density other than 1 g/cm³

*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ PUIFS UIBO H DNŽ UIFO UIF UIF UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPX EJËFSFOU TVQQPSU TQBDJOHT

Density of medium (g/cm³)	Type of medium	Factors for bracket spacing
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	1.30 for SDR11
		GPS 4%3

4.6.4 Bracket spacing for PP pipe

PP-H pipe for liquids with a density of 1 g/cm³

d (mm)	Bracket spacing L for SDR11 pipe (mm)						
	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
					550	525	500
20							550
25	800						
32	950	925	900		850	800	
	1100		1050	1000	950	925	
50	1250	1225	1200	1150	1100	1050	1000
				1350	1300	1250	1200
	1550	1500			1350	1300	1250
90			1550	1500			1350
110	1850	1800				1500	
125	2000	1950	1900	1800			1500
	2100	2050	2000	1900	1800		
	2250	2200	2100	2000	1900	1800	
180	2350	2300	2200	2100	2000	1900	1800
200	2500		2300	2200	2100	2000	1900
225		2550		2350	2250	2150	2000
250	2800			2500		2300	2150
280	2950	2850			2550		2300
315	3150	3050	2950	2850			
355	3350	3250	3150	3000	2850		
	3550		3350	3200	3050	2900	
	3800				3300	3100	2950
500			3850		3500	3350	3150

'PS PUIFS 4%3T NVMUJQMZ UIF WBMVFT HJWFO JO UIF UBCMF CZ UIF GPMMPXJOH
q 4%3 BOE 4%3

5IF QJQF CSBDLFU TQBDJOH HJWFO JO UIF UBCMF NBZ CF JODSFBTFE CZ JO U
QJQF SVOT J F NVMUJQMZ UIF WBMVFT HJWFO CZ

PP-H pipe for liquids with a density other than 1 g/cm³

*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ OPU FRVBM H DNŽ UIFO UIF
UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPXJOH
support spacings.

Density of medium (g/cm³)	Type of medium	Type of medium
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	1.30 for SDR11
		GPS 4%3 BOE 4%3

PP-R pipe for liquids with a density of 1 g/cm³

d (mm)	Bracket spacing L for SDR11 pipe (mm)						
	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
	500						
20	525	500	500				
25				550	525	500	500
32							
	825	800	800				
50	950	925	900		825		
	1100		1050	1025		925	900
	1150	1150	1100	1050	1000		950
90	1250	1200	1150	1150	1100	1050	1000
110		1350	1300	1300	1200	1125	1050
125	1500			1350	1300	1200	1150
		1550	1500		1350		1200
				1500		1350	1300
180					1500		1350
200	1900	1800				1500	
225	2000	1900	1850				1500
250	2100	2050	1950	1900	1800		
280	2950	2850			2550		2300
315	2350	2300	2200	2150	2050	1950	1850
355	2500		2350	2250	2125	2050	1950
			2500				2050
	2850					2325	2200
500		3000				2500	2350

'P S P U I F S 4 % 3 T N V M U J Q M Z U I F W B M V F T H J W F O J O U I F U B C M F C Z U I F G P M M P X J O H
q 4 % 3 B O E 4 % 3

5 I F Q J Q F C S B D L F U T Q B D J O H H J W F O J O U I F U B C M F N B Z C F J O D S F B T F E C Z J O U
Q J Q F S V O T J F N V M U J Q M Z U I F W B M V F T H J W F O C Z

PP-R pipe for liquids with a density other than 1 g/cm³

* G U I F M J R V J E U P C F U S B O T Q P S U F E I B T B E F O T J U Z O P U F R V B M H D N Ž U I F O U I F
U B C M F B C P W F T I P V M E C F N V M U J Q M J F E C Z U I F G B D U P S H J W F O J O U I F G P M M P X J O H
support spacings.

Density of medium (g/cm³)	Type of medium	Factors for bracket spacing
1.00	8 B U F S	1.00
1.25	0 U I F S N F E J B	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	1.30 for SDR11 G P S 4 % 3 B O E 4 % 3

4.6.5 Bracket spacing for PVC pipe

PVC-U pipe for liquids with a density of 1 g/cm³

d (mm)	DN (Inch)	Bracket spacings L for pipe SDR21 / S10 / PN10 (mm)				
		20 °C	30 °C	40 °C	50 °C	60 °C
	1	950	900	850		
20	½	1100	1050	1000	900	
25	¾	1200	1150	1050	950	
32	1	1350	1300	1250	1100	900
	1¼			1350	1250	1000
50	1½		1550	1500		1150
	2	1800			1550	1300
	2½	2000	1900	1850		
90	3	2200	2100	2000	1850	1550
110			2300	2250	2050	
125	-	2550			2200	1850
	5			2500	2300	1950
		2900	2800		2500	2100
180	-	3100	2950	2850		2200
200	-	3250	3150	3000	2800	2350
225	8		3300	3200	2950	2500
250	-		3500	3350	3100	
280	10			3550	3300	
315	12		3900		3500	2950
355						3100
					3950	3300

'PS PUIFS 4%3 BOE 1/ MFWFMT UIF WBMVFT NVTU CF NVMUJQMJFE XJUI UIF GPMM

q 4%3 4 1/

q 4%3 4 1/

q 4%3 4 1/

q 4%3 4 1/

5IF QJQF CSBDLFU TQBDJOH HJWFO JO UIF UBCMF NBZ CF JODSFBTFE CZ JO U
QJQF SVOT J F NVMUJQMZ UIF WBMVFT HJWFO CZ

PVC-U pipe for liquids with a density other than 1 g/cm³

*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ PUIFS UIBO H DNŽ UIFO UIF
UIF UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPX
EJËFSFOU TVQQPSU TQBDJOHT

Type of medium	Type of medium	Factors for bracket spacing
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	G×S 4%3 4 VOE 1/
		G×S 4%3 4 VOE 1/
		G×S 4%3 4 VOE 1/

PVC-C pipe for liquids with a density of 1 g/cm³

d (mm)	Bracket spacing L for pipe SDR21 / S10 / PN10 (mm)						
	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C
	1000	950	900	850			
20	1150	1100	1025	950			
25	1200	1150	1100	1000	900	800	
32	1350	1250	1200	1100	1000	900	800
	1500		1300	1250	1150	1050	900
50			1500		1300	1200	1100
	1850				1500	1350	1250
	2050	1950	1850			1500	1350
90	2250	2100	2000	1900	1800		1500
110	2500	2350	2200	2100	1950	1800	
125		2500	2350	2250	2100	1950	
	2800		2500	2350	2200	2050	1850
	3000	2850		2550		2200	2000
180	3150	3000	2850		2500	2300	2100
200	3350	3150	3000	2850			2200
225	3550	3350	3200	3000	2800		2350
250		3550	3350	3150	3000		2500
280	3950		3550	3350	3150	2900	
315				3550	3350	3050	2800
350				3800	3550	3250	2950
							3150

'PS PUIFS 4%3 MFWFMT UIF WBMVFT NVTU CF NVMUJQMJFE CZ UIF GPMMPXJOH G
q 4%3 4 1/
q 4%3 4 1/

5IF QJQF CSBDLFU TQBDJOH HJWFO JO UIF UBCMF NBZ CF JODSFBTFE CZ JO U
QJQF SVOT J F NVMUJQMZ UIF WBMVFT HJWFO CZ

PVC-C pipe for liquids with a density other than 1 g/cm³

*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ OPU FRVBM H DNŽ UIFO UIF
UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPXJOH
support spacings.

Density of medium (g/cm³)	Type of medium	Factors for bracket spacing
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	GPS 4%3 4 BOE 1/
		GPS 4%3 4 BOE 1/
		GPS 4%3 4 BOE 1/

4.6.6 Bracket spacing for PVDF pipe

Liquids with a density of 1 g/cm³

d (mm)	Bracket spacings L for pipe PN16 / SDR21 (mm)									
	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C	100 °C	120 °C	140 °C
						550	500			300
20	850	800						500		
25	950	900	850	800					500	
32	1100	1050	1000	950	900	850	800			500
	1200	1150	1100	1050	1000	950	900			550
50		1350	1300	1200	1150	1100	1000	900		

d (mm)	Bracket spacings L for pipe PN10 / SDR33 (mm)									
	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C	100 °C	120 °C	140 °C
		1350	1300	1250	1200	1150	1100	950	800	
	1500			1350	1300	1250	1200	1050	850	
90		1550	1500			1350	1300	1100	950	850
110	1800				1550	1500		1250	1100	950
125	1900	1850	1800				1500	1350	1200	1000
	2000	1950	1900	1800					1250	1050
	2150	2100	2050	1950	1850	1800		1550	1350	1150
180	2300	2200	2150	2050	1950	1900	1800			1200
200		2350	2250	2150	2100	2000	1900		1500	1300
225	2550	2500		2300	2200	2100	2000	1800		
250			2500		2300	2200	2100	1900		1500
280	2850			2550		2350	2250	2000	1800	
315	3000	2950	2850			2500		2150	1900	
355	3200	3100	3000	2850			2500	2250	2000	
		3300	3200	3050	2950	2800			2100	1800
		3550		3300	3200	3000	2850		2250	1900

'PS PUIFS 1/ BOE 4%3 MFWFMT UIF WBMVFT JO UIF UBCMF BCPWF EJBNFUFS È E
NVMUJQMJFE CZ UIF GPMMPXJOH GBDUPST
q 1/ 4%3

1JQF CSBDLFU TQBDJOH GPS MJOFT SVOOJOH WFSUJDBMMZ DBO CF JODSFBTFE C
WBMVFT JO UIF UBCMF J F UBCMF WBMVFT NVMUJQMJFE CZ

Liquids with a density other than 1 g/cm³

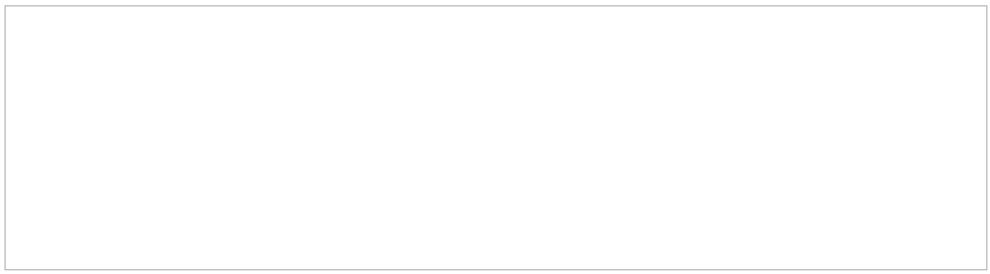
*G UIF MJRVJE UP CF USBOTQPSUFE IBT B EFOTJUZ OPU FRVBM H DNŽ UIFO UIF
UBCMF BCPWF TIPVME CF NVMUJQMJFE CZ UIF GBDUPS HJWFO JO UIF GPMMPXJOH
support spacings.

Density of medium (g/cm³)	Type of medium	Factors for bracket spacing
1.00	8BUFS	1.00
1.25	0UIFS NFEJB	
1.50		0.92
		0.88
2.00		
Ç	Gaseous media	G×S 4%3 VOE 1/
		G×S 4%3 VOE 1/

4.6.7 Bracket spacing for plastic pipe in carriers

$POUJOVPVT TVQQPSU NBZ CF NPSF FDPOPNJDBM BOE QSBDUJDBCMF UIBO QJQF IPSJ[POUBM PS WFSUJDBM QJQJOH TZTUFNT FTQFDJBMMZ GPS TNBMM EJBNFUFS high temperatures.

*O PSEFS UP BWPJE JOBENJTTJCMF MPBEJOHT PO UIF QJQJOH TZTUFNT FOTVSF UIF DBSSJFST JO UIF QJQF CSBDLFUT PWFSMBQ



Carriers, diameter (d) matched to pipe diameter, length (L) of carrier

5IF GPMMPXJOH UBCMF JOEJDBUFT UIF TVQQPSU TQBDJOHT XIFO VTJOH DBSSJFS regardless of the type of pipe material or the temperature.

d (mm)	Support spacing when using carriers (mm)
20	
25	1900
32	2000
	2150
50	2300
	2500
90	
110	2900

4.7 Internal pressure and leak test

4.7.1 Introduction to pressure testing

Overview of the di erent testing methods

Testing method	Internal pressure test		Leak test		
Medium	8 B U F S	Gas[1]	$ P N Q S F T T J C M F	$ P N Q S F T T J C M F	$ P N Q S F T T J C M F
5 Z Q F	Incompressible	$ P N Q S F T T J C M F	$ P N Q S F T T J C M F	$ P N Q S F T T J C M F	$ P N Q S F T T J C M F
5 F T U Q S F T T V S F P W F S Q S F T T V S F	$p_{p\,(perm)}$ or $q_{p\,(perm)}$	0 Q F S B U Q S F T T V S F + 2 bar	0 Q F S B U Q S F T T V S F + 2 bar	0.5 bar	1.5 bar
) B [B S E Q P U F - P X J B M during pressure test	- P X	High	High	- P X	Medium
Material	" M M Q M B T U J D	T# 4 1 &	1 # 1 &	" M M Q M B T U	J# 4 T
* O G P S N B U J W F H W B M V F	) F H W B M V F Proof of resistance to pressure including tightness against test medium	) J H I Proof of resistance to pressure including tightness against test medium	) J H I Proof of resistance to pressure including tightness against test medium	- P X	Medium

[1] 0 C T F S W F U I F B Q Q M J D B C M F T B G F U Z Q S F D B V U J P O T . P S F J O G P S N B U J P O J T B W B addendum 2.

" O V N C F S P G J O U F S O B U J P O B M B O E O B U J P O B M T U B O E B S E T B O E H V J E F M J O F T B S F Q S F T T V S F U F T U T 5 I F S F G P S F J U J S P G U F O O P U F B T Z U P Ì O E U I F B Q Q M J D B C M F U F Y B N Q M F U I F U F T U Q S F T T V S F

5 I F Q V S Q P T F P G B Q S F T T V S F U F T U J S

- & O T V S F U I F S F T J S T U B O D F U P Q S F T T V S F P G U I F Q J Q F M J O F B O E
- 4 I P X U I F M F B L U J H I U O F T T B H B J O T U I F U F T U N F E J V N

6 T V B M M Z U I F J O U F S O B M Q S F T T V S F U F T U J S E P O E B S B X B U F S Q S F T T V S F U F T U B C D B T F T V O E F S D O O T J E F S B U J P O P G T Q F D J B M T B G F U Z Q S F D B V U J P O T B S B H B T Q S nitrogen.

5 I F G P M M P X J O H D O N Q B S J T O B U U F N Q U T U P Q P J O U P V U U I F E J Ë F S F O D F C F U X F F O N F E J V N

8 B U F S J S B O J O D O N Q S F T T J C M F N F E J V N J F T F U U J O H B N 1 7 % ' Q J Q F X J U I B E V O E F S B Q S F T T V S F P G C B S F T V M U S J O B N D O N Q S F T T J C M F N F E J V N 5 I F S B N F Q J Q F X J U I U F T U Q S F T T V S F P G C B S B M S F F O F S H Z P G K P V M F * G U I F S F X F S E B G B J M V S E V S J O H U I F J O U F S O B M Q S F X B U F S Ì M M F E Q J Q F X P V M E K V N Q V Q N U I F B J S Ì M M F E Q J Q F N

Fracture behavior of plastics

* O D B T F P G B G B J M V S F U I F S N P Q M B T U J D N B U F S J B M S T I P X E J Ë F S F O U C F I B W J P S T F Y I J C J U B E V D U J M F C F I B W J P S B O E " # 4 T M J H I U M Z M P X F S T P U I B U C S J U U M F G S B

/ F W F S U I F M F S S U I F G P M M P X J O H T B G F U Z Q S F D B V U J P O S N V T U C F U B L F O J O U P D P O J O U F S O B M Q S F T T V S F U F T U " T N F O U J P O F D C F G P S F U I F Q S F T T V S F U F T U J S U I F Ì S U I F Q J Q F M J O F B O E J S J O U F O E E D U P V O D P W F S B O Z F Y J S T U J O H Q S P D F T T J O H G B V M fusioning).

(B S M F B L U J H I U O F S S D B O O P U C F E F N P O S T U S B U F D C Z B X B U F S Q S F S T T V S F U F T U O P U F T Q S F T T V S F

4.7.2 Internal pressure test with water or a similar incompressible test medium

Overview

5IF JOUFSOBM QSFTTVSF UFTU JT EPOF XIFO JOTUBMMBUJPO XPSL IBT CFFO DPN
QSFTVQQPTFT BO PQFSBUJPOBM QJQFMJOF PS PQFSBUJPOBM UFTU TFDUJPOT 5I
JOUFOEFE UP GVSOJTI FYQFSJNFOUBM QSPPG PG PQFSBUJPOBM TBGFUZ 5IF UFT
PO UIF PQFSBUJPOH QSFTTVSF CVU SBUIFS PO UIF JOUFSOBM QSFTTVSF MPBE DB
QJQF XBMM UIJDLOFTT

"EEFOEVN PG %74 GPSNT UIF CBTJT GPS UIF GPMMPXJOH JOGPSNBUJPO 5I
EBUB JO %74 FOUJSFMZ 5IF NPEJÌDBUJPOT CFDBNF OFDFTTBSZ CFDBVTF UI
WBMVF OPNJOBM QSFTTVSF 1/ JT CFJOH VTFE MFTT BOE MFTT UP EFUFSNJOF
{Y 1/ PS Y 1/ BOE JT CFJOH SFQMBDFE CZ 4%3 *O BEEJUJPO B TIPSU UFS
B SFEVDUJPO JO UIF TFSWJDF MJGF DBO PDDVS JG UIF QJQF XBMM UFNQFSBUVSF
NPSF UIBO ‹$ JO UIF DPVSTF PG UIF JOUFSOBM QSFTTVSF UFTU CBTFE PO UIF O

5FTU QSFTTVSFT BSF UIFSFGPSF EFUFSNJOFE JO SFMBUJPO UP 4%3 BOE UIF QJ
5IF I WBMVF GSPN UIF MPOH UFSN CFIBWJPS EJBHSBN JT VTFE GPS UIF UFTU

Test parameters

5IF GPMMPXJOH UBCMF QSPWJEFT SFDPNNFOEFE NFUIPET GPS QFSGPSNJOH UIF
test.

Object	Pre-test	Main test
5FTU QSFTTVSF (depends on the QJQF XBMM UFNQFSBUVSF BOE UIF permissible test pressure of the CVJMU JO DPNQPOFOUT TFF UIF TFDUJPO %FUFSNJOJOH UIF UFTU QSFTTVSF	Ç p (perm)	Ç p (perm)
5FTU EVSBUJPO EFQFOET PO UIF MFOHUI of the pipeline sections)	Ç N - Ç N I	Ç N I N - Ç N I
$IFDL UIF UFTU QSFTTVSF and temperature progression must be recorded)	EJTUSJCVUFE PWFS UIF UFTU EVSBUJPO XJUI UIF UFTU QSFTTVSF BU UIF UFTU QSFTTVSF	EJTUSJCVUFE PWFS UIF UFTU EVSBUJPO XJUI UIF UFTU QSFTTVSF BU UIF UFTU QSFTTVSF

Pre-test

5IF QSF UFTU TFSWFT UP QSFQBSF UIF QJQJOH TZTUFN GPS UIF BDUVBM UFTU N
PG QSF UFTUJOH B UFOTJPO FYQBOTJPO FRVJMJCSJVN JO SFMBUJPO UP BO JOD
EFWFMPQ JO UIF QJQJOH TZTUFN " NBUFSJBM SFMBUFE ESPQ JO QSFTTVSF XJMM
SFRVJSF SFQFBUFE QVNQJOH UP SFTUPSF UIF UFTU QSFTTVSF BOE BMTP GSFRVF
UIF ÍBOHF DPOOFDUJPO CPMUT

5IF HVJEFMJOFT GPS BO FYQBOTJPO SFMBUFE QSFTTVSF EFDSFBTF JO QJQF BSF

Material	Pressure drop (bar/h)
17$ 6	0.5
17$ $	0.5
"#4	
PP	0.8
PE	1.2
PB	
17%'	0.8

Main test

*O UIF DPOUFYU PG UIF NBJO UFTU B NVDI TNBMMFS ESPQ JO QSFTTVSF DBO CF
QJQF XBMM UFNQFSBUVSFT TP UIBU JU JT OPU OFDFTTBSZ UP QVNQ BHBJO 5IF D
QSJNBSJMZ PO MFBL EFUFDUJPO BU UIF ÍBOHF KPJOUT BOE BOZ QPTJUJPO DIBOH

Observe if using compensators

*G UIF QJQFMJOF UP CF UFTUFE DPOUBJOT DPNQFOTBUPST JU IBT BO JOÍVFODF
GPSDFT PO UIF ÌYFE QPJOUT PG UIF QJQFMJOF #FDBVTF UIF UFTU QSFTTVSF JT
PQFSBUJOH QSFTTVSF UIF BYJBM GPSDFT PO UIF ÌYFE QPJOUT JODSFBTF QSPQP
CF UBLFO JOUP BDDPVOU XIFO EFTJHOJOH UIF ÌYFE QPJOUT

Observe if using valves

8IFO VTJOH B WBMWF BU UIF FOE PG B QJQFMJOF FOE PS ÌOBM WBMWF UIF WBM
TIPVME CF DMPTFE CZ B EVNNZ ÍBOHF PS DBQ 5IJT QSFWFOUT BO JOBEWFSUFOU
BOE FYJU PG UIF NFEJVN PS BOZ QPMMVUJPO PG UIF JOTJEF PG UIF WBMWF

4.7.3 Filling the pipeline

#FGPSF TUBSUJOH XJUI UIF JOUFSOBM QSFTTVSF UFTU UIF GPMMPXJOH QPJOUT

- 8BT JOTUBMMBUJPO EPOF BDDPSEJOH UP UIF BWBJMBCMF QMBOT
- "MM QSFTTVSF SFMJFG EFWJDFT BOE ÍBQ USBQT NPVOUFE JO UIF ÍPX EJSFDUJP
- "MM FOE WBMWFT TIVU
- 7BMWFT JO GSPOU PG PUIFS EFWJDFT BSF TIVU UP QSPUFDU BHBJOTU QSFTTVS
- 7JTVBM JOTQFDUJPO PG BMM KPJOUT QVNQT NFBTVSFNFOU EFWJDFT BOE UBO
-)BT UIF XBJUJOH QFSJPE BGUFS UIF MBTU GVTJPO DFNFOUJOH CFFO PCTFSWFE

/PX UIF QJQFMJOF DBO CF ÌMMFE GSPN UIF HFPEFUJD MPXFTU QPJOU 4QFDJBM E
HJWFO UP UIF BJS WFOU *G QPTTJCMF WFOUT TIPVME CF QSPWJEFE BU BMM UIF
BOE UIFTF TIPVME CF PQFO XIFO ÌMMJOH UIF TZTUFN 'MVTIJOH WFMPDJUZ TIPVM

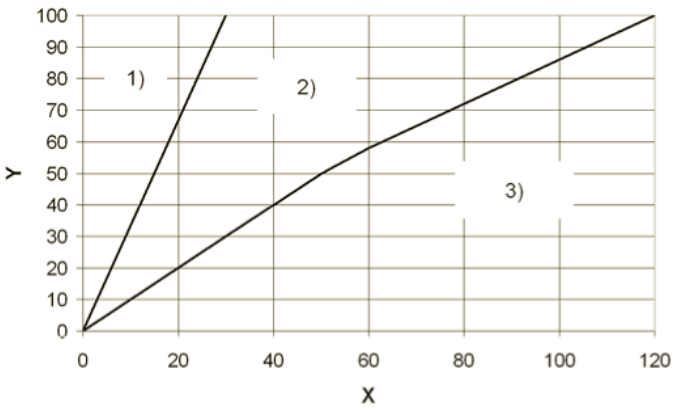
3FGFSFODF WBMVFT GPS UIF ÌMMJOH WPMVNF BSF HJWFO JO UIF UBCMF CFMPX

DN (mm)	V (l/s)	DN (mm)	V (l/s)
Ç	0.15	250	2.0
100	0.3	300	3.0
150			
200	1.5	500	

"EFRVBUF UJNF TIPVME CF BMMPXFE CFUXFFO ÌMMJOH BOE UFTUJOH UIF QJQFMJ
DPOUBJOFE JO UIF QJQJOH TZTUFN DBO FTDBQF WJB UIF WFOUT BQQSPY I
nominal diameter.

Applying the test pressure

5IF UFTU QSFTTVSF JT BQQMJFE BDDPSEJOH UP UIF EJBHSBN)FSF JU JT JNQPSU
JODSFBTF SBUF EPFT OPU DBVTF BOZ XBUFS IBNNFSJOH



: 5FTU QSFTTVSF
9 5JNF GPS QSFTTVSF J
(min)
1) Pressure increase rate up to DN100 mm
2) Range of pressure increase SBUFT CFUXFFO %/ E %/ NN 7BMVFT GPS QSFTTVS increase rate DN500 and HSFBUFS JT %/ CBSNJO

Determining the test pressure

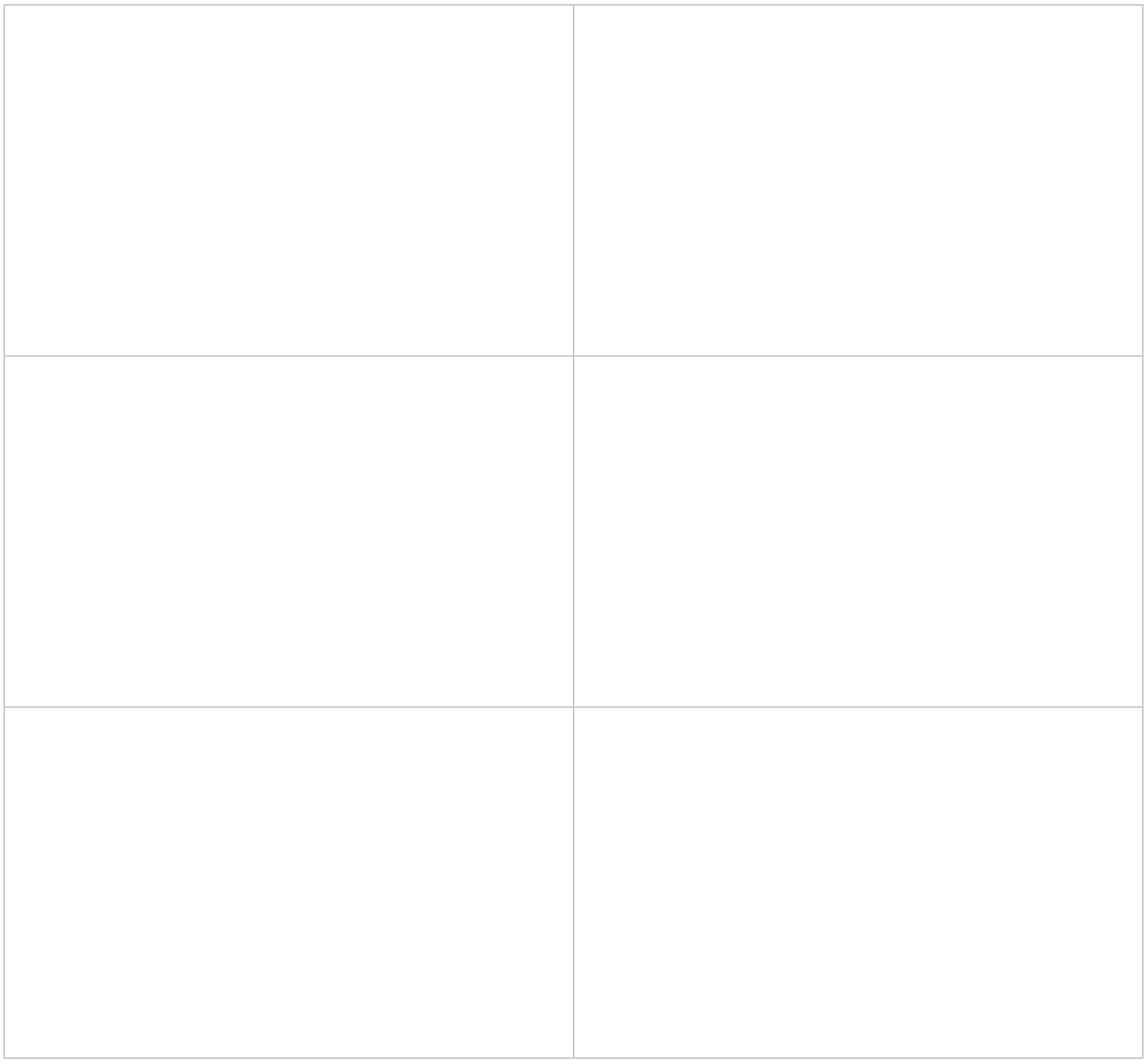
5IF QFSNJTTJCMF UFTU QSFTTVSF JT DBMDVMBUFE BDDPSEJOH UP UIF GPMMPXJO

$$P_{p(zul)} = \frac{1}{SDR} \cdot \frac{20}{S_p \cdot A_G} \cdot {}^{v(T,\,100\,h)}$$

VW 5 I-POH UFSN DSFFQ TUSFOHUI GRPSCEQJJQUF XBMMM UFNQFSBUVSF 5
Sp Minimum safety factor for long-term creep strength
"G 1SPDFTTJOH PS HFPNFUSZ TQFDJÌD GBDUPS UIBU SFEVDFT UIF BMMPXBCMF
5R 1JQF XBMM UFNQFSBUVSF BWFSBHF WBMVF PG UFTU NFEJVN UFNQFSBUVS
surface temperature

Material	S_p Minimum safety factor (ISO 12162)
" # 4	
1 & 1 &	1.25
PP-H	1.8
PP-R	
1 7 $ 61 7 $ $	2.5
1 7 % '	

To make things easier, the permissible test pressures can be taken directly from the following diagrams.



P Permissible test pressure (bar)
5 1JQF XBMM UFNQFSBUVSF ‹$

Checks during testing

5IF GPMMPXJOH NFBTVSFNFOU WBMVFT NVTU CF SFDPSEFE DPOTJTUFOUMZ EVSJ
q *OUFSOBM QSFTTVSF BU UIF BCTPMVUF MPXFTU QPJOU PG UIF QJQFMJOF
q Medium and ambient temperature
q 8BUFS WPMVNF JOQVU
q 8BUFS WPMVNF PVUQVU
q Pressure drop rates

4.7.4 Internal pressure test and leak-tightness test of ABS piping systems with gas/air as test medium (compressible medium)

Overview

6TVBMMZ UIF QSFTTVSF UFTU JT EPOF BT B XBUFS QSFTTVSF UFTU BOE POMZ JO
VOEFS DPOTJEFSBUJPO PG TQFDJBM TBGFUZ QSFDBVUJPOT BT B HBT QSFTTVSF

Compensators

*G UIF QJQFMJOF UP CF UFTUFE DPOUBJOT DPNQFOTBUPST JU IBT BO JOÍVFODF
GPSDFT PO UIF ÌYFE QPJOUT PG UIF QJQFMJOF #FDBVTF UIF UFTU QSFTTVSF JT
PQFSBUJOH QSFTTVSF UIF BYJBM GPSDFT PO UIF ÌYFE QPJOUT JODSFBTF QSPQP
CF UBLFO JOUP BDDPVOU XIFO EFTJHOJOH UIF ÌYFE QPJOUT

Valves

8IFO VTJOH B WBMWF BU UIF FOE PG B QJQFMJOF FOE PS ÌOBM WBMWF UIF WBM
TIPVME CF DMPTFE CZ B EVNNZ ÍBOHF PS DBQ 5IJT QSFWFOUT BO JOBEWFSUFOU
BOE FYJU PG UIF NFEJVN PS BOZ QPMMVUJPO PG UIF JOTJEF PG UIF WBMWF

Minimum waiting times for the internal pressure test

#FGPSF DBSSZJOH PVU UIF QSFTTVSF UFTU PCTFSWF UIF NJOJNVN XBJUJOH UJN
GPMMPXJOH UBCMF

Ambient temperature	Waiting time
‹$	.JO IPVST

Performing the internal pressure test

5IF UFTU QSFTTVSF TIBMM CF MFBTU CBS IJHIFS UIBO UIF PQFSBUJOH QSFTTVS
FYDFFE UIF OPNJOBM QSFTTVSF 1/ PG UIF JOTUBMMFE QJQJOH TZTUFN "OZ DPNC
1/ UIBO UIF SFTU PG UIF QJQJOH TZTUFNT IBWF UP CF UBLFO JOUP BDDPVOU 5IF
TIBMM CF CFUXFFO BOE ‹$

5IF QJQJOH TZTUFNT NVTU CF GSFF GSPN BOZ HSFBTF PS QBJOU

0OMZ PJM GSFF BJS PS JOFSU HBTFT TVDI BT OJUSPHFO TIPVME CF VTFE BT UIF
SFGSJHFSBOU HBTFT TVDI BT 3 NBZ CF VTFE

0ODF UIF QSFTTVSF JO UIF TZTUFN IBT TUBCJMJ[FE IPME UIF QJQFMJOF VOEFS U
BU MFBTU NJOVUFT *G B ESPQ JO QSFTTVSF JT PCTFSWFE JOTQFDU BMM UIF
MFBLT VTJOH B GPBN CVJMEJOH BHFOU " TPBQ TPMVUJPO XIJDI DBO CF SFNPWF
after the test is recommended.

⚠ Commercial leak detection sprays can cause stress cracks in plastics. If these sprays are used, remove any residues after testing.

⚠ The leak-tightness of valves against gases is not representative of the leak-tightness of valves against a liquid. Therefore, if a GF Piping Systems valve shows a leak during internal pressure testing with a gas, it is recommended to reduce the pressure to 1.5 bar and re-inspect the valves.

Leak-tightness test with gas/air

5P DIFDL UIF MFBL UJHIUOFTT TIPSUMZ BGUFS JOTUBMMBUJPO B UFTU QSFTTVSF
NJOJNVN XBJUJOH UJNF PG IPVST BGUFS UIF MBTU DFNFOUJOH BQQMJFT

4.7.5 Internal pressure test of compressed-air piping systems

Overview

'PS QSBDUJDBM SFBTPOT UIJT UFTUJOH JT EPOF XJUI DPNQSFTTFE BJS 5IF QSF
%7(8 (5IF QSFTTVSF UFTU GPS QJQFMJOF MFOHUIT MFTT UIBO N VTJOH BJ
WJTVBM JOTQFDUJPO JT EFTDSJDFE CFMPX .PSF EFUBJMT BSF BWBJMBCMF JO U

⚠ Compressible media like compressed air under internal pressure.

In case of failure: life-threatening danger during internal pressure testing due to explosive escape of the medium.

- J 5IF BSFB BSPVOE UIF QJQFMJOF VOEFS UFTU QSFTTVSF JT UP CF DMFBSMZ S BDDFTT POMZ CZ QFSTPOT BTTJHOFE XJUI UIF UFTUJOH
- J 3FRVJSFE DPOUSPM FRVJQNFOU JT UP CF QMBDFE BU B TBGF EJTUBODF
- J 5IF UFTUJOH TIPVME CF UJNFE TP UIBU UIFSF BSF BT GFX QFSTPOT BT QPTT JNNFEJBUF CMPDLFE PË BSFB
- J "EEJUJPOBM TJHOT F H %P /PU &OUFS PS 8BSOJOH (BT QSFTTVSF UFTUT QBSUJDVMBSMZ BU UIF FOUSBODFT UP UIF IB[BSE BSFB *G OFDFTTBSZ QFS neighboring buildings should be informed.

Testing procedure

5IF UFTU QSFTTVSF TIBMM CF MFBTU CBS IJHIFS UIBO UIF QFSNJTTJCMF PQFSB JT OPU QPTTJCMF CFDBVTF PG JOTVÎDJFOU DPNQSFTTPS PVUQVU UIFO UIF NBYJ pressure shall be used.

5IF QJQJOH TZTUFNT NVTU CF GSFF GSPN BOZ HSFBTF PS QBJOU

5IF UFTU QSFTTVSF JT BQQMJFE UP UIF JOTUBMMFE QJQFMJOF XJUI B NBYJNVN J CBS NJO SJTL PG XBUFS IBNNFS)PME UIF QJQFMJOF VOEFS UIF UFTU QSFTTV DPOOFDUJPO QBSUT PG UIF QJQFMJOF MJLF ÍBOHFT VOJPOT WBMWFT FUD BSF VTJOH B GPBN CVJMEJOH BHFOU " TPBQ TPMVUJPO XIJDI DBO CF SFNPWFE TJNQ UIF UFTU JT CFTU *U JT SFDPNNFOEFE UP TVCTFRVFOUMZ SFEVDF UIF UFTU QSI repeat the test using a foam-building agent.

Leak test with gas as test medium (compressible medium) and maximum test pressure of 0.5 bar

*G JU JT OPU QPTTJCMF UP EP BO JOUFSOBM QSFTTVSF UFTU XJUI XBUFS F H C B MFBL UFTU DBO CF DBSSJFE PVU XJUI TMJHIU PWFSQSFTTVSF 'PS TBGFUZ SFB NVTU UIFO CF MJNJUFE UP NBYJNVN CBS PWFSQSFTTVSF %VSJOH UIF MFBL UI CF TQSBZFE XJUI B GPBN CVJMEJOH BHFOU BOE DIFDLFE " TPBQ TPMVUJPO XIJD TJNQMZ XJUI XBUFS BGUFS UIF UFTU JT CFTU 4JODF UIF FÎDJFODZ PG UIF MFBL MJNJUFE EVF UP UIF MPX MPBE JU JT SFDPNNFOEFE UP VTF JU QSFGFSBCMZ GPS QSFTTVSFT CFMPX CBS

4.8 Modi cations, repairs, commissioning

4.8.1 Modi cations and repairs

5IF GPMMPXJOH TBGFUZ NFBTVSFT BSF UP CF PCTFSWFE XIFO NPEJGZJOH PS SFQ
TZTUFNT

- 8FBS QSPUFDUJWF DMPUIJOH
- %SBJO UIF SFTQFDUJWF QJQFMJOF TFDUJPO DPNQMFUFMZ
- Rinse the pipe section
- Protect against dripping
- $MFBO BOE ESZ UIF KPJOUT
- 1FSGPSN UIF UBTLT CZ USBJOFE QFSTPOOFM

.PEJÌDBUJPOT BOE SFQBJST UP UIF QJQJOH TZTUFN NVTU OPU DBVTF NFDIBOJDB
piping system.

5P FOTVSF UIF PQFSBUJPOBM TBGFUZ PG UIF QJQJOH TZTUFN GPMMPXJOH B NPE
internal pressure test should be done.

4.8.2 Commissioning

8IFO QVUUJOH B QJQFMJOF JOUP PQFSBUJPO GPS UIF ÌSTU UJNF JU JT OPU POM
QSFTTVSF MPBE CVU BMTP VOEFS UFNQFSBUVSF FËFDU 5IF UIFSNBM TUSFTT PS
simulated during testing.

8F SFDPNNFOE BO JOJUJBM JOTQFDUJPO BU UIF FBSMJFTU EBZT BU UIF MBUFT
commissioning and recording the results.

5IF DIFDLT EVSJOH UIF JOTQFDUJPO TIBMM DPWFS UIF GPMMPXJOH JUFNT

- 7JTVBM JOTQFDUJPO
- 'MBOHF KPJOUT VOJPOT WBMWFT MFBL QSPPG
- $POEJUJPO BOE GVODUJPBMJUZ PG FRVJQNFOU

5IF SFNBJOJOH JOTQFDUJPOT PG UIF QJQJOH TZTUFN UPHFUIFS XJUI UIF HFOFS
performed by the operating personnel according to the operating instructions.

5 Jointing technology – Mechanical, cementing and welding

5.1 Mechanical joints

5.1.1 Overview

0G UIF NBOZ EJWFSTF TPMVUJPOT PËFSFE CZ ('{1JQJOH 4ZTUFNT GPS NFDIBOJDB GPMMPXJOH UBCMF PËFST JOGPSNBUJPO PO UIF DPOWFOUJPOBM NFUIPET VTFE J TZTUFNTOTUSVDUJPO

Overview of mechanical connections

Figure	Connection type	Gasket	Connection of plastic with
	Flange connection	0 SJOH 1SPÌTMFFBM)JHI 1VSJUZ HBTLFU	Plastic or metal
	6OJPO	0 SJOH	1MBTUJD TBNF PS EJËFSFOU materials)
	"EBQUPS	0 SJOH	Metal
	"EBQUPS	5ISFBE TFBMJOH DPSE	Plastic or metal
	5ISFBEFE ÌUUJOH	5ISFBE TFBMJOH DPSE	1MBTUJD TBNF PS EJËFSFOU materials)
	Hose connection	-	Hose
	7 JD UBB	Seal	Steel
	SYGEF Plus sanitary adaptor	Special seal	Stainless steel
	6 O J W	Special seal	Plastic or metal

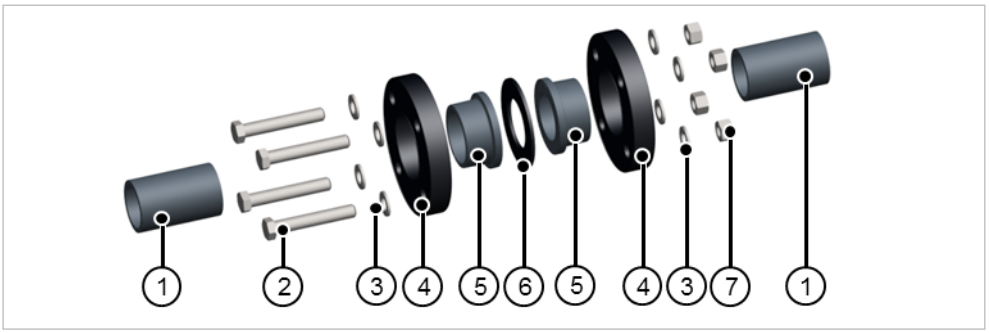
Thread types

5IF GPMMPXJOH UISFBE UZQFT BSF VTFE

Designation of the thread	Standard	Description	Application
Rp	*40 &/	1BSBMMFM JOUFSOBM UISFBET XIFSF QSFTTVSF UJHIU KPJOUT are made on the threads	5P CF VTFE XJUI 3D UISFBET 'PS DBTU JSPO BOE Malleable cast iron ÌUUJOHT
Rc	*40 &/	5BQFSFE JOUFSOBM UISFBET XIFSF QSFTTVSF UJHIU KPJOUT are made on the threads	'PS DPOOFDUJPOT BOE 'JUUJOHT
R	*40 &/	5BQFSFE NBMF UISFBET XIFSF QSFTTVSF UJHIU KPJOUT pressure-tight joints are made on the threads	5P CF VTFE XJUI 3D UISFBET 'PS UXJTUFE PS CFOU UISFBEFE ÌUUJOHT Steel pipe
G	*40	Parallel internal or male UISFBET XIFSF QSFTTVSF UJHIU KPJOUT are not made on UIF UISFBET EJNFOTJPO VQ UP BOE JODMVEJOH	6OJPOT XJUI DPVQMJOH Nut)
/15 /BUJPOBM 'JQF. "NFSJDBO Standard) Pipe 5BQFS	'JQF.	5BQFSFE JOUFSOBM UISFBET XIFSF QSFTTVSF UJHIU KPJOUT are made on the threads	'PS UXJTUFE PS CFOU UISFBEFE ÌUUJOHT
"DNF UISFBE	Special thread	Fastening thread for unions	6OJPOT
Buttress thread	Special thread	Fastening thread for unions	6OJPOT

5.1.2 Flange connections

'MBOHFT XJUI TVÎDJFOU UIFSNBM BOE NFDIBOJDBM TUBCJMJUZ NVTU CF VTFE 5I UZQFT CZ ('{1JQJOH 4ZTUFNT GVMÌMM UIFTF SFRVJSFNFOUT 5IF HBTLFU EJNFOTJ UIF PVUFS BOE JOOFS EJBNFUFS PG UIF ÍBOHF BEBQUFS PS WBMWF FOE %JËFSF JOOFS EJBNFUFST PG HBTLFU BOE ÍBOHF UIBU BSF HSFBUFS UIBO NN NBZ SFTV NBMGVODUJPOJOH ÍBOHF DPOOFDUJPOT



Pipe
Bolt
8BTIFS
Flange
7BMWF FOE ÍBOHF BEB
Flange seal
Nut

Comparison of ange connections

Flange connection	Properties
11 7 ÍBOHF	q $PSSPTJPO GSFF BMM QMBTUJD ÍBOHF NBEF PG QPMZQSPQZMFOF ÌCFS HMBTT SFJOGPSDFE q High chemical resistance (hydrolysis-resistant) q .BYJNVN QPTTJCMF CSFBL SFTJTUBODF EVF UP FMBTUJDJUZ EFGP is tightened too much) q 6TF GPS BNCJFOU UFNQFSBUVSFT VQ UP ‹$ q 5IF UFNQFSBUVSF PG UIF NFEJVN JT SFTUSJDUFE CZ UIF NBUFSJB QMBTUJD QJQJOH TZTUFN "#4 17$ 6 17$ $ 11 PS 1& q 'PS 17%' VQ UP ‹$ NFEJB UFNQFSBUVSF UIF BNCJFOU UFNQFSBUVSF JT MJNJUFE UP BU NPTU ‹$ q 67 TUBCJMJ[FE q 8JUIOUFHSBMFÌYJOH q 4FMG DFOUFSJOH BJE GPS UIF ÍBOHFT PO UIF ÍBOHF BEBQUFS q 4ZNNFUSJD EFTJHO BMMPXT BTTFNCMZ PO FJUIFS TJEF " SFWFST JOTUBMMBUJPO JT OFWFS QPTTJCMF "MM JNQPSUBOU JOGPSNBUJ q 7 HSPPWFUFOUFE q &WFO EJTUSJCVUJPO PG GPSDFT BDSPTT UIF ÍBOHF QSFTFSWFT M FYQFDUBODZ PG DPNQPOFOUT q 4VQQPSUT B MPOHFS MBTUJOH UPSRVF GPS B TBGF KPJOU
11 TUFFM ÍBOHF	q 7FSZ SPCVTU BOE TUJË EVF UP UIF TUFFM JOMBZ q $PSSPTJPO GSFF QMBTUJD ÍBOHF NBEF PG QPMZQSPQZMFOF 11 (' ÌCFS HMBTT SFJOGPSDFE XJUI TUFFM JOMBZ q High chemical resistance (hydrolysis-resistant) q .BYJNVN BNCJFOU UFNQFSBUVSF ‹$ q 67 TUBCJMJ[FE
17$ ÍBOHF	q 17$ 6 ÍBOHFT NBZ CF VTFE BT MPOH BT UIF ÍPX NFEJVN PS UIF BNCJFOU UFNQFSBUVSF EPFT OPU FYDFFE B UFNQFSBUVSF PG ‹ q "U IJHIFS UFNQFSBUVSFT UIF ÍBOHFT DPVME EJTUPSU PWFS UJNF q "U UFNQFSBUVSFT BCPWF ‹$ ÍBOHFT XJUI TVÎDJFOU UIFSNBM BO NFDIBOJDBM TUBCJMJUZ NVTU CF VTFE 5IFTF SFRVJSFNFOUT BSF UIF 11 7 BOE 11 TUFFM ÍBOHFT CZ ('{1JQJOH 4ZTUFNT
#MJOE ÍBOHF	q $PNCJOBUJPO PG B CBDLJOH ÍBOHF BOE BO FOE CMBOL 5IF FOE C BSF BWBJMBCMF JO 11) BOE 1& NBUFSJBMT q $PNCJOFT FOE CMBOLT JO UIF EJNFOTJPOT E UP E XJUI UIF 11 CBDLÍJBOHF q 5IF EJNFOTJPOT E UP E BSF DPNCJOFE XJUI B CBDLJOH ÍBOHF NBEF PG 11 XJUI TUFFM JOMBZ q 8JUI UIF CMBOLJOH ÍBOHF TFU UIF QJQJOH TZTUFN DBO CF DMPTI using the same material. q *G UIF QJQJOH TZTUFN JT FYUFOEFE UIF CBDLJOH ÍBOHF DBO CF BHBJO DVUUJOH EPXO PO BEEJUJPOBM DPTUT q Suitable for pressure piping q &BTZ BTTFNCMZ PG UIF CMBOL ÍBOHF TFU 5IF FOE CMBOL JT DFOU PO UIF JOOFS EJBNFUFS PG UIF CBDLJOH ÍBOHF

Creating ange connections

8IFO NBLJOH B ÍBOHF DPOOFDUJPO UIF GPMMPXJOH QPJOUT IBWF UP CF UBLFO J

Usage information

#BDLJOH ÍBOHFT BSF JEFOUJÌFE XJUI UIF GPMMPXJOH QJDUPHSBNT PG UIF VTBCM

4PDLFU GVTJPO	Butt fusion

Orientation of bolts beyond the two main axes

- 'PS IPSJ[POUBM QJQJOH TZTUFNT UIF PSJFOUBUJPO TIPXO PG UIF CPMUT CFZP TFF UIF GPMMPXJOH ÌHVSF JT QSFGFSSFE TJODF QPTTJCMF MFBLT BU UIF ÍBO cause the medium to run directly onto the bolts.

'MBOHF XJUI NBJO BYFT DFOUSFE PO UIF QJQF BYJT

- 'MBOHF BEBQUFS WBMWF FOE PS ÌYFE ÍBOHF HBTLFU BT XFMM BT CBDLJOH ÍB BMJHOFE DFOUFSFE PO UIF QJQF BYJT
- #FGPSF QSF UJHIUFOJOH UIF CPMUT UIF KPJOUJOH GBDFT NVTU CF ÍVTI XJUI F ÌU UJHIUMZ BHBJOTU UIF HBTLFU 1VMMJOH CBEMZ BMJHOFE ÍBOHFT UPHFUIFS DPOOFDUJPO NVTU UP CF TUSJDUMZ BWPJEFE CFDBVTF PG UIF SFTVMUJOH UFO

Selecting and handling bolts

- 5IF MFOHUI PG UIF CPMUT TIPVME CF TFMFDUFE JO TVDI B XBZ UIBU UIF CPMU QSPUSVEF NPSF UIBO UP UVSOT PG UIF UISFBE BU UIF OVU 8BTIFST NVTU C IFBE BT XFMM BT UIF OVU
  - 5P FOTVSF UIBU UIF DPOOFDUJOH CPMUT DBO CF FBTJMZ UJHIUFOFE BOE SFN QFSJPE PG VTF UIF UISFBE TIPVME CF MVCSJDBUFE F H XJUI NPMZCEFOVN
  - 5JHIUFOJOH UIF CPMUT CZ VTJOH B UPSRVF XSFODI
- 5IF CPMUT NVTU CF UJHIUFOFE EJBHPOBMMZ BOE FWFOMZ 'JSTU UJHIUFO UIF UIF HBTLFU JT FWFOMZ DPOUBDUJOH UIF KPJOUJOH GBDFT 5IFO UJHIUFO BMM PG UIF SFRVJSFE UPSRVF GPMMPXFE CZ PG UIF SFRVJSFE UPSRVF 5IF SF UJHIUFOJOH UPSRVFT BSF MJTUFE JO UIF UBCMF o#PMU UJHIUFOJOH UPSRVF H DPOOFDUJPOTp QBHF)PXFWFS EFWJBUJPOT NBZ PDDVS JO QSBDUJDF F H TUJË CPMUT PS QJQF BYFT UIBU BSF OPU BMJHOFE 5IF 4IPSF IBSEOFTT PG UIF JOÍVFODF UIF OFDFTTBSZ UJHIUFOJOH UPSRVF
- 8F SFDPNNFOE DIFDLJOH UIF UJHIUFOJOH UPSRVFT IPVST BGUFS BTTFNCMZ E TQFDJÌFE WBMVFT BOE JG OFDFTTBSZ SFUJHIUFO UIFN "MXBZT UJHIUFO EJBH
- "GUFS UIF QSFTTVSF UFTU UIF UJHIUFOJOH UPSRVFT NVTU CF DIFDLFE JO BOZ OFDFTTBSZ UJHIUFOFE

> For more information on ange connections, see DVS 2210-1 Supplement 3.

Tightening the bolts using a torque wrench

)PXFWFS EFWJBUJPOT NBZ PDDVS JO QSBDUJDF F H UISPVHI UIF VTF PG TUJË C BSF OPU BMJHOFE 5IF 4IPSF IBSEOFTT PG UIF HBTLFU DBO BMTP JOÍVFODF UIF C UPSRVF

> In the area of exible sections and expansion loops, no bolt connections or ange connections should be used since the bending stress may cause leaks.

Bolt tightening torque guidelines for metric (ISO) ange connections with PP-V, PP- steel and PVC anges

5 I F J O E J D U B R U S F B V S S F D P N N F O D Z ' { E J Q 4 Ø T H U F 5 N T F T U F P S R B V F S F B O E Z V S F
B T V Î D J F O U U J H H I U O F T T P G U I F Í B O H F D O O F D U J O 5 I F Z E F W J B U F G S P N U I E B U E
4 V Q Q M F N F O U X I J D H B S F U P C F V O E F S T U P P E B S V Q Q F S M J N J T 5 I F J O E J W J E V B
Í B O H F D O O F D U J O W B M W F F O E Í B O H F B E B Q U F S Í B O H F S C Z (' { 1 J Q J O H 4 Z T U
dimensioned for these upper limits.

Pipe outer diameter d (mm)	Nominal diameter DN (mm)	No. of bolts	For PROGEF PP, SYGEF PVDF, ecoFIT PE, ABS, PVC-U/C metric systems, with PP-Steel, PP-V and PVC-U anges (Nm)						
			Flat gasket, lubed	Flat gasket, unlubed	Pro le gasket, lubed	Pro le gasket, unlubed	O-ring, lubed	O-ring, unlubed	SYGEF HP gasket unlubed
E	DN10		10	13	10	13	10	13	-
d20	DN15		10	13	10	13	10	13	-
d25	DN20		10	13	10	13	10	13	
d32	DN 25		15	20	10	13	10	13	
E	DN 32		20		15	20	15	20	20
d50	% /		25	33	15	20	15	20	
E	DN 50		35		20		20		
E	% /		50		25	33	25	33	38
d90	DN 80	8	30	39	15	20	15	20	
E	DN 100	8	35		20		20		30
E	DN 125	8		59	25	33	25	33	-
E	DN 150	8			35		30	39	
E	DN 200	8		91		59	35		
E	DN 250	12		85	35		30	39	
d315	DN 300	12	90		50			52	
d355	DN 350		90		50		-	-	223
E	% /		100	130			-	-	
E	DN 500	20	190			91	-	-	
E	% /	20	220		90		-	-	-

Bolt tightening torque guidelines for ASME ange connections with PP-V, PP-steel and PVC anges

Flange size (inch)	Nominal diameter DN (mm)	No. of bolts	For PROGEF PP, SYGEF PVDF and ecoFIT PE systems, with PP-Steel and PP-V anges (ft-lb)				
			Flat gasket, lubed	Flat gasket, unlubed	SYGEF HP gasket, unlubed	Pro le gasket, lubed	Pro le gasket, unlubed
~	DN15			9	-	5	
™	DN20		9	12	10		9
	DN25		11		12	9	12
—	DN32			18	15	10	13
~	% /			21	19	13	
	DN50		28		25	19	25
~	% /				28	21	
	DN80				33	25	33
	DN100	8	30	39	22		21
	DN150	8		59		25	33
	DN200	8	52			33	
	DN250	12				31	
	DN300	12		83			
p	DN350						
p	% /			80	130		59
18”	% /		120	132	195		
20”	DN500	20			-		

⚠ Please observe the special bolt tightening torques listed for butter y valves. See also the section "Planning fundamentals for butter y valves, hand-operated".

Installation recommendation:

&JUIFS UIF CPMU PS UIF OVU BOE QSFGFSBCMZ CPUI TIPVME CF [JOD QMBUFE U friction.

- [JOD PO [JOD XJUI PS XJUIPVU MVCF
- [JOD PO TUBJOMFTT TUFFM XJUI PS XJUIPVU MVCF
- TUBJOMFTT PO TUBJOMFTT XJUI MVCF POMZ

$BENJVN QMBUFE GBTUFOFST BSF BMTP BDDFQUBCMF XJUI PS XJUIPVU MVCSJDBU DBSCPO TUFFM GBTUFOFST BSF OPU SFDPNNFOEFE 6TF B DPQQFS HSBQIJUF BOU ensure smooth engagement and the ability to disassemble and reassemble the system easily.

Length of bolts

*O QSBDUJDF JU JT PGUFO EJÎDVMU UP TQFDJGZ UIF DPSSFDU CPMU MFOHUI GP CF EFSJWFE GSPN UIF GPMMPXJOH QBSBNFUFST

- 5IJDLOFTT PG UIF XBTIFS Y
- 5IJDLOFTT PG UIF OVU Y
- 5IJDLOFTT PG UIF HBTLFU Y
- 'MBOHF UIJDLOFTT Y
- 5IJDLOFTT PG ÍBOHF DPMMBS WBMWF FOE PS ÍBOHF BEBQUFS Y
- 7BMWF JOTUBMMBUJPO MFOHUI JG BQQMJDBCMF Y

5IF GPMMPXJOH UBCMFT BSF VTFGVM JO EFUFSNJOJOH UIF OFDFTTBSZ CPMU MFO DPNCJOBUJPOT PG UIF JOEJWJEVBM DPNQPOFOUT POMZ UIJDLOFTTFT PG UIF JO DPOOFDUJPOT DBO CF QSPWJEFE)PXFWFS ZPV TJNQMZ BEE UIFN UPHFUIFS UP necessary bolt length.

ⓘ According to DVS 2210-1, you should dimension the necessary bolt length for ange connections so that 2-3 turns of the thread protrude beyond the nut.

■ Online tool "Bolt lengths and tightening torques" located at www.gfps.com/tools

Washer (mm)	Thickness (mm)
DN10–DN25	3
% / r % /	

Nuts (mm)			Pitch (mm)	Height of nut (thickness) (mm)
DN10–DN25	M12	8 " '		
DN32–DN125	.	8 " '	2.0	
DN150–DN350	M20	8 " '	2.5	20.2
% / r % /	.	8 " '	3.0	20.2
% /	.	8 " '	3.0	23.8

Flat gasket (mm)	Thickness (mm)
DN10–DN80	" Q Q S P Y
% / r % /	" Q Q S P Y

Pro le seal (mm)	Thickness (mm)
% / r % /	" Q Q S P Y
DN50–DN80	" Q Q S P Y
DN100–DN125	" Q Q S P Y
DN150–DN300	" Q Q S P Y
% / r % /	" Q Q S P Y

Flange (hole circle PN10) (mm)	Thickness (mm)			
	PP-V	PP steel	PVC-U, PVC-C	Blind ange (PVC-U)
DN10	–	–	10	–
DN15		12	11	12
DN20		12	12	13
DN25	18			15
DN32	20	20	15	
% /	22	20		
DN50		20	18	20
% /		20	19	21
DN80		20	20	22
DN100	28	20	22	
DN125	30			28
DN150	32		28	30
DN200			32	
DN250	38	30		
DN300				
DN350			38	38
% /	50			
DN500	–		–	–
% /	–		–	–

Metric valve end for socket joints, at or pro le gasket (mm)	Thickness (mm)		
	ABS, PVC-C, PVC-U	PP, PE	PVDF
E % /		–	–
E % /			
E % /		9	
E % /		10	
E % /	8	11	8
E % /	8	12	8
E % /	9		9
E % /	10		–
E % /	11		–
E % /	12	18	–
E % /	13	–	–
E % /		–	–
E % /		–	–
E % /		–	–
E % /	25	–	–
E % /	23	–	–
E % /	23	–	–
E % /		–	–
E % /	32	–	–
E % /		–	–

Metric valve end for socket joints, O-ring (mm)		Thickness (including gasket) (mm)		
		PVC-C, PVC-U	PP, PE	PVDF
E	% /	9	–	–
E	% /	9	9	9
E	% /	10	10	10
E	% /	10	10	10
E	% /	13	13	13
E	% /	13	13	13
E	% /			
E	% /	15	15	–
E	% /			–
E	% /	18	18	–
E	% /	19	–	–
E	% /	20	–	–
E	% /	22	–	–
E	% /	30	–	–
E	% /	31	–	–
E	% /	23	–	–
E	% /	30	–	–
E	% /	35	–	–
E	% /	–	–	–
E	% /	–	–	–

Metric ange adapters for butt fusion joints, at or pro le gasket (mm)		Thickness (mm)		
		PP, PE, SDR11	PP, PE, SDR17	PVDF, SDR33, SDR21
E	% /	–	–	–
E	% /		–	
E	% /	9	–	
E	% /	10	–	
E	% /	11	–	8
E	% /	12	12	8
E	% /			9
E	% /			10
E	% /			12
E	% /	18	18	13
E	% /	25	25	
E	% /	25	25	
E	% /	25	25	
E	% /	30	30	–
E	% /	32	32	22
E	% /	32	32	22
E	% /	35	25	22
E	% /	35	25	22
E	% /	35	35	
E	% /		30	30
E	% /		33	32
E	% /			–
E	% /			–
E	% /			–
E	% /			–

Valves installed in ange connection (mm)	Installation length (mm)		
	Butter y valve Type 567/578	Butter y valve Type 037/038	Wafer check type 369
DN32	–	–	15
% /	–	–	
DN50			18
% /			20
DN80			20
DN100		52	23
DN125			23
DN150			
DN200			35
DN250	113		
DN300	113		
DN350	129	–	–
% /		–	–
% /		–	–
DN500	190	–	–
% /	209	–	–

Selection of gaskets for ange connections

8IFO TFMFDUJOH TVJUBCMF ÍBOHF TFBMT GPS UIFSNPQMBTUJD QJQJOH TZTUFNT NVTU CF UBLFO JOUP BDDPVOU

- 0QFSBUJOH DPOEJUJPOT
- Sealing forces
- (BTLFU GPSN
- Dimension
- Material

Type of gasket

Flat gasket	Pro le gasket	O-ring

*O BQQMJDBUJPOT XJUI MPX PQFSBUJOH QSFTTVSFT UIF DVTUPNBSZ ÍBU HBTLFU {UP{ NN UIJDL TIFFU NBUFSJBM EFQFOEJOH PO UIF OPNJOBM XJEUI JT TVÎDJF DPOOFDUJPOT XJUI ÍBU HBTLFUT SFRVJSF ÍBOHFT XJUI TVÎDJFOU TUJËOFTT "MM ('{1JQJOH{4ZTUFNT NFFU UIFTF SFRVJSFNFOUT

'PS IJHIFS PQFSBUJOH BOE UFTUJOH QSFTTVSFT QSPÌMF ÍBOHF HBTLFUT BOE 0 S VTFGVM $PNQBSFE UP ÍBU HBTLFUT QSPÌMF ÍBOHF HBTLFUT DPOTJTU PG UXP QB DSPXOFE ÍBU HBTLFU QBSU XIJDI JT SFJOGPSDFE XJUI TUFFM BOE UIF PUIFS JT QBSU 0 SJOH MJQ TFBM PO UIF JOOFS TJEF PG UIF HBTLFU

4UBCJMJ[FE QSPÌMF ÍBOHF HBTLFUT BT XFMM BT 0 SJOH HBTLFUT IBWF UIF GPM

- 3FMJBCMF TFBM XJUI MPX CPMU UJHIUFOJOH UPSRVF
- 6TBCMF BU IJHIFS JOUFSOBM QSFTTVSFT BOE JOUFSOBM WBDVVN
- .JOPS JOÍVFODF PG ÍBOHF PS DPMMBS TVSGBDF
- 4BGF PQFSBUJPO XIFO DPOOFDUJOH QJQF NBEF PG EJËFSFOU NBUFSJBMT

" TVJUBCMF HBTLFU GPSN DBO CF GPVOE CZ VTJOH UIF UBCMF CFMPX

Gasket form	Recommended application limits	Flange or collar design
'MBU HBTLFU	Q Ç CBS BCPWF %/ 5 UP ‹$	8JUI TFBMJOH HSPPWFT POMZ Ç CBS
1SPÌMF HBTLFU	7BDVVN Q CBS UP 5 FOUJSF BQQMJDBUJPO SBOHF	8JUI PS XJUIPVU TFBMJOH HSPPWFT
0 SJOH	7BDVVN Q CBS UP 5 FOUJSF BQQMJDBUJPO SBOHF	CBSF TJEF XJUI HSPPWF

Gasket material

5IF DIPJDF PG B HBTLFU NBUFSJBM JT CBTFE PO UIF ÍPX NFEJB %FUBJMT BCPVU HBTLFU NBUFSJBM PS TQFDJÌDBMMZ JUT DIFNJDBM SFTJTUBODF DBO CF GPVOE resistance tables.

5IF VTF PG HBTLFU NBUFSJBMT XJUI B IJHI EFHSFF PG IBSEOFTT BT JO TUFFM Q SFDPNNFOEFE GPS UIFSNPQMBTUJD QJQJOH TZTUFNT CFDBVTF UIF ÍBOHF PS UIF CFDPNF EFGPSNFE EVF UP UIF SFRVJSFE IJHI TFBMJOH GPSDFT &MBTUPNFS NBU &1%. PS ',. XJUI B 4IPSF " IBSEOFTT PG VQ UP ‹ BSF QSFGFSBCMF

Gasket dimension

5IF EJNFOTJPOT PG UIF HBTLFUT BSF TFU JO UIF HFOFSBM TUBOEBSET GPS QJQF &YDFTTJWF EJNFOTJPOBM EFWJBUJPOT JO UIF JOTJEF PS PVUTJEF EJBNFUFS PG UIF ÍBOHF BEBQUFS PS WBMWF FOE DBVTF JODSFBTFE NFDIBOJDBM TUSFTT PG UI BDDFMFSBUFE XFBS PG UIF JOOFS TJEF PG UIF HBTLFU BT XFMM BT EFQPTJUT JO

5.1.3 Unions joining plastic piping components

8IFSFWFS BWBJMBCMF VOJPOT BSF UIF QSFGFSSFE DIPJDF PWFS ÍBOHF BEBQUFS DPOOFDUJPO PG QMBTUJD QJQF 8JUI OP NFUBM QBSUT UIFSF JT OP DPSSPTJPO DPOOFDUJPO JT BMTP SFEVDFE *O BEEJUJPO UIF TNBMMFS PVUTJEF EJBNFUFS DPOOFDUJPO NFBOT UIBU UIF EJTUBODF GSPN QJQF BYJT UP QJQF BYJT JT TIPSU BTTFNCMZ JT FBTJFS BOE GBTUFS 6OJPOT BSF BWBJMBCMF JO B XJEF WBSJFUZ combinations.

General notes on assembly

1MBTUJD VOJPOT BSF BMXBZT TFBMFE XJUI BO 0 SJOH 5IF DPVQMJOH OVU NBZ P NBOVBMMZ 1JQF XSFODIFT DVTUPNBSJMZ VTFE JO TUFFM QJQF DPOTUSVDUJPO E CJHHFS TJ[FT B QJQF XSFODI XJUI CFMU DBO CF VTFE 8IFO VTJOH VOJPOT DBS PCUBJO B MPX TUSFTT BTTFNCMZ

⚠ In the area of exible sections and expansion loops, unions cannot be used because the bending load can lead to leakages.

i To make assembly of large unions easier, "lubricate" the thread with some water.

Assembly of unions made of PP, PE, PVDF with d75, d90 and d110

5IF OFXFTU HFOFSBUJPO PG QMBTUJD VOJPOT JO UIF BCPWF NFOUJPOFE NBUFSJ IBT CFFO FRVJQQFE XJUI B NPEFSO QMBTUJDT PSJFOUFE CVUUSFTT UISFBE SFT XJUI DPOTJEFSBCMZ JODSFBTFE OPNJOBM QSFTTVSF BOE TBGFUZ SFTFSWFT 4FW JNQPSUBOU QPJOUT JO UIJT SFTQFDU BSF MJTUFE CFMPX

Threads on coupling nut and union bush for PP, PVDF and PE

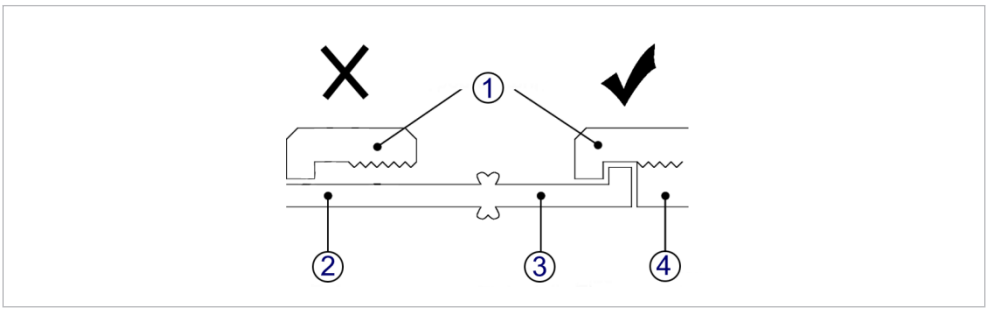
8IFO VTJOH JOEJWJEVBM QBSUT DIFDL QSJPS UP UIF BTTFNCMZ XIFUIFS UIF UIS CVTI BOE DPVQMJOH OVU BSF JEFOUJDBM BOE DBO CF CPMUFE UPHFUIFS

- $PVQMJOH OVU XJUI USBQF[PJEBM UISFBE PO VOJPO CVTI XJUI USBQF[PJEBM U
- $PVQMJOH OVU XJUI CVUUSFTT UISFBE PO VOJPO CVTI XJUI CVUUSFTT UISFBE

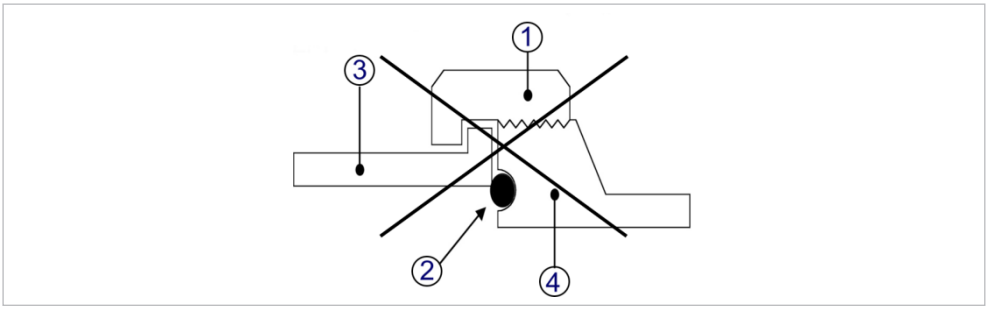
Fusion bead at unions for butt fusion

'PS UIF EJNFOTJPOT E BOE E XF BEWJTF GVTJOH UIF DPNQMFUF VOJPO UP UI
(or slide the coupling nut to the collar of the union end) because it may not be possible to slide
UIF DPVQMJOH OVU PWFS UIF GVTJPO CFBE BGUFS UIF GVTJPO

> Only use union bushes and union ends with the same nominal diameter. A butt fusion union bush d75 may not be combined with a butt fusion union end d90 to form a reducer, because this can cause leakage, as illustrated below.



$PVQMJOH OVU
Pipe
6OJPO FOE
6OJPO CVTI



$PVQMJOH OVU E
*OTVÎDJFOU TFBM
Butt fusion union end d90
#VUU GVTJPO VOJPO C

Unions as adaptor connections for di erent plastics

5IF DPNQPOFOU QBSUT PG UIF VOJPOT E UP E PG EJËFSFOU QMBTUJDT DBO C
UIF UXP DPNQPOFOUT XJUI UISFBE VOJPO CVTI BOE DPVQMJOH OVU NVTU CF NB
NBUFSJBM 5IF VOJPO FOE DBO CF TFMFDUFE GSPN BOPUIFS NBUFSJBM 'PS MBS
E UP E UIF NBUFSJBM USBOTJUJPO JT OPU HFOFSBMMZ QPTTJCMF BOE TIP
case by case basis.

5.1.4 Adaptor unions for connections between plastic and metal pipe

5IF ('{1JQJOH 4ZTUFNT MJOF PG ÌUUJOHT DPOUBJOT WBSJPVT BEBQUPS BOE UISF
DPOOFDUJPO PG QMBTUJD QJQJOH DPNQPOFOUT UP NFUBM QJQF ÌUUJOHT PS WB
WJDF WFSTB XJUI UISFBEFE DPOOFDUJPOT BEBQUPS VOJPOT XJUI NFUBM JOMBZ

5IF TFBM JO UIF NFUBM UISFBE DBO FJUIFS CF NBEF XJUI IFNQ PS B 15'& UBQF B
counterpart is not made of plastic.

> To prevent electrochemical corrosion, malleable iron connecting elements should preferably be used for steel transitions and brass connecting elements for transitions to non-ferrous metals.

5.1.5 Transitional and threaded ttings

Combination G and R threads

5IF DPOOFDUJPO PG BO FYUFSOBM QBSBMMFM QJQF UISFBE (JO BDDPSEBODF XJ
JOUFSOBM QBSBMMFM QJQF UISFBE 3Q JO BDDPSEBODF XJUI *40 JT OPU JOUF
TUBOEBSET " UJHIU DPOOFDUJPO JT QPTTJCMF VOEFS GBWPSBCMF DPOEJUJPOT
established.

NPT (US-American standard)

" DPNCJOBUJPO PG 3 PS (UISFBET XJUI /15 UISFBET JT OPU QPTTJCMF CFDBVTF
pitch.

Transitional and threaded tting	Figure	Property
"EBQUPS ÌUUJOHT internal pipe thread Rp and rustproof reinforcement ring " TPDLFUT	SBMMFM	.BLF JU QPTTJCMF UP DPOOFDU CP QJQF BT XFMM BT QMBTUJD QJQF X ⚠ Metal pipe may only be bolted into adaptor QJQF ÌUUJOHT XJUI B SFJOGPSD
"EBQUPS QJQF ÌUU tapered male thread R (nipple)	I	/JQQMFT XJUI UBQFSFE NBMF QJQF FYDFQUJPO PG B EPVCMF OJQQMF D QMBTUJD BT XFMM BT NFUBM TPDLF
5ISFBEFE TPDLFUT tapered internal pipe thread 3Q XJUIPVU SFJOG	F	5ISFBEFE ÌUUJOHT XJUIPVU SFJOG XJUI UBQFSFE JOUFSOBM QJQF UIS FTUBCMJTINFOU PG DPOOFDUJPOT pipe.

Installation tips for transition and threaded ttings

*U JT FTQFDJBMMZ JNQPSUBOU UIBU UIF QJQF JOTUBMMBUJPO JT MPX TUSFTT "
ÌUUJOHT TIPVME CF BWPJEFE BU QPJOUT JO UIF QJQJOH TZTUFN UIBU BSF TVCKF
*G QJQJOH TZTUFNT BSF TVCKFDU UP TJHOJÌDBOU UFNQFSBUVSF DIBOHFT BEBQ
VTFE CFDBVTF PG UIF 0 SJOH TFBM

⚠ To avoid damage to plastics ttings, remove any ash (if present) in the area of the metal thread before bolting in the ttings.

1MBTUJD USBOTJUJPO BOE UISFBEFE ÌUUJOHT BSF JOJUJBMMZ CPMUFE JO CZ IBC
6TJOH B TVJUBCMF UPPM UIF ÌUUJOHT BSF TVCTFRVFOUMZ CPMUFE JO VOUJM PC
UIF UISFBE BSF WJTJCMF

'PS QMBTUJD USBOTJUJPO BOE UISFBEFE ÌUUJOHT ('{1JQJOH 4ZTUFNT SFDPNNFO
GPS TFBMJOH "T BO BMUFSOBUJWF UISFBE TFBMJOH DPSE)FOLFM 5BOHJU 6OJ -
thread sealing paste Loctite 5331 can also be used. Please consider the appropriate
JOTUBMMBUJPO HVJEFMJOFT GSPN UIF NBOVGBDUVSFS *G PUIFS TFBMJOH NBUFS
DPNQBUJCJMJUZ XJUI UIF QMBTUJDT UP CF VTFE NVTU CF FTUBCMJTIFE ÌSTU

⚠ Do not use hemp! When using hemp, the plastic ttings may be overloaded when the hemp swells and may damage the thread. In addition, hemp is not resistant to chemicals depending on the medium used.

5.1.6 Adaptor pipe ttings for connecting plastic piping systems and metal threads

PVC-U/ stainless steel R	ABS/brass R	ABS/brass Rp	PVC-U/ stainless steel R

5IF BEBQUPS QJQF ÌUUJOHT GPS DPOOFDUJOH QMBTUJD QJQJOH TZTUFNT BOE NF HSFBUFTU QPTTJCMF ÍFYJCJMJUZ GPS BTTFNCMZ HJWFO UIF DPNCJOFE TPDLFU T 5IF NFUBM UISFBE DBO CF TFBMFE XJUI FJUIFS IFNQ PS 15'& UBQF

5IF BEBQUPS QJQF ÌUUJOH JT GBDUPSZ TFBMFE XJUI BO &1%. 0 SJOH 5IF 0 SJOH QSPUFDUJPO BHBJOTU EBNBHF UP UIF QMBTUJD EVSJOH BTTFNCMZ $PNQBSFE UP VOJPOT UIF TQFDJBM DPOOFDUJOH UFDIOPMPHZ XJUI DJSDMJQ JODSFBTFT SFMJ UFNQFSBUVSF DIBOHFT BOE EVSJOH WJCSBUJPO

*O BEEJUJPO UP UIF DMBTTJD USBOTJUJPO UP NFUBM QJQF UIF ÌUUJOHT DBO BM manometers.

⚠ To avoid electrochemical corrosion in transitions to non-ferrous metals, brass connections must be used.

5.1.7 Hose connections to plastic piping systems

('{1JQJOH 4ZTUFNT IBT B XJEF SBOHF PG QSPEVDUT GPS IPTF DPOOFDUJPOT UP systems.

⚠ The hose must be xed on the spigot by using a suitable hose clip.

Laboratory hose connector XJUI TPMWFOU DFNFOU and tapered hose spigot 17$ 6	1SFTTVSF IPTF OPTTMF XJUI TPMWFOU DFNFOU and tapered hose spigot (all materials)	[MBC PS XJUI BEBQUPS QJQF ÌUUJOH XJUI TPMWFOU DFNFOU #PTT *GVCTJPO GVTJPO DPOOFDU ÍBSFE 1'" JODI IPTFT 17%' POMZ

5.1.8 SYGEF Plus and PROGEF Natural sanitary adaptor for standard TriClamp connections

$MBNQ DPOOFDUJPOT GPSN QBSU PG UIF HSPVQ PG MPOHJUVEJOBM JOUFSGFSFO
DPOOFDUJPOT BOE BSF QSJNBSJMZ VTFE GPS QVSF XBUFS BOE QSPEVDUJPO QJQ
QIBSNBDFVUJDBM CJPUFDIOPMPHZ GPPE BOE DPTNFUJD JOEVTUSJFT " TQFDJBM
5SJ$MBNQ DPOOFDUJPO JT TJNQMF SBQJE BOE MPX DPTU BTTFNCMZ

SYGEF Plus sanitary adaptor

4:(&' 1MVT 4BOJUBSZ "EBQUPS XJUI DMBNQ plastic-stainless steel connection

6TF PG UIF 4:(&' 1MVT PS 130(&' /BUVSBM TBOJUBSZ BEBQUPS QSPWJEFT BO BTFQ
TUBJOMFTT TUFFM DPOOFDUJPO 5IF NBKPSJUZ PG DPOOFDUJPO TUBOEBSET BSF
EJBNFUFS PG TUBJOMFTT TUFFM DPNQPOFOU 5IF BEBQUPST DBO CF DPNCJOFE
BWBJMBCMF HBTLFUT BOE DMBNQT

5.1.9 Universal coupling

5IF DPVQMJOH NBEF PG TUBJOMFTT TUFFM PËFST WBSJPVT BEWBOUBHFT DPNQBS
connecting elements.

" QBUFOUFE HBTLFU QSFWFOUT MFBLBHF BOE UIF TQFDJBMMZ GPSNFE BODIPS SJ
BOE QFSNBOFOU DPOOFDUJPO *U GFBUVSFT B TQFDJBM IFMJDBM UPPUI QSPÌMF
FOTVSFT WFSZ HPPE TVQQPSU PO UIF QJQJOH QBSUJDVMBSMZ GPS IBSE TVSGBD
stainless steel and cast iron.

5IF TJNQMF EFTJHO BMMPXT UIF DPVQMJOH UP CF JOTUBMMFE JO OP UJNF 5IBOL
UZQFT JU DBO CF VTFE BT DPOOFDUPS CFUXFFO QJQF NBEF PG EJËFSFOU NBUFS
EJËFSFOU PVUTJEF EJBNFUFST (JWFO UIF MBSHFS DMBNQJOH SBOHF POF DPVQ
DPOOFDU VQ UP UISFF EJËFSFOU QJQF EJNFOTJPOT 5IF IPVTJOH DPOTJTUT PG D
TUBJOMFTT TUFFM UIF HBTLFU PG IJHI RVBMJUZ FMBTUPNFST &1%. PS /#3

5IF DPOOFDUJPO JT NBEF CZ TMJQQJOH UIF DPVQMJOH PWFS UIF FMFNFOUT UP C
UJHIUFOJOH UIF CPMUT XJUI UIF TQFDJÌFE UJHIUFOJOH UPSRVF

5.2 Solvent cement jointing using Tangit

5.2.1 Overview

Material/cement

PVC-U	PVC-C	ABS

5.2.2 Requirements and information

Safety information

Solvent cement jointing calls for adequate technical know-how, which can be acquired in the appropriate training courses. Your authorized GF Piping Systems representative will be happy to provide information about training options.

For the correct selection of the cement, observe the information on chemical resistance for the use of Tangit cement. For more information, see www.gfps.com/tools.

- The current safety data sheet from Henkel is available at www.mymsds.henkel.com

Adequate ventilation of the workplace

5BOHJU DFNFOU BOE 5BOHJU DMFBOFS DPOUBJO IJHIMZ WPMBUJMF TPMWFOUT 5
PS BEFRVBUF GVNF FYUSBDUJPO FTTFOUJBM JO DMPTFE TQBDFT 4JODF UIF TPM
UIBO BJS FYUSBDUJPO NVTU PDDVS BU ÍPPS MFWFM PS BU MFBTU CFMPX UIF XP
UIBU IBT CFFO VTFE GPS DMFBOJOH PS GPS UIF SFNPWBM PG TVSQMVT DFNFOU J
BWPJE PG TPMWFOU GVNFT JO UIF BJS

No open ames when cementing. No smoking.

$FNFOU BOE DMFBOFS BSF ÍBNNBCMF &YUJOHVJTI PQFO ÍBNFT CFGPSF TUBSUJO
FMFDUSJD EFWJDFT XJUIPVU FYQMPTJPO QSPUFDUJPO FMFDUSJD IFBUFST FUD
DIBSHFT %JTDPOUJOVF BOZ GVTJOH PQFSBUJPOT 'VSUIFSNPSF PCTFSWF BMM J
UIF TPMWFOU DFNFOU NBOVGBDUVSFS F H MBCFM PO UIF DBO BOE TVQQMFNFOU

Protection against spilled liquids

1JQF BOE ÌUUJOHT NVTU CF LFQU BXBZ GSPN TQJMMFE DFNFOU DMFBOFS BOE VT
DMFBOFS UIBU BSF OP MPOHFS OFFEFE NVTU CF EJTQPTFE PG JO BO FOWJSPONF

Use of gloves and protective glasses

5IF VTF PG QSPUFDUJWF HMPWFT JT SFDPNNFOEFE UP BWPJE DFNFOU PS DMFBOF
TLJO *G UIF DFNFOU PS UIF DMFBOFS DPNF JO DPOUBDU XJUI ZPVS FZFT SJOTF
XBUFS $POTVMU B EPDUPS *NNFEJBUFMZ DIBOHF DMPUIFT UIBU IBWF DFNFOU P

Always observe the safety regulations issued by the responsible authorities, as well as information in the safety data sheet. The safety data sheet is available at www.mymsds.henkel.com

5.2.3 Required tools and equipment

Nr.	Description	Dimensions
	Pipe cutter	E rE NN d50–d110 mm E rE NN
	$IBNGFS EFWJDF	E rE NN E rE NN
	%FCVSSJOH EFWJDF	$PNNFSDJBMMZ BWBJMBCMF
	$BO MJE	–
	5BOHJU DFNFOU 17$ $	LH DBO
	17$ 6	LH UVCF LH DBO LH DBO LH DBO
	"#4	LH DBO
	4DSFXESJWFS PS XPPEFO TQBUVMB	$PNNFSDJBMMZ BWBJMBCMF
	3PVOE CSVTI Ó NN Round brush ø 8 mm	'JUUJOH r NN Fitting 12–32 mm
	'MBU CSVTI o Y NN 'MBU CSVTI o Y NN 'MBU CSVTI o Y NN	'JUUJOH r NN 'JUUJOH r NN 'JUUJOH r NN
	5BOHJU 17$ 6 17$ $ "#4 DM	LH DBO
	.BSLJOH QFO	–
	8IJUF BCTPSCFOU MJOU GSFF	$PNNFSDJBMMZ BWBJMBCMF
	Folding ruler	$PNNFSDJBMMZ BWBJMBCMF
	4PMWFOU TBGFUZ HMPWFT	$PNNFSDJBMMZ BWBJMBCMF
	1SPUFDUJWF HMBTTFT	$PNNFSDJBMMZ BWBJMBCMF

5.2.4 Dimensions and tolerances

5IF EJNFOTJPOT PG QJQF ÌUUJOHT BOE WBMWFT NBEF PG 17$ 6 17$ $ BOE "#4 C
('{1JQJOH{4ZTUFNT HFOFSBMMZ DPOGPSN UP UIF TUBOEBSET &/ *40 BOE &/ *
DBO CF DPOOFDUFE XJUI BOZ ÌUUJOHT BOE WBMWFT NBEF PG UIF TBNF NBUFSJBM
produced based on these standards.

5.2.5 Required amounts of Tangit cement

Diameter (d)	Tangit (kg/100 connections)	Amount (g/joint)
20	0.25	2.5
32		
	0.55	5.5
50		
	1.10	11.0
	1.50	15.0
90	2.50	25.0
110		
	8.00	80.0
200	13.00	130.0
225	20.00	200.0
315		

i The amount of cement used depends on a variety of factors. The table provides average values. It is generally not necessary to exceed these values.

5.2.6 Cementing

Cementing should be performed at an ambient temperature of 5 °C to 35 °C.

Cutting the pipe to length

$VU PË UIF QJQF BU B SJHIU BOHMF CZ VTJOH B QJQF

Chamfering the pipe

$IBNGFS UIF FOE PG UIF QJQF XJUI UIF DIBNGFS EFWJ JIF GPM table to enable a perfect cementing joint.

d (mm)	b (mm)
r	1 – 2
10 – 55	2 – 3
r	r
r	r

i Well-chamfered pipe ends prevent the layer of cement from being removed as the pipe is inserted into the tting.

Deburring the pipe

%FCVSS UIF JOTJEF PG UIF QJQF XJUI B EFCVSSJOH E

Cleaning pipe and tting

'JSTU SFNPWF BOZ DPBSTF EJSU GSPN UIF DFNFOUJOH ÌUUJOHT $MFBO UIF DFNFOUJOH TVSGBDFT UIPSPVHIM BOE QBQFS "MXBZT VTF B GSFTI QJFDF PG QBQFS GPS UIBU NBZ IBWF GPSNFE PO UIF QBSUT

1JQF NBZ IBWF B XBYZ TVSGBDF 5P FOTVSF QSPQFS K QSPDFTT NVTU CF SFQFBUFE VOUJM UIF QJQF TVSGBDF CFDPNFT WJTJCMZ NBUU

.FDIBOJDBM NBDIJOJOH PG UIF QJQF TVSGBDF NBZ CF OFDFTTBSZ JO JOEJWJEVB JOEJDBUJPO PG FYQFDUFE JOBEFRVBUF KPJOUJOH RVBMJUZ JT BO BCTFOU PS JC KPJOUJOH QBSUT GPMMPXJOH ÌOF DMFBOJOH ÌOHFS OBJM DIFDL 5IF KPJOUJO CF SPVHIFOFE FWFOMZ XJUI FNFSZ DMPUI PG HSBJO PS ÌOFS PCTFSWJOH UIF permitted gaps.

The cementing surfaces must be dry and free from grease and dirt, and must not be touched after cleaning.

Marking the insertion depth

.BSL UIF DFNFOUJOH MFOHUI PG UIF ÌUUJOH PO UIF QJ QFO UIJT BMMPXT GPS DIFDLJOH UIF SFRVJSFE BQQMJ been completely inserted.

$BMDVMBUJOH UIF JOTFSUJPO EFQUI

$$t = \frac{d}{2} + 6$$

t Insertion depth (mm)
d Pipe diameter (mm)

If the outside diameter of the pipe and the inside diameter of the socket are at opposite extremes of their tolerances, then the pipe cannot be inserted dry into the tting socket. Insertion will only become possible once the cement has been applied.

Checking the cement

5BOHJU DFNFOU JT TVQQMJFE SFBEZ GPS VTF 4UJS UI TQBUVMB QSJPS UP VTF $FNFOU PG UIF DPSSFDU DPO TQBUVMB IFME BU B TMBOU $FNFOU UIBU OP MPOHFS OPU CF UIJOOFE TJODF UIJOOJOH XPVME GBMTJGZ UIF

Applying the cement

6TJOH ÌSN CSVTI QSFTTVSF BQQMZ BO FWFO DMPTFE ÌSTU JO UIF ÌUUJOH UIFO PO UIF QJQF 6TF B UIJO MB CFBE GPSNBUJPO JOTJEF UIF QJQF BQQMZ B HFOFSPV

Starting at d75 (ABS/PVC-C) or d90 (PVC-U), two people are needed to apply the cemer to the pipe end and tting socket simultaneously in order to avoid exceeding the maximum opening time of the cement.

Starting at d250, the cement is poured directly from the can into the middle of the cementing surface and distributed rst radially and then axially over the entire area with a at brush until an even, closed layer is present. The minimum layer thickness in the tting area is 1 mm, while a heavier coat is applied at the pipe end. Cementing in these dimension ranges must be performed by at least 2 people.

Connecting pipe and tting

*NNFEJBUFMZ QVTI QJQF BOE ÌUUJOH UPHFUIFS UP UIF M MFOHU
JOTFSUJPO EFQUI PO UIF QJQF XJUIPVU UXJTUJOH PS DE IPME
seconds until the cement has set.

⚠ Starting at d250, push pipe and tting together and align them by using 3 to 4 people. Hold the joint in this position for 1 minute.

Checking and removing surplus cement

"GUFS KPJOUJOH B DPNQMFUF CFBE NVTU CF WJTJCMF NBMMFS
*NNFEJBUFMZ XJQF PË BOZ TVSQMVT DFNFOU VTJOH DI QBQFS

⚠ Jointing faces must be kept clean.

⚠ Important note

Cement and cleaner should be stored in a cool, dry place (5 to 35 °C)! Under these conditions, the cement and cleaner can be used for 24 months starting from the date of lling (imprinted on the can).

Cans not in use should be closed immediately to prevent solvent losses and thickening. The brush lid can be used, which allows for leaving the brush in the can of cement.

4JODF CPUI DFNFOU BOE DMFBOFS EJTTPMWF UIF NBUFSJBM QJQF BOE ÌUUJOHT
BMMPXFE UP DPNF JOUP DPOUBDU XJUI TQJMMFE DFNFOU PS QBQFS DPOUBJOJOH

4DSBQF PË UIJDLFOFE DFNFOU TUJDLJOH UP UIF CSVTI VTJOH ESZ QBQFS BOE UI
XJUI DMFBOFS $MFBOFE CSVTIFT NVTU CF ESZ CFGPSF SFVTF

Flushing before putting into operation

"GUFS UIF ESZJOH QSPDFTT TFF UBCMF JO UIF TFDUJPO 8BJUJOH UJNF BOE QSF
TZTUFNT DBO CF ÌMMFE 5P SFNPWF SFNBJOJOH TPMWFOU WBQPS UIF QJQFMJOF
ÍVTIFE CFGPSF QVUUJOH JU JOUP PQFSBUJPO 'PS QJQF UIBU BSF OPU QVU JOUP
XF SFDPNNFOE ÌMMJOH UIFN XJUI XBUFS BOE ÍVTIJOH UIFN SFHVMBSMZ BGUFS DE
OPU VTF DPNQSFTTFE BJS GPS ÍVTIJOH

Documenting Tangit batch for ABS cementing

5P FOTVSF UIF USBDFBCJMJUZ PG U FT VTFE JG
OFFEFE EPDVNFOU UIF CBUDI JEFC IFE UP FWFSZ
TIJQQFE VOJU UP UIF UFTU BDDFQU TFWFSBM
CBUDIFT BSF VTFE JO POF QSPKFDU ÌDBUJPO GSPN
each batch to the test report.

5.2.7 Waiting time and pressure test

5IF MFOHUI PG UIF ESZJOH QFSJPE CFGPSF UIF KPJOU NBZ CF TVCKFDUFE UP UF
QSFTTVSF EFQFOET PO UIF ESZJOH UFNQFSBUVSF UIF EJNFOTJPO BOE UIF ÌU SF
BT BNCJFOU JOÍVFODFT

5IF GPMMPXJOH UBCMF TIPXT UIF DPSSFTQPOEJOH XBJUJOH UJNFT

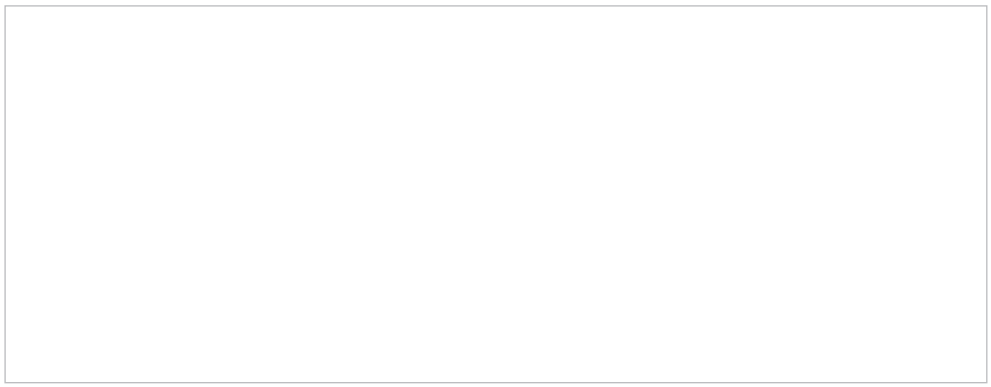
Materials and dimension	Temperature: 10 °C - 30 °C			Temperature: <10 °C / >30 °C		
	Between cementing	Operating pressure repair	Pressure test water max. 1.5 x PN	Between cementing	Operating pressure repair	Pressure test water max. 1.5 x PN
PVC-U						

Materials and dimension	Temperature: 10 °C - 30 °C			Temperature: <10 °C / >30 °C		
	Between cementing	Operating pressure repair	Pressure test water max. 1.5 x PN	Between cementing	Operating pressure repair	Pressure test water max. 1.5 x PN
< d250	5 Min	I C B S	I	15 min	I C B S	I
E	15 Min	I C B S	I	30 min	I C B S	I
PVC-C						
" M M E J N	5 Min	I C B S	I	15 min	I C B S	I
ABS						
E	10 Min	I C B S	I	15 min	I C B S	I
E	30 Min	I C B S	I	N J O	I C B S	I
d250-315	. J O	I C B S	I	120 min	I C B S	I

"DUVBM WBMVFT BU UIF DPOTUSVDUJPO TJUF NBZ EFWJBUF 5IFTF BSF FNQJSJDB

5.2.8 Internal pressure test or leak tightness test of ABS with gas/air

%VF UP UIF SJTL PG B QSFTTVSF UFTU XJUI B DPNQSFTTJCMF UFTU NFEJVN UIJT
CF DBSSJFE PVU POMZ JO FYDFQUJPOBM DBTFT 5IF GPMMPXJOH EJBHSBN TIPXT
UJNFT EFQFOEJOH PO UIF UFTU QSFTTVSF GPS BNCJGOU UFNQFSBUVSFT CFUXFFO



1 5FTU QSFTTVSF CBS
5 8BJUJOH UJNF BGUFS
cementing (h)
"NCJFOU UFNQFSBUVSF G
{UP{ ‹$

⚠ In principle, PVC-U and PVC-C may not be pressure tested by using a compressible medium!

5.2.9 Disposal

%SJFE QSPEVDU SFTJEVFT DBO CF BEEFE UP IPVTFIPME PS JOEVTUSJBM XBTUF
CF EJTQPTFE PG TFQBSBUFMZ 5IF EJTQPTBM LFZ &"$ DPEF JT BWBJMBCMF VQP
QBDLBHJOH DBO CF BEEFE UP SFDZDMJOH

5.3 2-component cement jointing using Tangit RAPID

5.3.1 Overview

5BOHJU 3"1*% JT TVJUBCMF GPS SFTUSBJOU QSPPG DPOOFDUJPOT PG QSFTTVSF JOTUBMMBUJPOT XJUI ÌUUJOHT BOE WBMWFT NBEF PG 17$ 6 PS 17$ $

- .FFUT %*/ &/
- 'PS QJQJOH TZTUFNT JO BDDPSEBODF XJUI &/ *40 17$ 6 BOE 17$ $
- "MTP TVJUBCMF GPS SFQBJST
- $POTUSVDUJPO DFNFOUJOH XJUI QMBUF NBUFSJBM F H DBUDI USBZT BOE IPVT

Technical data	
3BX NBUFSJBM CBTF	Methacrylate
Density	BOE 3 H DN
Processing temperature	‹$ UP ‹$
7JTDPTJUZ	N1BT DPNQPOFOUT " # %*/ &/ ‹$
0QFO UJNF	"QQSPY NJO
'JUOFTT GPS VTF	'PS ‹$ OFX JOTUBMMBUJPO I GPS SFQBJST CBS I NJO I
Final strength	$PSSFTQPOET UP UIF TUSFOHUI PG UIF DFNFOUFE NBUFSJBM
5FNQFSBUVSF SFTJTUBODF	17$ 6 ‹$ 17$ $ ‹$
Storage	/PU CFMPX ‹$
Minimum shelf life	"U ‹$ NPOUIT JO VOPQFOFE PSJHJOBM QBDLBHF Minimum shelf life date and batch number are located on the cartridge.

5.3.2 Requirements and information

Safety information

Cement jointing calls for adequate technical know-how, which can be acquired in the appropriate training courses. Your authorized GF Piping Systems representative will be happy to provide information about training options.

For the correct selection of the cement, observe the information on chemical resistance for the use of Tangit cement. For more information, see www.gfps.com/tools.

For acids and heavily oxidative substances as ow media, Tangit solvent cements can be used. The current safety data sheet from Henkel is available at www.mymsds.henkel.com

Protective measures before cementing

Adequate ventilation of the workplace

5BOHJU 3"1*% BOE 5BOHJU 1& 11 17%' 1# DMFBOJOH DMPUIT BOE TQFDJBM DMFBO ÍBNNBCMF 5IF TPMWFOU WBQPST BOE BJS DBO DPNNFDU BU UIF ÍPPS BOE GPSN F WBQPST 'PS UIJT SFBTPO FOTVSF UIBU TVÎDJFOU WFOUJMBUJPO BOE FYIBVTUJP QSPDFTTJOH BOE ESZJOH JODMVEJOH BGUFS DFNFOUJOH 1SPMPOHFE JOIBMBUJ IFBMUI IB[BSET

,FFQ VTFE DMFBOJOH QBQFS JO B DMPTFE DPOUBJOFS F H CVDLFU XJUI B MJE TPMWFOU WBQPST MPX

No open ames when cementing. No smoking.

*O UIF XPSL SPPN BOE JO BEKBDFOU SPPNT /P TNPLJOH /P GVTJPO %P OPU VTF ÌSF BWPJE DSFBUJOH TQBSLT VOEFS BOZ DJSDVNTUBODFT 1SJPS UP GVTJPO UB DPMMFDUFE TPMWFOU WBQPST BOE FYQMPTJWF NJYUVSFT 5IPSPVHIMZ ÍVTI QJQ BOE CMPX UIFN PVU %P OPU DMPTF QJQJOH TZTUFNT EVSJOH UIF ESZJOH QIBTF

"WPJE QSPEVDU BDDVNVMBUJPOT 'JSF IB[BSE 5XP DPNQPOFOU QSPEVDUT DBO H EVSJOH IBSEFOJOH JG UIFZ BSF BQQMJFE JO B CMPDL "MXBZT TQSFBE QSPEVDU surface.

Protection against spilled liquids

1JQF BOE ÌUUJOHT NVTU CF QSPUFDUFE BHBJOTU TQJMMFE DFNFOU DMFBOJOH E
OPU QPVS DFNFOU PS DMFBOFS UIBU JT OP MPOHFS OFFEFE JOUP TFXFS MJOFT

Use of gloves and protective glasses

5IF VTF PG QSPUFDUJWF HMPWFT JT SFDPNNFOEFE UP BWPJE DPOUBDU PG DFNF
TLJO *G UIF DFNFOU PS UIF DMFBOFS DPNFT JO DPOUBDU XJUI ZPVS FZFT SJOT
XBUFS $POTVMU B EPDUPS *NNFEJBUFMZ DIBOHF DMPUIFT UIBU IBWF DFNFOU P

Always obey the safety regulations issued by the responsible authorities, as well as the information in the safety data sheet. The safety data sheet is available at www.mymsds.henkel.com.

5.3.3 Required tools and equipment

Nr.	Description	Dimensions
	Pipe cutter	E r NN d50–110 mm E r NN
	$IBNGFS EFWJDF	E r NN d32 –200 mm
	%FCVSSJOH EFWJDF	$PNNFSDJBMMZ BWBJMBCMF
	5BOHJU 3"1*% DFNFOU	,JU XJUI NM DBSUSJEHFT ,JU XJUI NM DBSUSJEHFT
	Folding ruler	$PNNFSDJBMMZ BWBJMBCMF
	.BSLJOH QFO	-
	5BOHJU DMFBOFS 11 1& 17%1 liter can	
	8IJUF BCTPSCFOU MJOU GSFFNQBQFS	$PNNFSDJBMMZ BWBJMBCMF
	5BOHJU DMFBOJOH DMPUIT 11 1& 17%' 1#	
	Plastic brush	1” 2”
	4BGFUZ HMPWFT	$PNNFSDJBMMZ BWBJMBCMF
	1SPUFDUJWF HMBTTFT	$PNNFSDJBMMZ BWBJMBCMF
	$BSUSJEHF HVO	50 ml NM

5.3.4 Dimensions and tolerances

5IF EJNFOTJPOT PG QJQF ÌUUJOHT BOE WBMWFT CZ ('{1JQJOH 4ZTUFNT NBEF PG DPOGPSN UP UIF TUBOEBSET &/ *40 BOE &/ *40 5IFZ DBO CF DPOOFDUF QJQF ÌUUJOHT BOE WBMWFT NBEF PG UIF TBNF NBUFSJBM UIBU IBWF BMTP CFFO these standards.

5.3.5 Cementing

Cutting the pipe to length

$VU PË UIF QJQF BU B SJHIU BOHMF CZ VTJOH B QJQF

Chamfering the pipe

$IBNGFS UIF QJQF XJUI B DIBNGFS EFWJDF BDDPSEJOH H ÌHVSF a perfect cementing joint.

Pipe outer diameter (mm)	b (mm)
r	1 – 2
10 – 55	2 – 3
r	r
r	r

i Well-chamfered pipe ends prevent the layer of cement from being removed as the pipe is inserted into the tting.

Deburring the pipe

%FCVSS UIF JOTJEF PG UIF QJQF XJUI B EFCVSSJOH EF

Cleaning pipe and tting

$MFBO UIF QJQF BOE ÌUUJOH XJUI 5BOHJU 1& 11 17%' 1 IT PS DI 3FQMBDF UIF QBQFS BGUFS FWFSZ DMFBOJOH 5IF DMF VTU CF the cement.

⚠ Pipe end and tting socket must be dry and free from grease and dirt, and must not be touched after cleaning.

Marking the insertion depth

.BSL UIF DFNFOUJOH MFOHUI PG UIF ÌUUJOH PO UIF QJ GPMEJO
QFO UIJT BMMPXT GPS DIFDLJOH UIF SFRVJSFE BQQMJ WF BOE
been completely inserted.

$BMDVMBUJOH UIF JOTFSUJPO EFQUI

$$t = \frac{d}{2} + 6$$

t Insertion depth (mm)
d Pipe diameter (mm)

If the outside diameter of the pipe and the inside diameter of the socket are at opposite extremes of their tolerances, then the pipe cannot be inserted dry into the tting socket. Insertion will only become possible once the cement has been applied.

Checking the cement

5BOHJU 3"1*% DFNFOU JT TVQQMJFE SFBEZ GPS VTF # FDL XIFU
DPNQPOFOUT DBO CF FWFOMZ QVTIFE PVU PG UIF DBS

Tangit RAPID should not be stored below +5 °C since this would cause an increase in viscosity and solidi cation of the structure, which would a ect its processing ability. After bringing the cement to room temperature, the temperature-based increase in viscosity and structure is reduced again.

Applying the cement

- "QQMZ 3"1*% UP UIF DFNFOUJOH TVSGBDFT GSPN Z VTJOH BOE TUBUJ'DQQMZ FUSIF DFNFOU JO UIF GPSN PG SJOHT FOU BN cement.
- 'JSTU UXFOMZ EJTUSJCVUF UIF DFNFOU JO BYJBM EJSF FU BOE using a plastic brush.
- "QQMZ B UIJDBQQMZ B HFOFSPVT BNPVOU PG DFNFOU UIF QJBQQMZ %*/ &/ UP DPWFS EJBNFUFS UPMFSBODFT VQ UP NN

%FQFOEJOH PO UIF QSPDFTTJOH UFNQFSBUVSF UIF G JNBUF U

Temperature (°C)	Estimated processing time (min)
10	10
20	8
30	

If there is series production, the static mixer can be used multiple times. However, after the processing time has been exceeded, a new static mixer is required. Immediately tightly close any cartridges that are not in use. (For short-term interruptions, the static mixer used can remain on the cartridge.)

Connecting pipe and tting

- *NNFEJBUFMZ QVTI QJQF BOE ÌUUJOH UPHFUIFS UP U MM MFO DIFDL JOTFSUJPO EFQUI PO UIF QJQF XJUIPVU UXJT ONFOU B GPS B GFX TFDPOET VOUJM UIF DFNFOU IBT TFU
- 5IF KPJOUJOH QBSUT NVTU CF QVTIFE UPHFUIFS EVS F PG UIF {NJOVUFT GSPN UIF TUBSU PG UIF BQQMJDBUJPO PG
- &YDFTT DFNFOU EPFT OPU IBWF UP CF SFNPWFE)PX U JT DS TIBSQ FEHFT BOE TIPVME CF SFNPWFE
- 8JQF PË DFNFOU SFTJEVFT GSPN UIF QMBTUJD CSVTI 5IF ESJFE DFNFOU ÌMN D the plastic brush by using a slight rotation.

⚠ For dimensions starting at d160, one person should apply the cement to the pipe and socket while the second person distributes the cement.

Wiping o the cement bead

" DFNFOU CFBE NVTU CF WJTJCMF PO UIF JOTJEF BOE DFNFOU DFNFOUJOH KPJOU RVBMJUZ BTTVSBODF PS CF XJQF

5.3.6 Waiting time and pressure test

%VSJOH UIF ÌSTU NJOVUFT BGUFS DFNFOUJOH UIF QJQF NVTU OPU CF NPWFE CFMPX ‹$ UIJT UJNF JT FYUFOEFE UP BU MFBTU NJOVUFT -BSHFS QJQJOH T TVQQPSUFE EVSJOH UIF ÌSTU NJOVUFT EVF UP UIFJS JOUSJOTJD XFJHIU

'JMMJOH UIF QJQFMJOF BT XFMM BT UIF QSFTTVSF UFTU VQ UP UIF UFTU QSFTTV VOUJM IPVST BGUFS UIF MBTU DFNFOUJOH *G UIF MJOF JT UP CF TUSFTTFE BU B NJOJNVN XBJUJOH UJNF PG CBS I NVTU CF GPMMPXFE NJO IPVS "U ‹$ U BSF EPVCMFE 'PS QJQF UIBU BSF OPU QVU JOUP JNNFEJBUF PQFSBUJPO XF SFD them thoroughly.

5.3.7 Internal pressure test with water

⚠ In principle, PVC-U and PVC-C may not be pressure tested by using a compressible medium!

To remove remaining product vapors, thoroughly ush the pipeline before putting it into operation.

5.3.8 Disposal

%SJFE QSPEVDU SFTJEVFT DBO CF BEEFE UP IPVTFIPME PS JOEVTUSJBM XBTUF CF EJTQPTFE PG TFQBSBUFMZ 5IF EJTQPTBM LFZ &"$ DPEF JT BWBJMBCMF VQP QBDLBHJOH DBO CF BEEFE UP SFDZDMJOH

5.4 Special cements

5.4.1 Tangit DTX

5BOHJU %59 JO DPOKVODUJPO XJUI UIF 17$ 6 17$ $ "#4 DMFBOFS JT B TQFDJBM D
GPS 17$ 6 17$ $ QJQJOH TZTUFNT UIBU BSF FYQPTFE UP UIF FËFDUT PG IJHIMZ B
DIFNJDBMT TVDI BT DPODFOUSBUFE JOPSHBOJD BDJET

Applications

- $FNFOUJOH UIFSNPQMBTUJD 17$ 6 17$ $ QJQJOH TZTUFNT JO BDDPSEBODF XJUI
- 4VJUBCMF GPS DSJUJDBM NFEJB TFF UIF MJTU PG DIFNJDBM SFTJTUBODF BU X

Properties

- 4PMWFOU DFNFOU CBTFE PO UFUSBIZESPGVSBOF 5)' TUBCJMJ[FE
- 0QFO UJNF NJOVUF
- (BQ ÌMMJOH BOE UIJYPUSPQJD
- %JBNFUFS QJQF NBY NN HBQ NBY NN
- .BYJNVN PQFSBUJOH UFNQFSBUVSF MJNJUFE UP ‹$
- .FFUT %*/ &/ "EIFTJWFT GPS UIFSNPQMBTUJD QJQJOH TZTUFNT GPS ÍVJET
- $& NBSLJOH BOE %P1

Resistance

5IF DFNFOUJOH KPJOUT BSF XBUFSUJHIU 5IFJS DIFNJDBM SFTJTUBODF FTQFDJB
BOE TUSPOHMZ PYJEJ[JOH NBUFSJBMT EFQFOET PO UIF GPMMPXJOH GBDUPST

- Diameter tolerances
- $VSJOH UJNFT
- Pressure ratings
- 5FNQFSBUVSFT
- "DJE UZQF
- "DJEEPODFOUSBUJPO

'PS QSFTTVSF QJQJOH TZTUFNT NBEF PG 17$ $ TQFDJBM 17$ $ DFNFOU JT SFDPN
UFNQFSBUVSFT UFDIOJDBM EBUB TIFFU VQPO SFRVFTU

$FNFOUFE 17$ 6 PS 17$ $ QJQF DPOOFDUJPOT JG UIFZ BSF JOTUBMMFE GPMMPX
DFNFOUJOH JOTUSVDUJPOT BSF KVTU BT TUBCMF BT UIF JOTUBMMFE QJQF NBUF
NFEJB MJTUFE JO UIF GPMMPXJOH UBCMF 8IFO UIFTF NFEJB BSF VTFE UIF VTF P
DFNFOU GPS MBZJOH QJQJOH NBEF PG 17$ 6 PS 17$ $ JT SFDPNNFOEFE 4JODF U
BUUBDL UIF QJQF NBUFSJBM ('{1JQJOH 4ZTUFNT SFDPNNFOET UIF VTF PG 1/ QJ
OPU GFBUVSFE JO UIF MJTU PG DIFNJDBM SFTJTUBODF PS UIPTF XJUI B MPXFS D
17$ 6 PS 5BOHJU 17$ $ DFNFOU DBO CF VTFE JG UIF QJQF BOE ÌUUJOH NBUFSJBM
VTJOH 5BOHJU %59 TQFDJBM DFNFOU GPS 17$ $ QJQJOH BOE B DSJUJDBM NFEJVN
UIF UFNQFSBUVSF BOE QSFTTVSF SFDPNNFOEBUJPOT GPS 17$ 6 NBUFSJBM NVTU
GPMMPXFE

Medium	Concentration range	Upper limit	
Sulfuric acid	$_2$)4 0	Ç "' NBY	‹$
		Ç "' NBY	‹$
Hydrochloric acid	) $ M	Ç "' NBY	‹$
Nitric acid	) /$_3$0	Ç "' BC POMZ NBY	‹$
Sodium hypochlorite (calcium hypochlorite)	/B0$M BDUJWF chlorine	Ç "' NBY	‹$
) ZESP[JEF	$_2$)0$_2$	Ç "' NBY	‹$
) ZESÍWPMPSJE	In any concentration	Ç "' NBY	‹$

⚠ Tangit DTX solvent cement jointing calls for adequate technical know-how, which can be acquired in the appropriate training courses. Your authorized GF Piping Systems representative will be happy to provide you with information about training options.

⚠ For the correct selection of the cement, observe the information on chemical resistance for the use of Tangit DTX cement. For more information, see www.gfps.com/tools

5.4.2 GF Dytex

(' %ZUFY JO DPOKVODUJPO XJUI UIF (' %ZUFY TPMWFOU JT B TQFDJBM BEIFTJW
NBEF PG 17$ 6 17$ $ GPS DPODFOUSBUFE TVMGVSJD BDJE

1MFBTF OPUF UIF OPUJDF JO QMBOOJOH GVOEBNFOUBMT DIBQUFS o+PJOUJOH 5F
DFNFOUJOH KPJOU 5BOHJUp *O UIJT DIBQUFS POMZ UIF (' %ZUFY TQFDJÌD UPQJ

Speci cations for GF Dytex cement	
Resource base	1PTU DIMPSJOBUFE 17$ EJTTPMWFE JO NFUIZMFOF DIMPSJE
Density	H DNŽ
5FNQFSBUVSF SBOHF	‹$
Processing temperature	‹$ r ‹$
7JTDPTJUZ	r N1BT %*/ &/ ‹$
0QFSBUJPOBM TUSFOHUI PVST	
Full Strength	$PSSFTQPOET UP UIF TUSFOHUI PG UIF CPOEFE NBUFSJBM
Dilution	(' %ZUFY NVTU OPU CF EJMVUFE

Speci cations for GF Dytex solvent	
Resource base	Methylene chloride
Density	H DNŽ
7JTDPTJUZ	Runny

Area of application

+PJOUJOH PG UIFSNPQMBTUJD 17$ 6 17$ $ QJQJOH TZTUFNT BDD &/ *40 GPS
DPODFOUSBUFE TVMGVSJD BDJE %VF UP UIF JOÍVFODF PG UIF IJHIMZ DF
TVMGVSJD BDJE UP UIF QJQF NBUFSJBM JU JT SFDPNNFOEFE UP VTF QJQF XJUI
1/ 3FHBSEJOH UIF FYQFDUFE TFSWJDF MJGF BOE QSFTTVSF SBUJOH QMFBTF D
PODIFN!HFPSHÌTDIFS DPN

(' %ZUFY JT OPU TVJUBCMF GPS VTF JO ESJOLJOH XBUFS BQQMJDBUJPOT 'PS UIF
17$ 6 PS 17$ $ JO VTF XJUI PUIFS NFEJB VTJOH 5BOHJU 17$ 6 17$ $ PS 5BOHJU %
SFDPNNFOEFE GPS NBUFSJBM BOE BEIFTJWF TFMFDUJPO TEE MJTU PG DIFNJDBM
XXX HGQT DPN UPPMT

Important features

- q $FNFOU JT OPU HBQ ÌMMJOH NVMUJQMF DFNFOU BQQMJDBUJPO QPTTJCMZ OFD
- q .BYJNVN PVUFS EJBNFUFS QJQF E NN HBQ NBY NN
- q MJNJUFE NBYJNVN PQFSBUJOH UFNQFSBUVSF ‹$

Resistance

5IF DFNFOUFE KPJOUT BSF XBUFSQSPPG 5IFJS DIFNJDBM SFTJTUBODF EFQFOET
GBDUPST

- q Diameter tolerances
- q $VSJOH UJNF
- q Pressure charges
- q 5FNQFSBUVSFT
- q $PODFOUSBUJPO PG TVMGVSJD BDJE
- q 2VBMJUZ PG UIF KPJOUJOH

Processing

'JSTU DMFBO UIF DFNFOUJOH TVSGBDFT PVUTJEF PG UIF QJQF FOE ÌUUJOH JOT
1PUFOUJBMMZ BEIFSJOH JDF NVTU CF SFNPWFE CZ IFBUJOH MVLFXBSN

5IF QJQF FOET NVTU CF DVU TRVBSF DIBNGFSFE BOE EFCVSSFE *G UIFSF JT OP
DIBNGFS OP QFSNBOFOU UJHIU DPOOFDUJPO JT BDIJFWFE

%VF UP UIF NJTTJOH HBQ ÌMMJOH QSPQFSUJFT PG (' %ZUFY DIFDL UIF QJQF ÌU

⚠ If the pipe end can slide in to the pipe stop without resistance, multiple application of cement is required. Gaps with a di erence in diameter of >0.4 mm are not permitted! Pipe / ttings from dimension d110 mm have to be measured for admissible gap size.

$MFBOJOH JT EPOF XJUI (' %ZUFY TPMWFOU 'PS UIJT DPBU UIF TVSGBDFT XJUI
B CSVTI VOUJM UIFZ BSF TJHOJÌDBOUMZ EJTTPMWFE TMJNZ UFTU ÌOHFSOBJM UF

5IFO NBSL UIF DFNFOUJOH MFOHUI PG UIF ÌUUJOH PO UIF QJQF FOE TP UIBU UIF
BQQMJDBUJPO BOE UIF DPNQMFUF JOTFSUJPO PG UIF QJQF DBO CF DIFDLFE

"QQMZ UP TUJMM TPMWBUFE TVSGBDF UIF (' %ZUFY XJUI B CSVTI JO BYJBM EJSF
MFBTU TFDPOET 3FQFBU DFNFOU BQQMJDBUJPO TFWFSBM UJNFT EFQFOEJOH

"GUFS UIF ÌOBM BEIFTJWF BQQMJDBUJPO BQQMZ (' %ZUFY TPMWFOU BHBJO UP C
BSF TVÎDJFOUMZ XFUUFE UIFO JNNFEJBUFMZ QVTI UIF QBSUT UP UIF GVMM ÌUUJ
UXJTUJOH UJMUJOH BOE IPME GPS B GFX TFDPOET %VF UP UIF SBQJE TFUUJOH
PG UIF QBSUT NVTU CF EPOF XJUIJO POF NJOVUF BGUFS UIF MBTU BQQMJDBUJPO
"U UFNQFSBUVSFT BCPWF ‹$ UIF PQFO UJNF JT SFEVDFE UP MFTT UIBO POF NJ
JOTFSUJOH B EFÌOJUF SFTJTUBODF TIPVME CF GFMU 5IF GPSNJOH CFBE NVTU C

5IF FYDFTT BEIFTJWF TIPVME CF XJQFE PË JNNFEJBUFMZ

⚠ The production of GF Dytex cemented joints requires adequate expertise, which can be acquired in the appropriate training courses. The local branch of GF Piping Systems provides information on training opportunities and adhesive instructions.

⚠ For the correct choice of adhesive, observe the instructions for use of the chemical resistance of GF Dytex. More information on www.gfps.com/tools

5.4.3 Tangit EXPRESS

5BOHJU &913&44 JT TVJUBCMF GPS QSFTTVSF SFTJTUBODF DPOOFDUJPOT PG QSF
QPUBCMF XBUFS QJQF XJUI ÌUUJOHT NBEF PG 17$ 6

Applications

- 'PS DFNFOUJOH UIFSNPQMBTUJD QSFTTVSF QJQJOH TZTUFNT NBEF PG 17$ 6 QF BDDPSEBODF XJUI &/ BOE &/
- 'PS DPOTUSVDUJPO DFNFOUJOH XJUI 17$ 6 17$ $ QMBUF NBUFSJBM F H DBUDI CPYFT
- 4QFDJÌDBMMZ TVJUFE GPS 17$ 6 17$ $ QJQF BOE IPTFT JO TXJNNJOH QPPM BOE

Properties

- 'BTU MPBE DBQBDJUZ BT FBSMZ BT NJOVUFT CBS
- $FNFOUJOH KPJOU BT QFSNBOFOU BT UIF QJQF NBUFSJBM FYDFQUJPO DSJUJDBM
- .FFUT %*/ &/
- $FSUJÌFE CZ UIF UFTUJOH JOTUJUVUF 5FDIOPMPHJF[FOUSVN 8BTTFS 5;8 JO , Germany
- 'PS RVJDL SFQBJST F H ESBJO QJQF QSFTTVSF QJQF BOE HVUUFST
- Ideal for pipe up to d110

5.5 Retro t of branch ttings into an existing ABS, PVC-U or PVC-C piping system

Existing situation

0DDBTJPOBMMZ JU NBZ CF OFDFTTBSZ UP JOTUBMM NFBTVSJOH TFOTPST WFOUJ
EFWJDFT JO BO FYJTUJOH QJQJOH TZTUFN XJUIPVU VTJOH BEEJUJPOBM JOTUBMM

Solution

" IPMF JT ESJMMFE GPS UIF TPMWFOU DFNFOU TQJHPU JO UIF TFDUJPO PG UIF QJ
HSFBUFTU XBMM UIJDLOFTT JO UIF DFOUFS PG UIF QJQF TPDLFU KPJOU " TVJU
cemented into the hole.

Detailed installation steps

1. 5IF IPMF JT ESJMMFE JOUP B ESBJOFE QJQF TFDUJPO
2. 5IF IPMF JT ESJMMFE BU B SJHIU BOHMF UP UIF QJQF BYJT
3. 5IF IPMF EJBNFUFST BOE UPMFSBODFT QSPWJEFE JO UIF UBCMF CFMPX DPSSFT
   EJNFOTJPOT BDDPSEJOH UP *40 BOE BSF UP CF PCTFSWFE
   5IF EJNFOTJPO 9 JO UIF UBCMF CFMPX JOEJDBUFT UIF EJTUBODF GSPN UIF FOU
   to the center of the hole to be drilled in order to place the hole in the center of the joint.
5. 5IF FEHFT PG UIF IPMF BSF EFCVSSFE VTJOH B EFCVSSJOH UPPM
   4IBWJOHT NVTU CF SFNPWFE GSPN UIF QJQF
   1FSNJTTJCMF DPNCJOBUJPOT PG QJQF BOE CSBODI ÌUUJOH EJNFOTJPOT BSF JO
   CFMPX CZ UIF 4TFZMNFCDPUMJPO DSJUFSJB XFSF UIF TQJHPU PG UIF CSBODI ÌUUJOH E
   FYUFOE JOUP UIF QJQF CZ NPSF UIBO NN BOE UIF TPDLFU KPJOU XJUI UIF IPM
   DPWFSFE
8. 5IF CSBODI ÌUUJOH T TQJHPU JT DFNFOUFE JOUP UIF ESJMMFE IPMF BDDPSEJOH
   GPS TQJHPU KPJOUJOH QSPWJEFE JO UIF 1MBOOJOH 'VOEBNFOUBMT PG ('{1JQJ
9. 5IF XBJUJOH UJNFT CFGPSF SFBQQMZJOH QSFTTVSF NVTU CF PCTFSWFE

i If properly installed, such a connection can be pressurized up to PN10 at 20 °C and water as the medium.

Permissible combinations of pipe and outlet

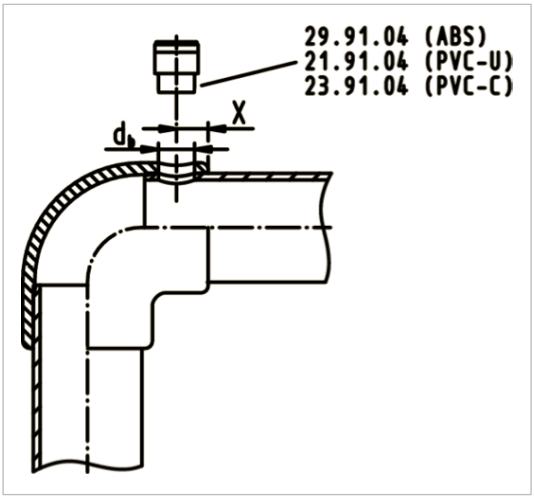
ABS PN10		Wall thickness e (mm)		Outlet dimension d (mm)	
Pipe dimension (mm)	S8, SDR17	20	25	32	40
		9	9	Y	Y
90		9	9	Y	Y
110		9	9	Y	Y
125		9	9	Y	Y
	8.3.	9	9	Y	Y
	9.5	9	9	Y	Y
180		9	9	9	Y
200	11.9	9	9	9	Y
225		9	9	9	9

ABS PN6		Wall thickness e (mm)		Outlet dimension d (mm)	
Pipe dimension (mm)	S12.5, SDR26	20	25	32	40
250		Y	9	9	Y
280		Y	9	9	9
315		Y	Y	9	9

PVC-U PN10		Wall thickness e (mm)		Outlet dimension d (mm)	
Pipe dimension (mm)	S10, SDR21	20	25	32	40
125		Y	Y	Y	Y
		9	Y	Y	Y
		9	9	Y	Y
180		9	9	Y	Y
200		9	9	9	Y
225	10.8	9	9	9	9
250	11.9	Y	9	9	9
280		Y	9	9	9
315	15.0	Y	Y	9	9
	19.1	Y	Y	9	9

PVC-U PN16		Wall thickness e (mm)		Outlet dimension d (mm)	
Pipe dimension (mm)	S6.3, SDR13.6	20	25	32	40
125	9.2	9	Y	Y	Y
	10.3	9	9	Y	Y
	11.8	9	9	9	Y

Drilling speci cations



Outlet dimension d (mm)	Hole diameter, d_b (mm)
20	20.2
25	25.2
32	32.2
Tolerance	± 0.1 mm

Pipe dimension d (mm)	Drilling position X (mm)
	22
90	
110	31
125	
	38
180	
200	53
225	59
250	
280	
315	82
	103
Toleranz	± 1 mm

5.6 Cementing di erent pipe materials

*U JT QPTTJCMF UP DFNFOU UIF QJQF NBUFSJBMT "#4 17$ 6 BOE 17$ $ XJUI POF DPOEJUJPOT NVTU IPXFWFS CF PCTFSWFE

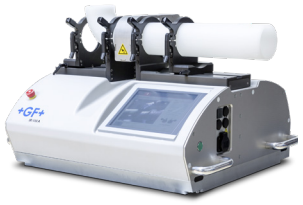
If di erent pipe materials are to be cemented, please contact your authorized GF Piping Systems representative.

5.7 Infrared fusion jointing

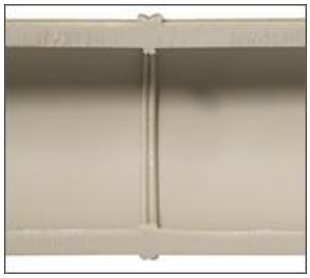
5.7.1 Overview

Material

- q 1 7 % '
- q PP
- q PP-n
- q PE100
- q & $ 5 ' &



Fusion device



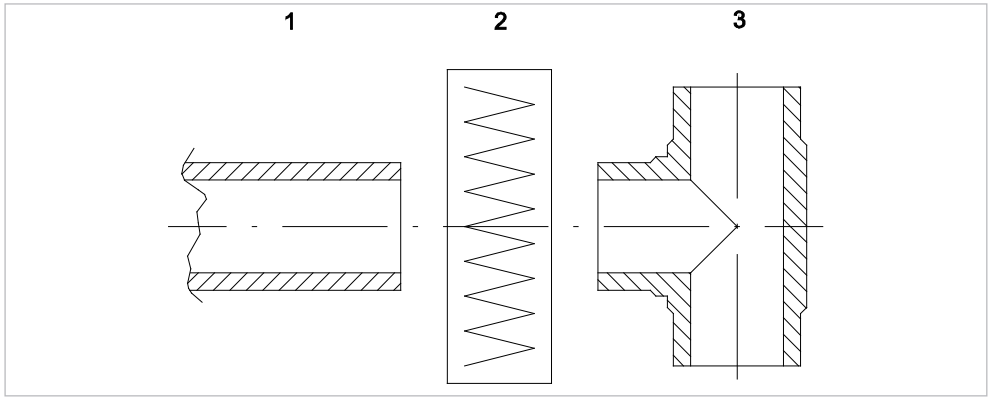
Jointing cross section (PP-H)

Macro view

5.7.2 Fusion procedure

*O JOGSBSFE *3 GVTJPO UIF GVTJPO BSFBT PG UIF DPNQPOFOUT QJQF ÌUUJOH
UP GVTJPO UFNQFSBUVSF XJUIPVU DPOUBDU UP UIF IFBUJOH FMFNFOU BOE GVTF
NFDIBOJDBM QSFTTVSF PS KPJOUJOH QSFTTVSF QBUI XJUIPVU VTJOH BEEJUJPOB

Principle of the fusion procedure



1 Pipe
2 Heating element
3 Fitting

5IF SFTVMUJOH GVTJPO KPJOUT BSF IPNPHFOFPVT BOE EJTQMBZ UIF GPMMPXJOH
- q /PO DPOUBDU IFBUJOH PG UIF KPJOUJOH DPNQPOFOUT FMJNJOBUFT UIF SJTL PG inhomogeneities
- q Small fusion beads due to adjustment of jointing pressure path prior to the fusion process

JUTFMG J F FMJNJOBUJPO PG UIF FRVBMJ[BUJPO QSPDFTT

- q -PX TUSFTT GVTJPO KPJOUT EVF UP WFSZ VOJGPSN IFBUJOH CZ VTJOH BO *3 SE

5.7.3 Properties and advantages compared to conventional butt fusion

Non-contact heating

5IF DPNQPOFOUT CFJOH KPJOUFE BSF IFBUFE UP UIF JEFBM GVTJPO UFNQFSBUVS
XJUIPVU DPOUBDU CZ VTJOH JOGSBSFE SBEJBUJPO

" EFÌOFE HBQ CFUXFFO UIF JOGSBSFE IFBUFS BOE UIF FOE GBDFT NJOJNJ[FT UIF
DPOUBNJOBUJPO PG UIF KPJOUJOH TVSGBDF $POUBNJOBUJPO PG UIF JOGSBSFE
is thus also eliminated.

Reduced bead formation

5IF GVTJPO CFBE QSPEVDFE EVSJOH GVTJPO JT DPOTJEFSBCMZ SFEVDFE XJUIPVU
#FBE GPSNJOH FRVBMJ[BUJPO JT FMJNJOBUFE CZ OPO DPOUBDU NFMUJOH PG UIF
NJOJNBM EFÌOFE CFBE JT POMZ GPSNFE EVSJOH UIF KPJOUJOH QSPDFTT 5IF GV
JNQSPWFE ÍPX EZOBNJDT JT OFBSMZ [FSP TUBUJD BOE GFBUVSFT B HSFBUFS UI

Reproducible jointing processes

5IF KPJOUJOH QBUI DPOUSPMT UIF KPJOUJOH QSFTTVSF BOE UIVT UIF GVTJPO QS
SFQSPEVDJCJMJUZ PG UIF KPJOUT JT BTTVSFE CZ UIF DMFBSMZ EFÌOFE BOE DPO
TFRVFODF

Clear, simple operator guidance

$MFBS TUSBJHIUGPSXBSE PQFSBUPS HVJEBODF JO EJËFSFOU MBOHVBHFT HVJEF
through the fusion process in logical operating steps.

Fusion reports and traceability

'VTJPO SFQPSUT XJUI BMM SFMFWBOU GVTJPO QBSBNFUFST GPS UIF DPSSFTQPOE
DBO CF QSJOUFE PVU PO B DPNNFSDJBM QSJOUFS WJB 64# JOUFSGBDFT PO UIF G
JEFOUJÌDBUJPO QVSQPTFT MBCFMT DBO CF QSJOUFE PO B MBCFM QSJOUFS UIBU
DPSSFTQPOEJOH QSPUPDPM *O BEEJUJPO UIF EBUB DBO CF FYQPSUFE GPS FYE
5PHFUIFS XJUI UIF TJHOBUVSFT PG GVTJPO PQFSBUPS BOE JOTQFDUPS UIJT BMM
NPTU TUSJOHFOU RVBMJUZ BTTVSBODF SFRVJSFNFOUT

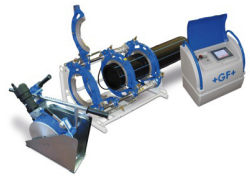
> For additional information about using the fusion procedure for corresponding materials, see www.gfps.com

5.8 Butt fusion jointing (heating element butt fusion conventional butt fusion)

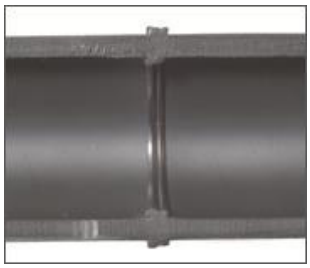
5.8.1 Overview

Material

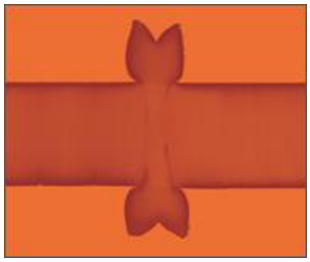
- PE
- PP
- 1 7 % '



Fusion device



Jointing cross section

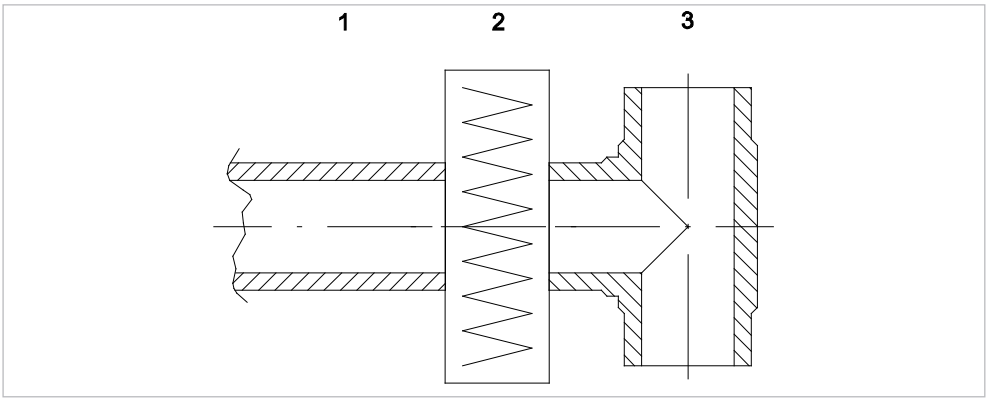


Macro view

5.8.2 Fusion procedure

'PS IFBUJOH FMFNFOU CVUU GVTJPO)# UIF GVTJPO BSFBT PG UIF QBSUT UP CF WBMWFT BSF IFBUFE UP GVTJPO UFNQFSBUVSF BOE KPJOFE CZ NFBOT PG NFDIBO XJUIPVU VTJOH BEEJUJPOBM NBUFSJBMT " IPNPHFOFPVT KPJOU JT UIF SFTVMU QSFTTVSF QJQJOH TZTUFNT NVTU POMZ CF DSFBUFE XJUI B GVTJPO EFWJDF UIBU QSFTTVSF UP CF SFHVMBUFE 8IFO CVJMEJOH QSFTTVSF QJQJOH TZTUFNT UIF D KPJOUFE NVTU IBWF UIF TBNF XBMM UIJDLOFTTFT

Principle of the fusion procedure



1 Pipe
2 Heating element
3 Fitting

5.8.3 Advantages and properties

)FBUJOH FMFNFOU CVUU GVTJPO KPJOUT BSF JOFYQFOTJWF DPOOFDUJPOT UIBU DPSSFTQPOEJOH TZTUFNT VQ UP MBSHF EJBNFUFST NN BOE NPSF 1SPGFTT CVUU GVTJPOT NFFU UIF TBNF SFRVJSFNFOUT BT UIF DPNQPOFOUT 0O TQFDJBMM GVTJPO EFWJDFT JU JT BMTP QPTTJCMF UP GVTF QBSUT BU BO BOHMF TP UIBU T 5 QJFDFT DBO CF NBEF GSPN QJQF TFHNFOUT " XJEF SBOHF PG EFWJDFT JT BWB DPOWFOUJPOBM CVUU GVTJPO UIFTF BSF EFTJHOFE GPS XPSLTIPQT QJQF USFO BOE DBO CF PQFSBUFE NBOVBMMZ FMFDUSJDBMMZ PS IZESBVMJDBMMZ

i For additional information about using the fusion procedure for corresponding materials, see www.gfps.com

5.9 Socket fusion jointing (heating element socket fusion)

5.9.1 Overview

Material

- PE
- PP
- 1 7 % '

Fusion device

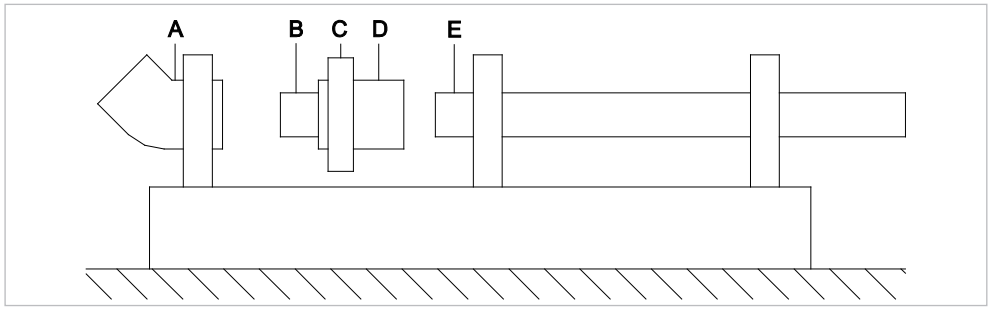
Jointing cross section

Macro view

5.9.2 Fusion procedure

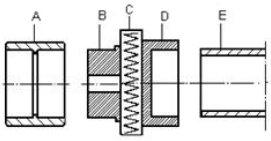
*O IFBUJOH FMFNFOU TPDLFU GVTJPO UIF QJQF FOE BOE GVTJPO TPDLFU PWFSM XJUIPVU VTJOH BOZ BEEJUJPOBM NBUFSJBM 5IF QJQF FOE BOE ÌUUJOH TPDLFU B UFNQFSBUVSF VTJOH B TPDLFU PS TQJHPU TIBQFE IFBUJOH FMFNFOU BOE BSF U PUIFS 5IF EJNFOTJPOT PG UIF QJQF FOE ÌUUJOH TPDLFU BOE IFBUJOH FMFNFOU XBZ UIBU B GVTJPO QSFTTVSF JT PCUBJOFE EVSJOH KPJOUJOH SFTVMUJOH JO B

Fusion device

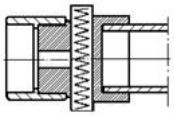


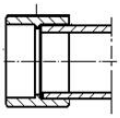
" 'JUUJOH
B Heating spigot
$)FBUJOH FMFNFOU
D Heating bush
E Pipe

Principle of the fusion procedure



Heating





Finished joint

" 'JUUJOH
B Heating spigot
$)FBUJOH FMFNFOU
D Heating bush
E Pipe

5.9.3 Advantages and properties

)FBUJOH FMFNFOU TPDLFU GVTJPO KPJOUT VQ UP B QJQF EJBNFUFS PG BQQSPY NBOVBMMZ 5IBU JT POMZ B IFBUJOH FMFNFOU XJUI NBUDIJOH BUUBDINFOUT JT EFWJDF XJUI DMBNQJOH FMFNFOUT JT OPU OFFEFE 'PS MBSHFS EJBNFUFST B GV NPWBCMF DMBNQJOH FMFNFOUT JT SFRVJSFE EVF UP UIF IJHIFS KPJOUJOH GPSD

5IF SBUIFS MBSHFS GVTJPO TVSGBDF DPNQBSFE UP CVUU GVTJPO QSPWJEFT UIF XJUI BO VOVTVBMMZ IJHI GBVMU UPMFSBODF

For additional information about using the fusion procedure for corresponding materials, see www.gfps.com

5.10 Electrofusion (heating element fusion joints)

5.10.1 Overview

Material

q PE100

Fusion device

Jointing cross section

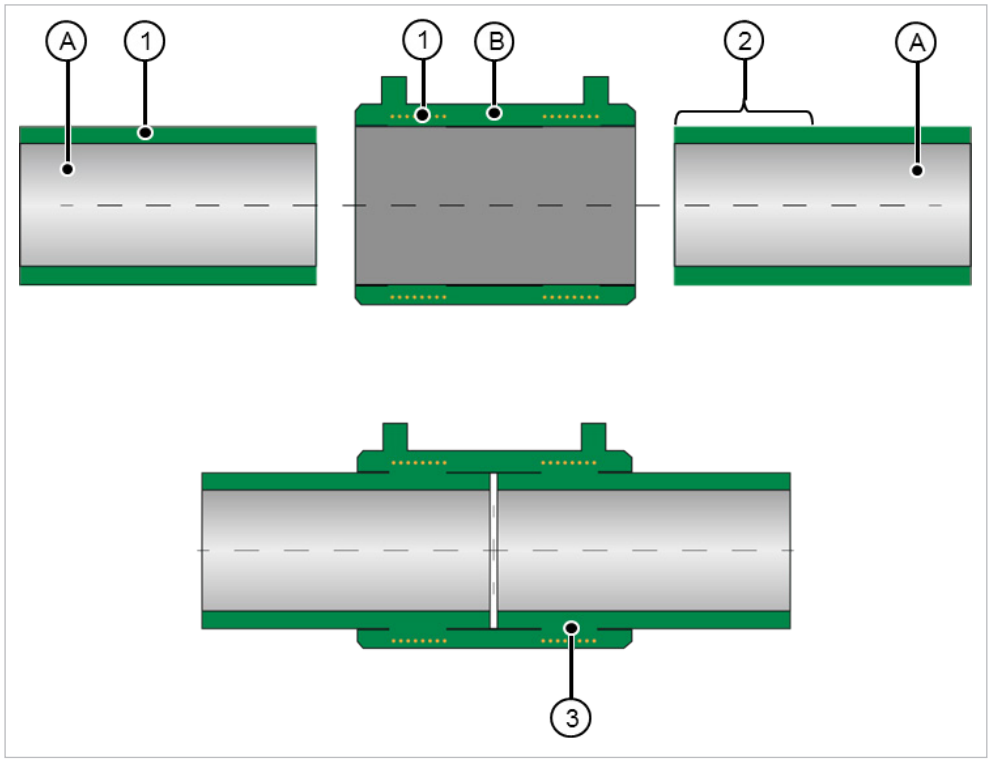
Macro view

5.10.2 Fusion procedure

#Z FMFDUSP GVTJPO QMBTUJD QJQF BOE FMFDUSPGVTJPO ÌUUJOH BSF QFSNBOF
other by a restraint and homogenuous joint s.

5IF FMFDUSPGVTJPO ÌUUJOHT BSF FRVJQQFE XJUI JOUFSOBM SFTJTUBODF XJSFT
DVSSFOU JT BQQMJFE EVSJOH UIF GVTJPO QSPDFTT 5IJT IFBUT UIF JOTJEF PG U
PVUTJEF PG UIF QJQF UP UIF GVTJPO UFNQFSBUVSF BOE NFMUT UIFN 5IF EJNFO
BOE ÌUUJOH TPDLFU DPSSFMBUF JO TVDI B XBZ UIBU B GVTJPO QSFTTVSF JT PCU
SFTVMUJOH JO B IPNPHFOFPVT KPJOU 5IF KPJOUJOH GPSDF JO UIF QPMZNFS NFN
GVTJPO JT UIF SFTVMU PG UIF WPMVNF JODSFBTF PG UIF NFMU "GUFS JU DPPMT
QFSNBOFOUMZ NPMFDVMFT PG UIF PMEFS QIBTF DSZTUBMMJUF BSF SFPSJFOUFE

Principle of the fusion procedure



" 1JQF
B Fitting
$PPMFDUJOH BSFB
Insertion depth
+PJOUJOH MFWFM

5.10.3 Advantages and properties

5IF VTF PG FMFDUSPGVTJPO UP DPOOFDU QJQF BOE ÌUUJOHT BMMPXT TBGF SBU
FÎDJFOU JOTUBMMBUJPO PG VOEFSHSPVOE BOE BCPWFHSPVOE 1& QJQJOH TZTUF

Advantages

- No fusion bead on inside of the pipe
- 'BTU QJQF MBZJOH TQFFE DPNQBSFE UP DPOWFOUJPOBM CVUU GVTJPO CFDBV CBSFMZ ÌYFE
- $POOFDUJPO PG QJQF NBEF PG 1& 1& BT XFMM BT B DPNCJOBUJPO PG 1&
- -PX JOWFTUNFOU OFFE CFDBVTF BMM EJNFOTJPOT BSF GVTFE XJUI POF GVTJPO
- 4NBMM TQBDF SFRVJSFNFOU GPS FYFDVUJPO CFDBVTF PG MJHIUXFJHIU BOE DP
- Fully automatic fusion process (high process reliability)

i For additional information about using the fusion procedure for corresponding materials, see www.gfps.com

5.11 BCF Plus fusion jointing (bead and crevice-free)

5.11.1 Overview

Material

- q 1 7 % '
- q PP-n (PP Natural)

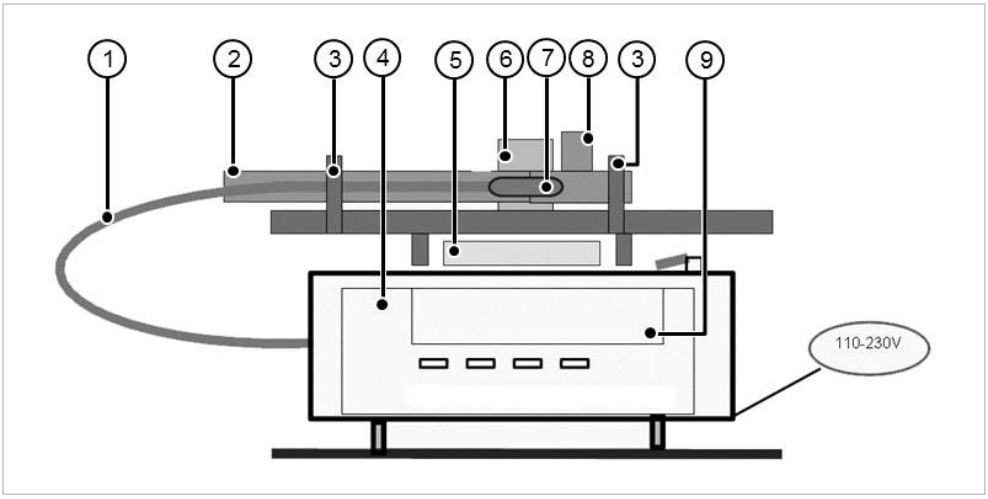
Fusion device

Jointing cross section

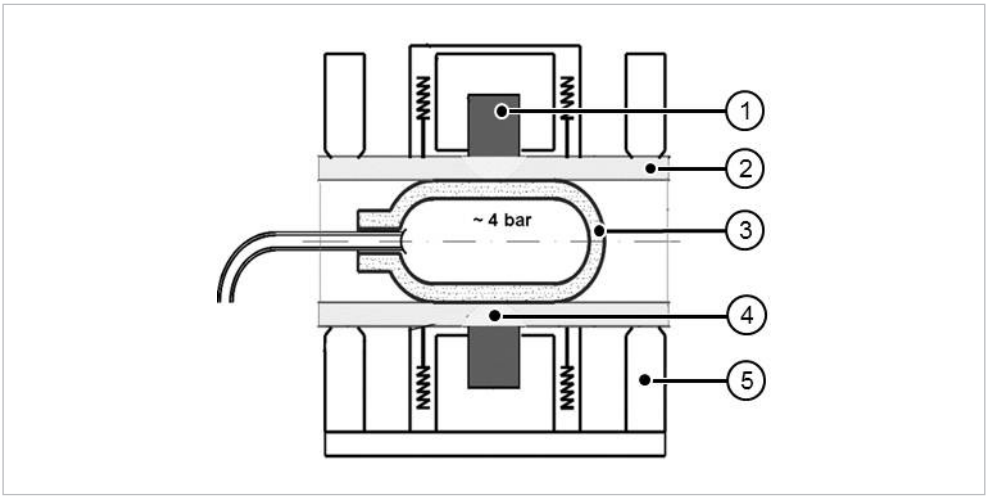
Macro view

5.11.2 Fusion procedure

5IF GVTJPO QSPDFTT DPOTJTUT PG USBOTNJUUJOH QSFDJTFMZ EFÌOFE UIFSNBM
QJQF BOE ÌUUJOH FOET CFJOH KPJOUFE CZ NFBOT PG IBMG TIFMM IFBUJOH FMFN
BO FMBTUJD QSFTTVSJ[FE CMBEEFS TVQQPSUT UIF JOTJEF TVSGBDF PG UIF GVT
QSFWFOU UIF GPSNBUJPO PG B GVTJPO CFBE ,FFQJOH UIF NFMUFE UIFSNPQMBTU
QSFTTVSF FOTVSFT JEFBM IPNPHFOFPVT GVTJPO PG UIF QMBTUJD DPNQPOFOUT
QSPDFTT DPOUSPM PG UIF GVTJPO QSPDFTT XJUI B GVTJPO EFWJDF EFWFMPQFE
QFSNJUT FYUSFNFMZ TJNQMF IBOEMJOH BOE SFQSPEVDJCMF GVTJPO RVBMJUZ



$PNQSFTTFE BJS TVQQ
Pipe
$MBNQJOH QPTJUJPO
$PNQSFTTPS GPS CMB
$PPMJOH BJS CMPXFS
)FBUJOH FMFNFOU XJU
DMBNQJOH EFWJDF
Bladder (elastic pressure
WFTTFM
Fitting
$POUSPM VOJU XJUI D
panel



Heating element
1JQF ÌUUJOH
Bladder
FMBTUJD QSFTTVSF W
'VTJPO [POF
$MBNQJOH QPTJUJPO

5.11.3 Advantages and properties

Bead and crevice-free fusion result

5IF SFTVMU PG UIF KPJOUJOH QSPDFTT JT B TVSGBDF TJNJMBS UP UIF BDUVBM Q
XJUIPVU BOZ CFBET PS DSFWJDF)FODF OP EFBE TQPUT BSF DSFBUFE 5IF TVSG
XJUIJO UIF SBOHF PG UIF QJQJOH TZTUFN DPNQPOFOUT

Reproducible jointing processes

5IF IJHI SFQSPEVDJCJMJUZ PG UIF GVTJPOT JT BTTVSFE CZ UIF DMFBSMZ EFÌOFE
QSPDFTTFTRTVFODF

Clear, simple operator guidance

$MFBS TUSBJHIUGPSXBSE PQFSBUPS HVJEBODF JO EJËFSFOU MBOHVBHFT MFBET
through the fusion process in logical operating steps.

Fusion reports and traceability

'VTJPO SFQPSUT XJUI BMM SFMFWBOU GVTJPO QBSBNFUFST GPS UIF DPSSFTQPOE
DBO CF QSJOUFE PVU PO B DPNNFSDJBM QSJOUFS WJB 64# JOUFSGBDFT PO UIF G
JEFOUJÌDBUJPO QVSQPTFT MBCFMT DBO CF QSJOUFE PO B MBCFM QSJOUFS UIBU
DPSSFTQPOEJOH QSPUPDPM *O BEEJUJPO UIF EBUB DBO CF FYQPSUFE UP B 64#
TQFDJBM TPGUXBSF 5PHFUIFS XJUI UIF TJHOBUVSFT PG GVTJPO PQFSBUPS BOE
GPS NFFUJOH UIF NPTU TUSJOHFOU RVBMJUZ BTTVSBODF SFRVJSFNFOUT

i For additional information about using the fusion procedure for corresponding materials, see www.gfps.com

Design and Installation

of Special Solutions

Content

1 CONTAIN-IT Plus 255

1.1 Introduction

%PVCMF DPOUBJONFOU QJQJOH TZTUFNT

1MBOOJOH DSJUFSJB

1.4 Installation instructions

1.5 Fittings for solvent cementing / socket fusion and installation

'JUUJOHT GPS CVUU BOE *3 GVTJPO BOE JOTUBMMBUJPO

-FBL EFUFDUJPO BOE MFBL MPDBUJOH TZTUFNT

0QFSBUJOH BOE NBJOUFOBODF JOTUSVDUJPOT

1.9 Pressure testing the inner and outer pipe

1.10 Static evidence

8FMEJOH NBDIJOFT GPS CVUU BOE TPDLFU GVTJPO

%PVCMF DPOUBJONFOU TQFDJBM DPNQPOFOUT

2 COOL-FIT 2.0/2.0M 308

(FOFSBM *OGPSNBUJPO

4ZTUFN 4QFDJÌDBUJPO

5FDIOJDBM %BUB

%JNFOTJPOJOH BOE EFTJHO

+PJOUJOH BOE *OTUBMMBUJPO

5SBOTQPSU BOE 4UPDLJOH

&OWJSPONFOU

V

3 COOL-FIT 4.0 358
(FOFSBM *OGPSNBUJPO
4ZTUFN 4QFDJÌDBUJPO
5FDIOJDBM %BUB
%JNFOTJPOJOH BOE %FTJHO
+PJOUJOH BOE *OTUBMMBUJPO
5SBOTQPSU)BOEMJOH BOE 4UPSBHF
4 COOL-FIT ABS Plus 413
4.1 General Information
$00- '*5 "#4 1MVT 414
$00- '*5 POMJOF DBMDVMBUJPO UPPM
%JNFOTJPOJOH IZESBVMJD DBMDVMBUJPO BOE JOTUBMMBUJP
+PJOUJOH 5FDIOPMPHZ
*OUFSOBM QSFTTVSF UFTU
4UPSBHF BOE IBOEMJOH 440
&OWJSPONFOU 440

1 CONTAIN-IT Plus

1.1 Introduction

Application areas

- 'PS HBTFPVT PS MJRVJE NFEJB XIFSF BOZ MFBLBHF PG UIF QJQJOH TZTUFN XP QFSTPOOFM UIF FOWJSPONFOU PS UIF PQFSBUJPOT
- 'PS TUSPOH EJËVTJOH N)FEJB)')$-)/0
- 'PS QJQJOH TZTUFNT XIJDI NVTU CF NBJOUBJOFE JO PQFSBUJPO VOEFS BMM DJ PSEFS UP HVBSBOUFF QSPDFTT SFMJBCJMJUZ FWFO JO UIF DBTF PG B MFBL
- For application conveying critical liquids

Market segments

- 8BUFS SFBUNFOU XBTUFXBUFS UFBUNFOU
- $IFNJDBM QSPDFTT JOEVTUSZ EJTUSJCVUJPO QJQF TZTUFNT HBMWBOJ[BUJPO treatment)
- .JDSPFMFDUSPOJDT JOEVTUSZ DIFNJDBM XBTUF QIPUPWPMUBJDT
- $PPMJOH CSFXFSJFT BOE GPPE JOEVTUSZ

Characteristics

Connection bene t

5IF QBUFOUFE EPVCMF DPOUBJONFOU KPJOUJOH UFDIOJRVF FOBCMFT UIF KPJOUJOH PG UIF EPVCMF DPOUBJONFOU QJQF TJNJMBS UP UIF KPJOUJOH PG B TJOHMF QJQF BDDPSEJOH UP UIF TBNF EJSFDUJWFT BOE HVJEFMJOFT GSPN UIF %74 (FSNBO BTTPDJBUJPO GPS KPJOUJOH BT GPS TUBOEBSE UIFSNPQMBTUJD QJQJOH DPOOFD tions.

5IF UZQF PG DPOOFDUJPO BMMPXT B QSFTTVSF UFTUJOH PG UIF JOOFS QJQF CFGPSF UIF PVUTJEF QJQF JT XFMEFE

Design bene t

5P FOTVSF PQFSBUJPOBM TBGFUZ BOE B MPOH MJGF UIF DIPJDF PG UIF NBUFSJB JT PG LFZ JNQPSUBODF (' 1JQJOH 4ZTUFNT IFMQT ZPV UP ÌOE UIF JEFBM NBUFSJ BQQMJDBUJPO GSPN B MBSHF QSPEVDU SBOHF PG TJY EJËFSFOU UIFSNPQMBTUJD

Planning bene t

" MBSHF OVNCFS PG XFMM LOPXO JOUFSOBUJPOBM DPNQBOJFT DIPPTF B DPNQMF TJOHMF TPVSDF TVQQMJFS CFDBVTF SFMJBCMF DBMDVMBUJPO DBO CF NBEF POM TZTUFN 'PS B EPVCMF DPOUBJONFOU QJQJOH TZTUFN UIF UFOTJPOT DSFBUFE C FYQBOTJPO TUSFTTFT BOE UFNQFSBUVSF EJËFSFODFT CFUXFFO UIF JOOFS BOE F DBMDVMBUFE 5IJT XJMM DPOÌSN UIF NFDIBOJDBM TUBCJMJUZ PG UIF XIPMF QJQJ

Environmental bene t

&OWJSPONFOUBM SJTLT BSF TZTUFNBUJDBMMZ BOBMZ[FE JO UIF TDPQF PG *40 NFBTVSFT BSF UIFO UBLFO UP NJOJNJ[F UIFTF SJTLT %PVCMF DPOUBJONFOU QJC NJOJNJ[F UIF SJTLT PG JODJEFOUT HJWJOH ZPV UIF PQQPSUVOJUZ UP SFEVDF J maintain your company image.

&OWJSPONFOUBM BXBSFOFTT BOE JODSFBTFE TBGFUZ TUBOEBSET BSF CFDPNJOH JNQPSUBOU JO UPEBZ T TPDJFUZ 1FSTPOBM JOKVSZ QSPQFSUZ EBNBHF BOE FO DBVTFE CZ MFBLBHFT BSF LFZ DPODFSOT UIBU IBWF MFE VT BT B QJQJOH TZTUF B TVJUBCMF TZTUFN UP SFEVDF QPUFOUJBM IB[BSET 5P FOTVSF QMBOU TBGFUZ TVCTUBODFT XIJDI DPVME FOEBOHFS IVNBOT BOE UIF FOWJSPONFOU BOE QSPDFT QJQJOH TZTUFN XIJDI PËFST PQUJNBM DIFNJDBM SFTJTUBODF BOE XIJDI SFDPHO BOZ MFBLBHF UIBU NBZ PDDVS $VTUPNFS GSJFOEMZ JOTUBMMBUJPO BOE QSPWF connection technologies are important requirements for manufacture.

Legal provisions

Switzerland

5IF SFHVMBUJPO DPODFSOJOH UIF QSPUFDUJPO PG EJTUVSCBODFT , (FOFSBM TUBUFT UIBU DPNQBOJFT IBWF UP UBLF BMM TVJUBCMF NFBTVSFT JO PSEFS UP N JODMVEFT NFBTVSFT UP SFEVDF UIF IB[BSE QPUFOUJBM QSFWFOU EJTUVSCBODF environmental impacts.

5IF GFEFSBM MBX BCPVU UIF QSFWFOUJPO PG XBUFS QPMMVUJPO , (FOFSBM UIBU PXOFST PG JOTUBMMBUJPOT DPOWFZJOH MJRVJET IB[BSEPVT UP XBUFST IB NFBTVSFT BSF UBLFO UP QSPUFDU XBUFST 5IFTF NFBTVSFT EFÌOF UIBU JOTUBMM EFTJHOFE JOTUBMMFE NBJOUBJOFE BOE PQFSBUFE UP HVBSBOUFF UIBU OP OBU CF QPMMVUFE 'VSUIFSNPSF BOZ LJOE PG MPTT PG MJRVJET NVTU CF BWPJEFE E MJRVJET NVTU CF QSFWFOUFE GPS TUPSBHF GBDJMJUJFT BOE SFÌMMJOH QPJOUT

Germany

5IF (FSNBO 8BUFS .BOBHFNFOU "DU , H 8)(BQQMJFT UIF EVUZ PG DBSF QSJ TUPSBHF ÌMMJOH NBOVGBDUVSJOH BOE USFBUNFOU PG TVCTUBODFT XIJDI BSF BOE UP JOUFSOBM QJQJOH TZTUFNT JO UIF JOEVTUSZ 5IJT TUJQVMBUFT UIBU JO MJRVJET UIBU FOEBOHFS UIF XBUFS RVBMJUZ NVTU CF EFTJHOFE JOTUBMMFE N UP HVBSBOUFF UIBU OP OBUVSBM XBUFS TVQQMJFT DBO CF QPMMVUFE

*O BDDPSEBODF XJUI B SVMJOH PG UIF (FSNBO 'FEFSBM "ENJOJTUSBUJWF $PVSU QSJODJQMF SFRVJSFT UIF FMJNJOBUJPO PG FWFO UIF MJLFMJIPPE UIBU BOZ XBU

Requirement of German regulations on installations handling substances which are hazardous to water (§3 VAwS)

*OTUBMMBUJPOT NVTU CF EFTJHOFE BOE PQFSBUFE JO TVDI B XBZ UIBU OP TVCT IB[BSEPVT UP XBUFS DBO MFBL 5IFZ NVTU CF MFBL QSPPG TUBCMF BOE TVÎDJFO BHBJOTU UIF FYQFDUFE UIFSNBM NFDIBOJDBM BOE DIFNJDBM JOÍVFODFT

-FBLBHF PG BOZ QBSU PG BO JOTUBMMBUJPO DPOWFZJOH NFEJB XIJDI FOEBOHFS CF SFDPHOJ[FE JO B GBTU BOE SFMJBCMF XBZ 5IF BGPSFNFOUJPOFE SFRVJSFNF TZTUFNT DBO CF GVMÌMMFE UISPVHI UIF FYJTUJOH SFUFOUJPO TQBDF CFUXFFO U QJQF JO ('nT EPVCMF DPOUBJONFOU QJQJOH TZTUFN

1.2 Double containment piping systems

1.2.1 Pressure-tight outer pipe

5IF $0/5"*/ *5 1MVT EPVCMF DPOUBJONFOU QJQJOH TZTUFN DPNQSJTFT BO PVUFS
NBEF GSPN 1& XIJDI JT XFMEFE QSFTTVSF UJHIU VTJOH &-(&' 1MVT FMFDUSPG
5IF QSPUFDUJWF QJQF TFSWFT BT B MFBL NPOJUPSJOH TQBDF XIFSF TQJMMT UI
JOOFS QJQF VOEFS DFSUBJO DJSDVNTUBODFT BSF DPOUBJOFE VOUJM UIF MFBL
SFQBJSFE *O BEEJUJPO JU JT VTFE UP DPOWFZ MJRVJET GPS UIF QVSQPTF PG T
of the medium in the inner pipe.

#PUI UIF JOOFS BOE UIF PVUFS QSPUFDUJWF QJQF BSF SFMJBCMF RVBMJUZ DPO
TZTUFNT XIJDI BSF JNQMFNFOUFE XJUIPVU DIBOHFT 5IF KPJOUJOH UFDIOJRVFT
XJUIPVU FYDFQUJPO UP UIF SFMFWBOU HVJEFMJOFT GPS QSFTTVSF QJQJOH TZTU
BSF OP MJNJUT UP UIF DIPJDF PG JOOFS QJQF NBUFSJBMT FOTVSJOH UIBU UIF N
NBUDIFE UP UIF DIFNJDBM SFTJTUBODF SFRVJSFE CZ UIF QBSUJDVMBS BQQMJDBU

1.2.2 Outer pipe splash guard

5IF $0/5"*/ *5 1MVT TQMBTI QSPUFDUJPO TZTUFN EJËFST GSPN UIF QSFTTVSF UJH
VTBHF PG BO &1%. SVCCFS DPMMBS XJUI B TUBJOMFTT TUFFM DPVQMFS GPS DPO
5IF &1%. SVCCFS DPMMBS JT QSFTTVSF UJHIU VQ UP CBS 5IF SVCCFS DPMMBS
QJQF NBUFSJBMT 1& BOE USBOTQBSFOU 17$ 6 UP CF RVJDLMZ DPOOFDUFE UP
VTF PG UPPMT PS BOZ NBDIJOJOH PG UIF QJQF 5IF DPOOFDUJPO PG UIF ÌUUJOHT
QSFTTVSF UJHIU TZTUFN 5IF QSFGFSSFE NBUFSJBM GPS UIF PVUFS QJQF JT USB

1.2.3 Criteria for safe operation

5IF GPMMPXJOH DSJUFSJB BSF JNQPSUBOU GPS TBGF PQFSBUJPO

- 'PS TBGFUZ SFBTPOT UIF DPNQPOFOUT PG UIF NFEJB DPOWFZJOH JOOFS QJQF
  BMUFSFE GSPN UIFJS TUBOEBSE WFSTJPO 5IJT FOTVSFT UIF DPOTJTUFOU UFT
  %*#U BQQSPWFE (FSNBO *OTUJUVUF GPS #VJMEJOH 5FDIOPMPHZ JOEJWJEVBM
  ÌUUJOHT GPS UIF GPMMPXJOH NBUFSJBMT 17$ 6 ; 1& BOE 1& ;
  11) ; BOE 17%' ; 5IF QJQF IBWF UP CF %*#U BQQSPWFE
- 5IF %74 (FSNBO "TTPDJBUJPO GPS 'VTJPO 5FDIOPMPHZ GVTJPO HVJEFMJOFT B
  1JQF "TTPDJBUJPO TPMWFOU DFNFOUJOH JOTUSVDUJPOT BSF BQQMJDBCMF XJ
  FTQFDJBMMZ UP EPVCMF DPOUBJONFOU QJQJOH TZTUFNT 1BSUJDVMBSMZ JNQP
  NPOJUPSJOH BOE UIF WJTVBM JOTQFDUJPO EVSJOH UIF CVJME VQ PG UIF GVTJ
  pipe during the fusion process.
- 5IF QSFTTVSF UFTU PO UIF JOOFS QJQF NVTU CF DBSSJFE PVU CFGPSF UIF PVU
  1BSUJDVMBSMZ JO UIF DBTF PG EPVCMF DPOUBJONFOU QJQJOH TZTUFNT XIFSF
  TBGFUZ OP ESZ KPJOUT DBO CF UPMFSBUFE
- 'JY QPJOU JOTUBMMBUJPO XJUI TUSVDUVSBM DFSUJÌDBUF UIF NJOJNVN EJNFOT
  CFUXFFO UIF JOOFS BOE PVUFS QJQF QSFWFOUT BOZ QPTTJCMF MPOHJUVEJOBM
  TZTUFN NVTU CF ÌOJTIFE BT B ÌY QPJOU JOTUBMMBUJPO " TUSVDUVSBM DFSUJÌ
  for the pipe system. See chapter 4UBUJD FWJEFOD5HFPQOSQBWIDU SBOHF
  JODMVEFT SBEJBM EJTNPVOUBCMF NFDIBOJDBM DPVQMJOHT GPS NBJOUFOBODF
  TZTUFN PS UP DBSSZ PVU TVCTFRVFOU FYUFOTJPOT $POOFDUJPOT GPS DPNN
  EFWJDFT NVTU CF QSPWJEFE

1.2.4 Authorization of installation personnel

&BTZ UP MFBSO UFDIOPMPHZ TUSJDU BEIFSFODF UP TUBOEBSET BOE SFHVMBUJP
decades of experience in plastic piping system construction are the marks of distinction of
UIF EPVCMF DPOUBJONFOU QJQJOH TZTUFN GSPN (' 1JQJOH 4ZTUFNT "EEFE UP U
SFRVJSFNFOUT JO UIF JOUFSFTU PG TBGFUZ JT UIF DBSFGVM USBJOJOH PG UIF
DPOUBJONFOU TZTUFNT NBZ CF JOTUBMMFE POMZ CZ QFSTPOT XIP IBWF CFFO TQ
BOE BVUIPSJ[FE CZ (' 1JQJOH 4ZTUFNT

1.2.5 CONTAIN-IT Plus product range

PE100 outer pipe

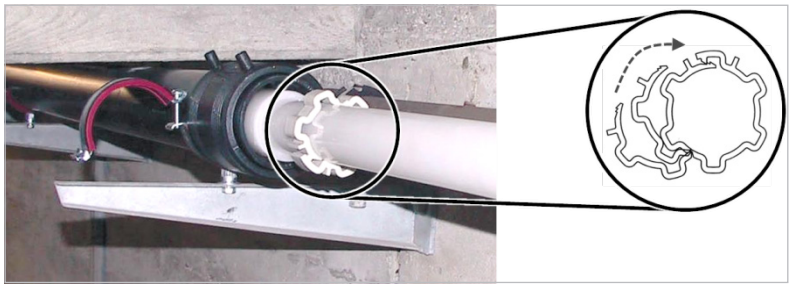
Dimension (mm)		Inner pipe										
		Solvent cementing				Socket fusion			Butt fusion			
		17$ 5BOH%UZUFY	617$ %UZUFY	617$ 5BOH%UZUFY	17 %UZUFY	$11) 1&		17%'	11) 1& 4%3	1& 4%3	17%' 1/	17%' 1/
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9	9	y	y	y	
E	%	9	9	9	9	9	9		y	y	y	
E	%	9	9	9	9	9	9		y	y	y	
E	%	9	9	9	9	9	9		y	y	y	
E	%	9							9	9		9
E	%	9							9	9		9
E	%	9							9	9		9
E	%	9							9	9		9
E	%	9							9	9		9

y $PNQBUJCMF XJUI CVU
JOGSBSFE *3 XFMEJO
technology
0UIFS DPNCJOBUJPOT
F H 17%' XJUI #$' CFBE
DSFWJDF GSFF PO SFRV

1.2.6 Inner pipe

5IF DIPJDF PG EJËFSFOU UZQFT PG QMBTUJD GPS UIF JOOFS QJQF BMMPXT UIF Q
PQUJNBMMZ NBUDIFE UP QIZTJDBM BOE DIFNJDBM SFRVJSFNFOUT 17$ 6 17$ $ 1

$MJDL TZTUFN TQBDFST BSF DMBNQFE UP UIF JOOFS QJQF XIJDI JT UIFO QVTIF
r QJQF BSF OPU TVQQMJFE FY XPSLT BT EPVCMF QJQF 5IF QJQF DBO BMTP CF VT



Spacer on inner pipe

Outer pipe PE100

5IF PVUFS QSPUFDUJWF QJQF XIJDI TVSSPVOET UIF NFEJVN DPOWFZJOH JOOFS
1& QPMZFUIZMFOF 5IF LFZ GFBUVSFT PG UIJT NBUFSJBM BSF JUT HPPE DIFNJD
BDJET BMLBMJT BOE TBMUT BT XFMM BT B OVNCFS PG PSHBOJD BOE JOPSHBOJD
SFTJTUBODF PG UIJT CMBDL TUBCJMJ[FE XJUI DBSCPO CMBDL QPMZFUIZMFOF U
JOTVTDFQUJCJMJUZ UP OPUDIJOH ÍFYJCJMJUZ BOE JNQBDU SFTJTUBODF FWFO
UP ‹$ NBLF UIJT QSPUFDUJWF QJQF NBUFSJBM JEFBM GPS QJQF MBJE JOEPPS
ground.

Transparent PVC-U splash outer pipe

5IF QSFTTVSF MFWFM PG UIF PVUFS QJQF JT SFTUSJDUFE UP CBS CZ UIF VTF PG
5IF DPEF OVNCFST BOE XBMM UIJDLOFTTFT PG UIF QSPUFDUJWF QJQF 1& PS 1
UIF EPVCMF DPOUBJONFOU QSPEVDU DBUBMPH

Gaskets

8IFO MBZJOH UIF JOOFS QJQF TFBMJOH NBUFSJBM TIPVME CF TFMFDUFE UIBU JT
QSFWBJMJOH PQFSBUJPO DPOEJUJPOT "WBJMBCMF DIPJDFT BSF &1%. ',. BOE G
'',. PO SFRVFTU 5IF TFBMJOH NBUFSJBM VTFE GPS UIF QSPUFDUJWF QJQF JT &

Fittings for inner and outer pipe

5IF JOEJWJEVBM ÌUUJOHT GPS UIF JOOFS BOE PVUFS QJQF BSF JOKFDUJPO NPME
BTTVSFE QSPDFEVSFT 5IF JOOFS ÌUUJOHT BSF BWBJMBCMF JO BMM (' 1JQJOH 4Z
NBUFSJBMT 'JUUJOHT BSF GBDUPSZ NBEF BOE TVQQMJFE SFBEZ UP JOTUBMM *C
EPVCMF DPOUBJONFOU TZTUFN UIF PVUFS ÌUUJOH r BMXBZT NBEF GSPN 1& QP
BMSFBEZ BUUBDIFE UP UIF JOOFS ÌUUJOH 5IF JOOFS BOE PVUFS ÌUUJOHT BSF DF
TUVSEZ TVQQPSU SJOHT XIJDI BDU BT ÌYFE QPJOUT GPS UIF JOOFS QJQF 5IJT Q
PG UIF JOOFS QJQF JOTJEF UIF PVUFS QJQF 5IF FOUJSF TZTUFN NVTU CF ÌOJTIF
JOTUBMMBUJPO XJUI B TUSVDUVSBM DFSUJÌDBUF

0O TPMWFOU DFNFOUBCMF QMBTUJDT 17$ 6 17$ $ B DFNFOUFE TPDLFU KPJOU
JOOFS QJQF " OVNCFS PG EJËFSFOU GVTJPO QSPDFTTFT BSF BWBJMBCMF GPS D
QMBTUJDT 1& 11) BOE 17%' 4PDLFU GVTJPO DBO CF VTFE GPS 11) 1& E
BOE 17%' E UP E 'PS UIF SBOHF E UP E CVUU GVTJPO UFDIOJR
CF VTFE BMUIPVHI JOGSBSFE GVTJPO UFDIOJRVFT DBO BMTP CF VTFE JO DFSUBJ
$0/5"*/ *5 1MVT QSPEVDU SBOHF PO QBHF

8IFSFWFS QPTTJCMF GBDUPSZ ÌOJTIFE KPJOUT BSF NBEF CZ JOGSBSFE GVTJPO

5IF 1& PVUFS ÌUUJOHT IBWF JOUFHSBUFE QJQF TQJHPUT r XIJDI BMTP BDU BT UIF
JOOFS QJQF r GPS DPOOFDUJPO CZ NFBOT PG QVTI PO &-(&' 1MVT FMFDUSPGVTJF
SVCCFS DPMMBST 5IF QVTI PO &-(&' 1MVT FMFDUSPGVTJPO TPDLFU PS SVCCFS D
PWFS UIF FOE PG UIF QJQF CFJOH DPOOFDUFE PS UIF MPOH FOE PG UIF ÌUUJOH
DPOOFDUFE 5IF FMFDUSPGVTJPO TPDLFU XJMM ÌU BMPOH POMZ IBMG UIF MFOHU
ÌUUJOH

Termination tting

4QFDJBMMZ EFTJHOFE BOE QBUFOUFE UFSNJOBUJPO ÌUUJOHT XJUI BO 3Q˜ DPOO
NPOJUPSJOH TQBDF BSF JOTUBMMFE BU UIF TUBSU BOE FOE PG UIF EPVCMF DPC
ÌUUJOHT BSF BMTP TVJUBCMF GPS TVCEJWJEJOH UIF PVUFS QJQF J F UP EJWJE
EFUFDUJPO [POFT UIFSFCZ FOBCMJOH FBTJFS MPDBUJPO PG MFBLT

Branch saddles

#SBODI TBEEMFT GPS ÌUUJOH UP UIF QSPUFDUJWF QJQF BGUFS DPOOFDUJPO BS
PG B MFBLBHF MPDBUJOH TZTUFN GPS ÍVTIJOH UIF TQBDF CFUXFFO UIF QJQF GI
IJHIFTU QPJOU PG UIF QJQJOH TZTUFN PS BT VOJPOT GPS DBSSZJOH PVU B QSF
CFUXFFO UIF QJQT

Valves

Specially designed manual and actuatedE PVCMF DPOUBJONFOU WBMWFT DBO CF FBTJMZ JOUFHSB
JO UIF TZTUFN BOBMPHPVT UP UIF ÌUUJOHT %PVCMF DPOUBJONFOU WBMWFT BSF
TVQQMJFE BT B TZTUFN VOJU 5IFZ DBO CF FYUFSOBMMZ PQFSBUFE BOE PQFOFE
purposes and to carry out a pressure test on the inner pipe.

1.3 Planning criteria

1.3.1 Material selection for the medium-conveying inner pipe

5IF DIPJDF PG NBUFSJBM BOE UIF QSFTTVSF SBUJOH PG UIF QJQF DPNQPOFOUT E
PQFSBUJOH TBGFUZ BOE GPS BUUBJOJOH UIF TQFDJÌFE NJOJNVN PQFSBUJPOBM M
EFDJTJWF GBDUPST BSF UIF GPMMPXJOH

- 0QFSBUJOH UFNQFSBUVSF
- 0QFSBUJOH QSFTTVSF
- Medium transported
- 5JNF PG PQFSBUJPO

5IF DIFNJDBM SFTJTUBODF MJTU BOE UIF NBUFSJBM SFMBUFE QSFTTVSF BOE UFN
CF VTFE UP QSFTFMFDU UIF NBUFSJBM

5IFTF BJET DBO CF GPVOE JO UIF UFDIOJDBM NBOVBM BOE PO PVS XFCTJUF XXX

General chemical resistance of thermoplastics

Resistance	PVC-U and PVC-C	PP and PE	PVDF
3FTJTUBOU	"DJET BOE CBTFT	"DJET CBTFT	"DJET BOE CBTFT
		XFBL TPMWFOUT BOE halogens	TPMWFOUT BOE
/PU SFTJTUBOU	4USPOH PYJEJ[JOH BHFOUT BOE tenside	NJOFSBM PJM halogens	TUSPOH PYJEJ[JOH BHFOUT BOE BMLBMJT

1.3.2 Material selection for the outer pipe

5IF QSFTTVSF SBUJOH PG UIF PVUFS QJQF NVTU DPSSFTQPOE UP UIF TFSWJDF QS
QJQF VOUJM UIF EBNBHF JT SFQBJSFE *O DBTF PG MFBLBHF UIF QSFTTVSF SFTJ
SFTJTUBOU 1& PVUFS QJQF NVTU CF BCMF UP DPOUBJO UIF TQJMM *O UIF FWF
UIF NFEJVN OPSNBMMZ EPFT OPU SFRVJSF BO JNNFEJBUF TIVUEPXO PG UIF PQFS
QPTTJCMF UP DPNQMFUF POHPJOH QSPEVDUJPO SVOT CFGPSF TIVUUJOH EPXO

8IFO VTJOH UIF TQMBTI HVBSE PVUFS QJQF TZTUFN XJUI B USBOTQBSFOU 17$ 6 P
SFTUSJDUFE QSFTTVSF MPBEJOH PG CBS NVTU CF UBLFO JOUP BDDPVOU 5IFSF
of higher pressure developing in the protective pipe in the event of a leak.

1.3.3 Questionnaire for static evidence

5IF RVFTUJPOOBJSF GPS TUBUJD FWJEFODF 4FDUJPO 4UBUJD FWJEFODF JT VTF
the selected piping system is resistant under the given operating conditions. See chapter
2VFTUJPOOBJSF GPS TUBUJD FWJEFODF PO QBHF

'PS ÌY QPJOU JOTUBMMBUJPO SFTUSJDUFE MPOHJUVEJOBM FYQBOTJPO JU JT O
TUSFTTFT BOE GPSDFT PO UIF PVUFS QJQF ÌUUJOHT XIJDI UIF ÌY QPJOU QJQF CS
UP BCTPSC

5IF ÌY QPJOU GPS UIF JOOFS QJQF JT BMSFBEZ CVJMU JOUP FBDI ÌUUJOH CZ NFB
UIF DBMDVMBUFE TUSFTT PO UIF QJQF JT UPP HSFBU UIF PQFSBUJOH DPOEJUJPO
changed.

5IF DBMDVMBUJPO BMTP JOEJDBUFT UIF EJTUBODFT CFUXFFO TQBDFST GPS UIF J
EJTUBODFT CFUXFFO QJQF CSBDLFUT GPS UIF PVUFS QJQF BT XFMM BT UIF GPSI

&YQBOTJPO JO UIF QJQJOH TZTUFN OFFE OPU CF UBLFO JOUP DPOTJEFSBUJPO C
loops or compensators are required.

1.3.4 Determining the layout

5IF QJQF MBZPVU TIPVME CF QMBOOFE TP UIBU UIF QJQF BSF QSPUFDUFE GSPN N
UIFSNBM FËFDUT 5IF OFDFTTBSZ NJOJNVN EJTUBODF GSPN XBMMT BOE DFJMJOH
considered.

'PS MBSHF ÌY QPJOU GPSDFT UIF BODIPSJOH NFUIPE PO UIF CVJMEJOH NBUFSJBI
*G CVJMEJOH NBUFSJBM DBOOPU BCTPSC BOZ ÌY QPJOU GPSDFT F H USBQF[PJE
GPSDFT NVTU CF BCTPSCFE WJB TUVSEZ USBWFMJOH SBJMT

1.3.5 Determining the leak detection

-FBL EFUFDUJPO JT BO JNQPSUBOU FMFNFOU PG UIF EPVCMF DPOUBJONFOU QJQJ
taken into consideration.

Leak detection and locating systems must be observed. See chapter "1.7 Leak detection and leak locating systems" on page 288

1.3.6 Isometric drawing

5IF ‹ JTPNFUSJD ESBXJOH TFF FYBNQMF PG DVUUJOH MFOHUI DBMDVMBUJPO Q
WJFX PG UIF QJQJOH MBZPVU 8IFO UIF BYJT EJNFOTJPOT BSF FOUFSFE UIF DVU
DBMDVMBUFE BOE UIF JOTUBMMBUJPO EJSFDUJPO PG UIF ÌUUJOHT EFUFSNJOFE

5IJT DBO CF VTFE UP SFQSFTFOU UIF WFOUJMBUJPO SJOTJOH BOE TIVU PË SFRV
JOTUBMMBUJPO QPTJUJPO PG UIF FOE BOE TFDUJPOBM ÌUUJOHT

1.3.7 Sizing

5IF QJQF EJBNFUFS JT EFUFSNJOFE CZ DBMDVMBUJOH UIF QSFTTVSF MPTT XJUIJO
EFQFOET OPU POMZ PO UIF EJBNFUFS MFOHUI PS QJQF NBUFSJBM CVU BMTP PO
UIF ÍPX SBUF

" DBMDVMBUJPO DBO CF EPOF CBTFE PO %74

'PS QSPKFDU QMBOOJOH DPOTUSVDUJPO BOE JOTUBMMBUJPO PG EPVCMF DPOUB
SFGFS UP UIF %74 HVJEFMJOF %74

1.4 Installation instructions

1.4.1 Jointing double containment pipe

Patented double containment jointing technology

5IFQSJODPJGQMFJQJZFUFNTDPFUBJOPNFDIPJDFCFUE
GBDU UIBU UIF JOOFS QJQF JT KPJOFE ÌSTU VTJOH UIF UFDIOJRVFT EFTDSJCFE O
EPVCMF DPOUBJONFOU QJQJOH TZTUFN JT KPJOUFE JO UIF TBNF NBOOFS BT B TJ
5IF TP DBMMFE oMBTU KPJOUTp XIJDI PDDVS XJUI FWFSZ DIBOHF PG EJSFDUJPO
XIJDI BSF UIFO VTVBMMZ EPOF oCMJOEp BSF UIFSFGPSF OPU BQQMJDBCMF 8IFO
SFNPWFE UIFSF JT B HBQ PG NN CFUXFFO UIF FOET PG UIF PVUFS QJQF 5IJT
KPJOU PG UIF JOOFS QJQF BDDPSEJOH UP UIF %74 HVJEFMJOFT 8IFO UIF QSFTTV
QJQF IBT CFFO DPNQMFUFE shaping HBQ JT DMPTFE XJUI B

Inner pipe

5IF JOOFS QJQF BSF DPOOFDUFE VTJOH TUBOEBSE USJFE BOE UFTUFE KPJOUJOH
UIF NBUFSJBM BOE TJ[FT UIF BWBJMBCMF PQUJPOT BSF TPMWFOU DFNFOUJOH
BOE JOGSBSFE GVTJPO 5IF DIPJDF PG NFUIPE JT BMTP EFUFSNJOFE CZ TVJUBCJ
DPOEJUJPOT 17%' #$' CFBE BOE DSFWJDF GSFF PO SFRVFTU

Solvent cementing (PVC-U and PVC-C)

" RVJDL KPJOUJOH NFUIPE UIBU JT DBSSJFE PVU XJUIPVU FYUFOTJWF VTF PG UPI

Socket fusion heater element (PP, PE and PVDF)

4PDLFU GVTJPO JT QBSUJDVMBSMZ TVJUFE GPS EJNFOTJPOT GSPN E VQ UP E
JODMVEJOH EJNFOTJPO E UIFTF KPJOUT DBO CF FBTJMZ NBEF JO UIF QJQJOH
hand fusion equipment.

Butt fusion heater element (PP, PE and PVDF)

*O QSFTTVSJ[FE QJQF TZTUFNT BMM CVUU GVTJPO KPJOUT NVTU CF QSPEVDFE J
BOE OPU CZ IBOE

IR infrared fusion (PP, PE100 and PVDF)

*O *3 GVTJPO UIF QBSUT UP CF DPOOFDUFE QJQF BOE ÌUUJOH BSF IFBUFE UP C
UIF GVTJPO BSFB BOE GVTFE JO B DPOUBDU GSFF QSPDFTT 5IJT MPX TUSFTT GV
TNBMMFS GVTJPO CFBET UP CF DSFBUFE

1.4.2 Jointing the outer pipe

"GUFS UIF JOOFS QJQF IBT CFFO QSFTTVSF UFTUFE UIF PVUFS QJQF JT TFBMFE WFSTJPO XJUI BO FMFDUSPGVTJPO TPDLFU BOE UIF TQMBTI HVBSE WFSTJPO 1/ DPMMBS BSF BWBJMBCMF GPS UIJT QVSQPTF 5IF BDUJWJUJFT EFTDSJCFE CFMPX KPJOU NVTU CF DBSSJFE PVU BU UIF TBNF UJNF BT UIF JOTUBMMBUJPO PG UIF J

Jointing the outer pipe with ELGEF Plus electrofusion coupler

- $VU UIF QJQF TJ[F BU B SJHIU BOHMF JO BDDPSEBODF XJUI UIF DBMDVMBUJPO OVNCFS UIF DVU MFOHUIT PG QJQF
- $MFBO BOZ DPCSTF EJSU GSPN UIF QJQF
- 1SFQBSF UIF QJQF FOET XJUI B SPUBSZ TDSBQFS
- %FQFOEJOH PO UIF SFDFTT UZQF PG UIF FMFDUSPGVTJPO TPDLFU UIF MFOHUI TDSBQFE JT FJUIFS ˜ PS GVMM MFOHUI PG UIF TPDLFU
- /FX EPVCMF DPOUBJONFOU ÌUUJOHT SFNPWFE GSPN UIF QBDLBHJOH TIPSUMZ C EP OPU OFFE UP CF TDSBQFE
- 1MFBTF SFGFS UP UIF TFQBSBUF JOTUBMMBUJPO JOTUSVDUJPOT GPS FMFDUSPG EJNFOTJPOBM UPMFSBODFT XIFO TDSBQJOH UIF 1& QJQF
- $MFBO EFHSFBTF QJQF FOE XJUI 5BOHJU ,4 DMFBOFS BOE DMFBO BCTPSCFOU Q

Permissible minimum outside pipe diameter*

d (mm)	Min. chip thickness (mm)	Permissible minimum outer pipe diameter (mm)
50		49.5
90		
110		109.4
140		
		159.4
		199.4

.FBTVSFE BU ‹$ BNC temperature

Pushing on the electrofusion coupler

Calculating the insertion depth:

Insertion depth = ½ socket length – snap ring(mm

$$\text{Snap ring width} = \frac{30\ \text{mm}}{2} = 15\ \text{mm}$$

Insertion depth = ½ socket length – 15 mm

- *NNFEJBUFMZ QSJPS UP VTF SFNPWF &-(&' 1MVT FMFDUSPGVTJPO DPVQMFS GS LFFQJOH JU DMFBO SFNPWF UIF NJEEMF TUPQ BOE QVTI DPNQMFUFMZ PWFS UI QJQF 4FBM TFDVSF XJUI UIF 1& TUSFUDI ÌMN UP QSPUFDU GSPN DPOUBNJOBUJ $IFDL GPS QSPQFS GVODUJPOJOH

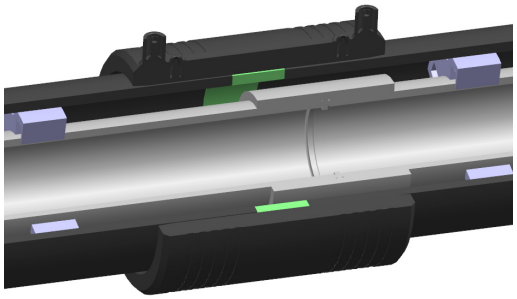
The ELGEF Plus coupler must be on the pipe before the inner pipe are jointed.

- 3FNPWF UIF TUSFUDI ÌMN JNNFEJBUFMZ CFGPSF GVTJOH UIF PVUFS QJQF
- "QQMZ UIF TOBQ SJOH

If the electrofusion socket is pushed on XJUIPVU B TOBQ SJOH UIF TP UIBU B SFMJBCMF GVTJF HVBSBOUFFE 5IF TOBQ SJC PO UIF &-(&' 1MVT FMFDUSF DPME [POF 5IF FOET PG U CVUU VQ UP UIF TOBQ SJOH

- $MFBO UIF GVTJPO [POF
- 3FGFS UP JOTUSVDUJPOT XIFSFWFS QPTTJCMF VTF DMBNQT GPS FMFDUSPGVT CSBODI TBEEMFT
- Fuse.

Snap ring 30 mm	MSA 4.0 fusion machine for ELGEF Plus couplers with GPS function



d (mm)	SDR	L (mm)	½L – 15 (mm)
50	11		
	11		
	11	110	40.0
90	11		
110	11	145	
	11		
140	11		
			111.0

- -FOHUI PG &-(&' 1MVT couplers

1.4.3 Jointing the outer pipe using the EPDM rubber collar with stainless steel

8IFO DBSSZJOH PVU JOTUBMMBUJPO VTJOH UIF SVCCFS DPMMBS JU JT FTTFOUJB
pipe is securely clamped to prevent axial movement (clamping force details in structural
DFSUJÌDBUF BOE UIBU OP QJQF FYQBOTJPO PDDVST 5IF SVCCFS DPMMBS IBT OP
$MFBO UIF TRVBSF DVU QJQF XJUI B DMFBO DMPUI BOE QVTI UIF SVCCFS DPMMBS
5IF TOBQ SJOH NVTU TJU DFOUSBMMZ PO UIF SVCCFS DPMMBS 5IF FOET PG UIF P
UP UIF TOBQ SJOH XJUIPVU HBQ 0O MPOH MFOHUIT PG QJQF UIF TOBQ SJOH DBC
USBOTQBSFOU 17$ 6 QJQF QJQF KPJOUT
"EWBOUBHF "DIJFWJOH HSFBUFS UFOTJMF TUSFOHUI CZ KPJOUJOH QJQF QJQF

Calculating the insertion depth for pipe and tting:

Insertion depth = ½ socket length – snap ring width (mm

$$\text{snap ring width} = \frac{30\ \text{mm}}{2} = 15\ \text{mm}$$

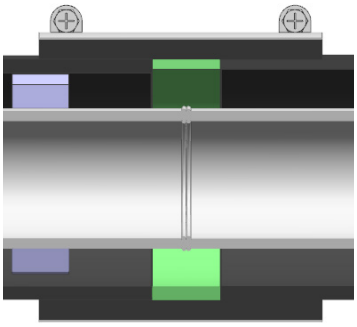
Insertion depth = ½ Insertion depth – 15 mm

⚠ The rubber collar must be on the pipe before the inner pipe are jointed.

d (mm)	Number of clamps	L (mm)	½L - 15 (mm)
50			
90			
110	4		
	4		
140	4		
	4		
	4		
	4		
	4		
	4	150	
	4	150	

- -FOHUI PG SVCCFS DP

V2A middle pipe clip



1.5 Fittings for solvent cementing / socket fusion and installation

1.5.1 Overview

4JODF UIF BYJT TJ[FT [EJNFOTJPO PG ‹ BOE ‹ FMCPXT BOE UIF 5 QJFDFT BSF
UIF ‹ FMCPX JT TIPXO 5IF TPDLFU JT BMXBZT PO UIF MPOH TJEF PG UIF ÌUUJOH

1PTTJCMFO FDUJPOT

- %JSFDU ÌUUJOH UP ÌUUJOH
- Fitting to intermediate pipe section
- 'JUUJOH UP UFSNJOBUJPO ÌUUJOH

Spigot for solvent cementing / socket fusion
4QBDF GPS ˜ &-(&' 1MV coupler
4PDLFU PO EPVCMF DPOUBJONFOU ÌUUJOH solvent cementing / socket fusion
4QBDF GPS DPNQMFUF 1MVT TPDLFU PS &1%.

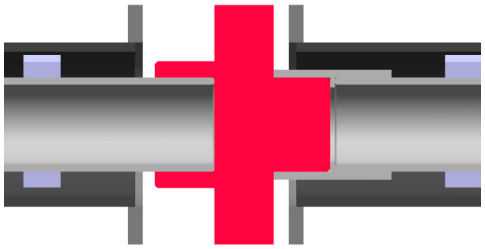
'SPN UIF DFOUSBM BYJT UP UIF GSPOU FEHF BMM UZQFT PG ÌUUJOHT IBWF UIF T TBNF BYJT TJ[F 5IJT BQQMJFT POMZ UP ÌUUJOHT NBEF GSPN UIF TBNF NBUFSJBM TBNF KPJOUJOH NFUIPE

5IF MFOHUIT PG UIF PVUFS QJQF C)E DMFBOFE GVTJPO TVSGBDFT BOE JOOFS QJQ QFE PO TQBDFST BSF EJËFSFOU

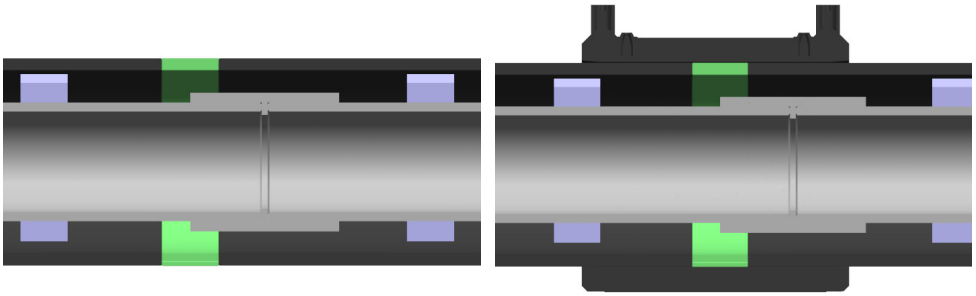
5IF JOOFS QJQF JT QVTIFE JOUP UI UIF GVTJPO sockets are positioned on the outer pipe.

5IF ÌUUJOH JT ÌSTU PG BMM KPJOUF OUFE UP UIF JOOFS QJQF XJUI UIF QSFQBSFE EP U QJQF QJFDF 5IF JOOFS QJQF JT OPX QSF MMPXJOH UIF TVDDFTTGVM QSFTTVSF UFTU B QS OU PG UIF PVUFS QJQF XJUI JOTFSUFE TOBQ SJOH JT BO electrofusion socket.

1.5.2 Fusion procedures



1. Special clamps hold the inner pipe and the JOOFS ÌUUJOH	Standard heating element for socket GVTJPO QJQF BOE ÌUUJOH BSF IFBUFE simultaneously
)FBUJOH FMFNFOU GPS TP4.DLFTVJBMTQJPOU	DIFDL UIF KPJOU UIFO QSFTTVSF UFTU PG UIF inner pipe



5. 1MBDF UIF TOBQ SJOH CFUXFOTFUTFOUTPG the outer pipe	QSPEVDFE CZ UIF &-(&' 1MVT FMFDUSPGVTJPO DPVQMFS PS UIF &1%. DPMMBS JT VTFE BT splash guard

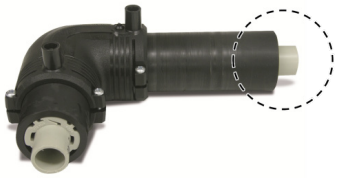
1.5.3 Various connection examples

CONTAIN-IT Plus: socket cementing / fusion

- 4IPSU FOE PG ÌUUJOH XJUI JOUFSOBM TQJHPU 4 ‹ FMCPX ‹ FMCPX ‹ 5 QJ
- -POH FOE PG ÌUUJOH XJUI JOUFSOBM TPDLFU - ‹ FMCPX ‹ FMCPX ‹ 5 QJP
- 5FSNJOBUJPO ÌUUJOH 5 MPOH FOE PG ÌUUJOH XJUI JOUFSOBM TPDLFU
- Pipe (P)

Legend

5IF GPMMPXJOH TZNCPMT BSF VTFE UP EFNPOTUSBUF UIF WBSJPVT DPOOFDUJPO GVTJPO DFNFOUJOH BOE CVUU GVTJPO

Abbreviation	Name	Symbol	Example 90° elbow
,	4IPSU FOE PG ÌUUJOH XJUI JOUFSOBM TQJHPU		
-	-POH TJEF PG ÌUUJOH XJUI JOUFSOBM TPDLFU		
&	5FSNJOBUJPO ÌUUJOH XJUI MPOH TJEF PG ÌUUJOH XJUI JOUFSOBM TPDLFU		

Example	Symbol	Combination
a) , r 3 r ,		'JUUJOH FOE XJUI TQJHPU r 1JQF XJUI FRVBM TPDLFUT r 'JUUJOH FOE XJUI TQJHPU
C , r -		'JUUJOH FOE XJUI TQJHPU r %JSFDU r 'JUUJOH FOE XJUI socket
c) , r 3 r -		'JUUJOH FOE XJUI TQJHPU r 1JQF XJUI TPDLFU r 'JUUJOH FOE XJUI TPDLFU

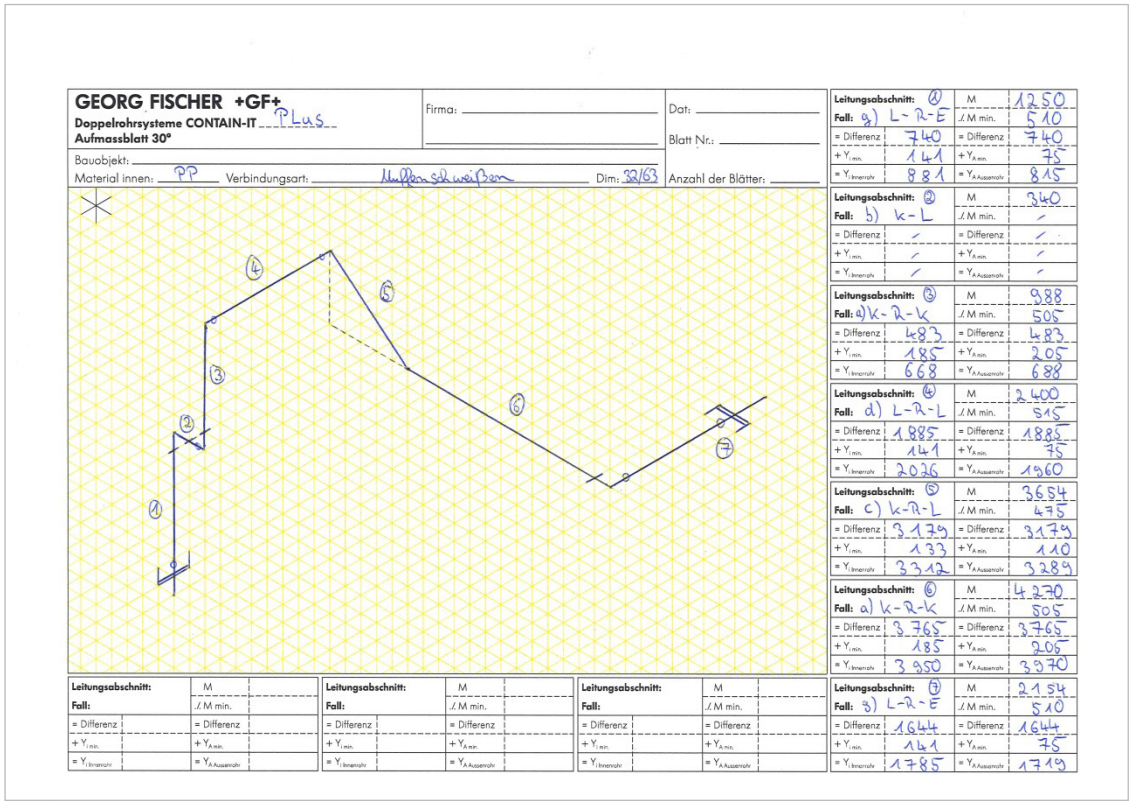
Example	Symbol	Combination
d) - r 3 r -		'JUUJOH FOE XJUI TPDLFU r 1JQF r 'JUUJOH FOE XJUI socket
e) , r &		'JUUJOH FOE XJUI TQJHPU r 5FSNJOBUJPO ÌUUJOH XJUI socket
f) , r 3 r &		'JUUJOH FOE XJUI TQJHPU r 1JQF XJUI TPDLFU r 5FSNJOBUJPO ÌUUJOH XJUI TPDLFU
g) - r 3 r &		'JUUJOH FOE XJUI TPDLFU r 1JQF r 5FSNJOBUJPO ÌUUJOH XJUI TPDLFU

Sample calculation to nd cutting lengths for inner and outer pipe

*O UIF EPVCMF DPOUBJONFOU TZTUFN UIF JOOFS BOE PVUFS QJQF BSF BMXBZT E MFOHUIT 5IF EFEVDUJPO BOE BEEJUJPO PG UIF JOOFS QJQF BOE

min GPS UIF PVUFS QJQF BSF EFQFOEFOU PO B DPNCJOBUJPO PG UIF JOTUBMMB ÌUUJOHT BOE DBO CF GPVOE JO UIF GPMMPXJOH UBCMFT

- Since the axis sizes for the 90° elbow, 45° elbow and T-piece are the same, only the 90° elbows are shown and discussed here.



Piping system section 1		M	1250
Case g) L – P – T		./. M min.	510
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.	141	: o min.	
: inner pipe		: outer pipe	

Piping system section 2		M	340
Case b) S – L direct		./. M min.	-
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.		: o min.	
: inner pipe		: outer pipe	

Piping system section 3		M	988
Case a) S – P – S		./. M min.	505
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.		: o min.	
: inner pipe		: outer pipe	

Piping system section 4		M	2400
Case d) L – P – L		./. M min.	515
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.	141	: o min.	
: inner pipe		: outer pipe	

Piping system section 5		M	3654
Case c) S – P – L		./. M min.	475
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.		: o min.	110
: inner pipe		: outer pipe	

Piping system section 6		M	4270
Case a) S – P – S		./. M min.	505
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.		: o min.	
: inner pipe		: outer pipe	

Piping system section 7		M	2154
Case g) L – P – T		./. M min.	510
% J Ë F S F O D F		% J Ë F S F O D F	
: i min.	141	: o min.	
: inner pipe		: outer pipe	

Calculation of examples on previous pages

5IF TIPSUFTU DPOOFDUJPO CFUXFFO UXP EPVCMF DPOUBJONFOU ÌUUJOHT JT UIF 5IF . EJNFOTJPO CFUXFFO BYFT JT QSFTFU

Piping system section 2	M	340*
Case b) S – L direct	./. M min.	-
% J Ë F S F O D F	% J Ë F S F O D F	
: i min.	: o min.	
; inner pipe /P QJQF SFRVJSFE	o outer pipe /P QJQF SFRVJSFE	

* Give axes distance

*G B QJQF JT SFRVJSFE CFUXFFO UIF ÌUUJOHT UIF NJOJNVN EJNFOTJPO . NJO CF PCTFSWFE

Piping system section 3	M	988
Case a) S – P – S	./. M min.	505*
% J Ë F S F O D F	% J Ë F S F O D F	
: i min.	: o min.	
; inner pipe	: o outer pipe	

.JOJNVN EJTUBODF C axes

"MM MPOHFS EJNFOTJPOT BSF DBMDVMBUFE BT GPMMPXT

Piping system section 6	M	4270*
Case a) S – P – S	./. M min.	505
% J Ë F S F O D F	% J Ë F S F O D F	
: i min.	: o min.	
; inner pipe	: o outer pipe	

%JNFOTJPO CFUXFFO

Material checklist

Required quantity per	Socket equal	Snap ring	ELGEF Plus electrofusion socket	EPDM rubber collar
‹ F M C P X	1			
‹ F M C P X	1			
5 ‹ F R V B M				
5F S N J O B U J P O (1*) ÌUUJOH				
# V U U G V T J P O				
‹ F M C P X	0			
‹ F M C P X	0			
5 ‹ F R V B M	0			
5F S N J O B U J P O ÌUUJOH	1	1	1	
Inner piping system	4	0	0	0
0 V U F S Q J Q J O H T Z T U F N	4	4	4	

Y Q F S Q J Q F M F O H U I processed

* For segmentation of the piping system into leak detection sections

1.5.4 Dimensions for calculating the cutting lengths

CONTAIN-IT Plus: socket cementing / fusion

⚠ Caution: The “last joint“ should always be made on the double containment tting. Loose sockets should rst be connected with the intermediate pipe.

Case a) S – P – S

1JQJOH TZTUFN TFDUJPO BOE

4IPSU FOE PG ÌUUJOH

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)				Outer pipe: $Y_{A\,min}$ (mm)
		S – P – S	PVC-U	PVC-C	PP-H, PE80	PVDF	
							190
							190
		505					
50/90							
90/140		910					
		1055					405
		1100					440
		1405					
							555

Case b) S – L

1JQJOH TZTUFN TFDUJPO

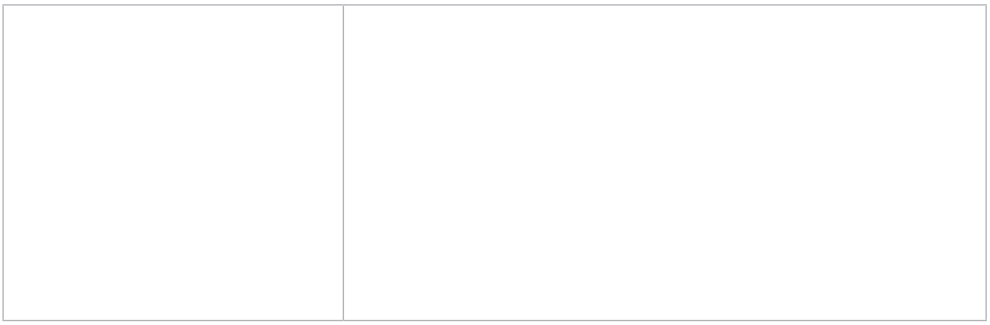
4IPSU FOE PG ÌUUJOH
-POH FOE PG ÌUUJOH

Case c) S – P – L

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)				Outer pipe: $Y_{A\,min}$ (mm)
	S – L	S – P – L	PVC-U	PVC-C	PP-H, PE80	PVDF	
		440					100
		440					100
							110
	400	550	144	144			
50/90			159	159			
	550						155
90/140							
		1010					
	990						

Case d) L – P – L

-POH FOE PG ÌUUJOH

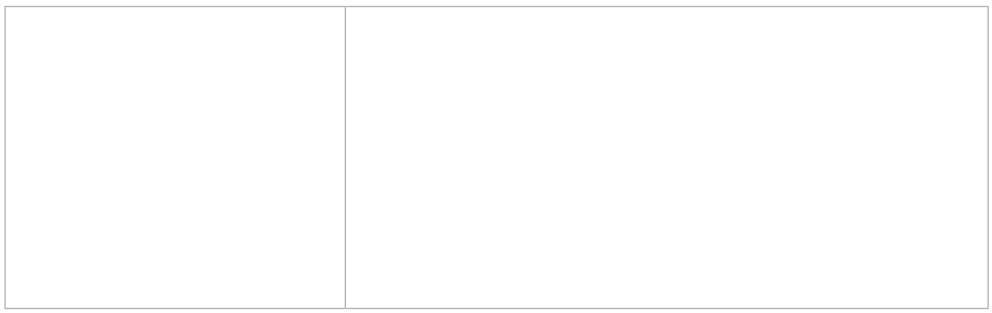


d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\ min}$ / material (mm)				Outer pipe: $Y_{A\ min}$ (mm)
		L – P – L	PVC-U	PVC-C	PP-H, PE80	PVDF	
		515	149	149	141	141	
		595			155	155	
50/90							100
90/140							145
							155
		1445					

Case e) S – T

4IPSU FOE PG ÌUUJOH
5FSNJOBUJPO ÌUUJOH

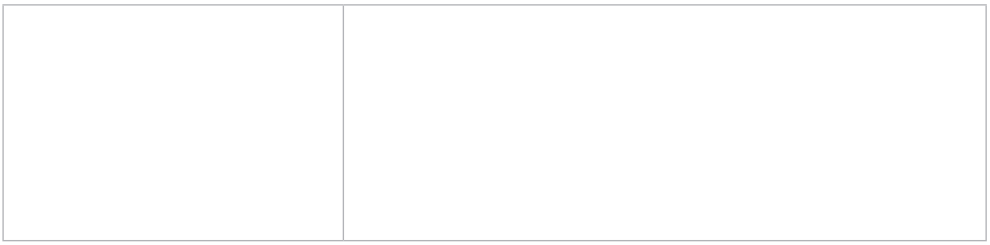
Case f) S – P – T



4IPSU FOE PG ÌUUJOH
5FSNJOBUJPO ÌUUJOH

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)				Outer pipe: $Y_{A\,min}$ (mm)
	S – T	S – P – T	PVC-U	PVC-C	PP-H, PE80	PVDF	
		440					100
		440					100
							110
			144	144			
50/90	450		159	159			
	510						155
	545						
90/140	590						
		915					
		950					
		1045					
		1150					

Case f) L – P – T

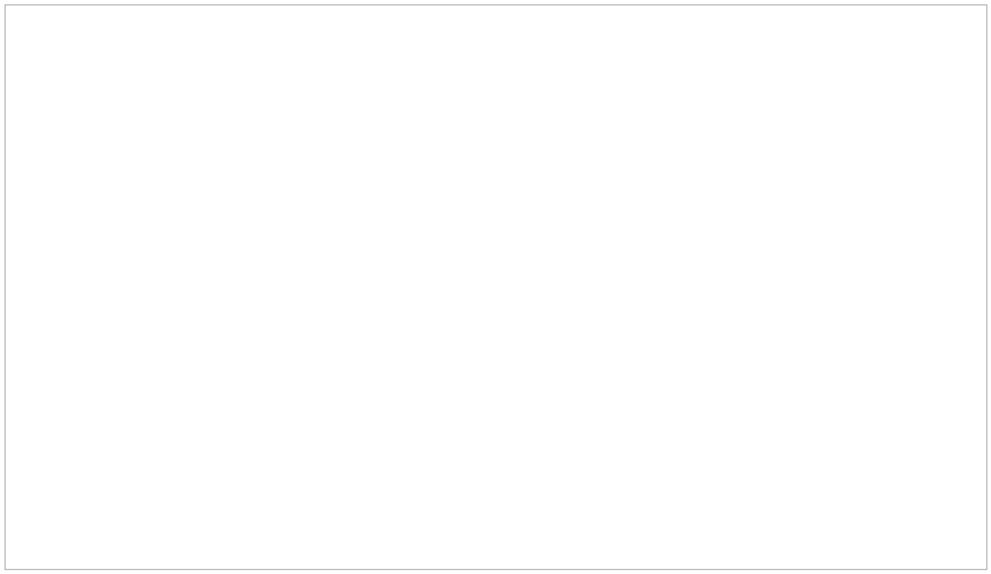


d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)				Outer pipe: $Y_{A\,min}$ (mm)
		L – P – T	PVC-U	PVC-C	PP-H, PE80	PVDF	
		510	149	149	141	141	
					155	155	
50/90							100
90/140							145
		955					155
		990					

1.5.5 Connection sizes for double containment

*G UIF DVUUJOH TJ[FT PO MPOH QJQF BSF OPU DBMDVMBUFE GSPN UBCMFT UIF J
ÌOJTIFE UP EJNFOTJPO G GPS DPOOFDUJPO UP ÌUUJOH FOE 4 BOE UP EJNFOTJP
ÌUUJOH FOE -

⚠ Last connection always on the double containment tting! First, t equal socket to the pipe section to be connected.



G *OTFSUJPO EFQUI PG
- [EJNFOTJPO PG F
TPDLFU [r NN
H *OTFSUJPO EFQUI PG
- NN
15 Width of snap ring
- *OTFSUJPO EFQUI PG
socket
[[EJNFOTJPO PG FRVB
5ZQ
5ZQ

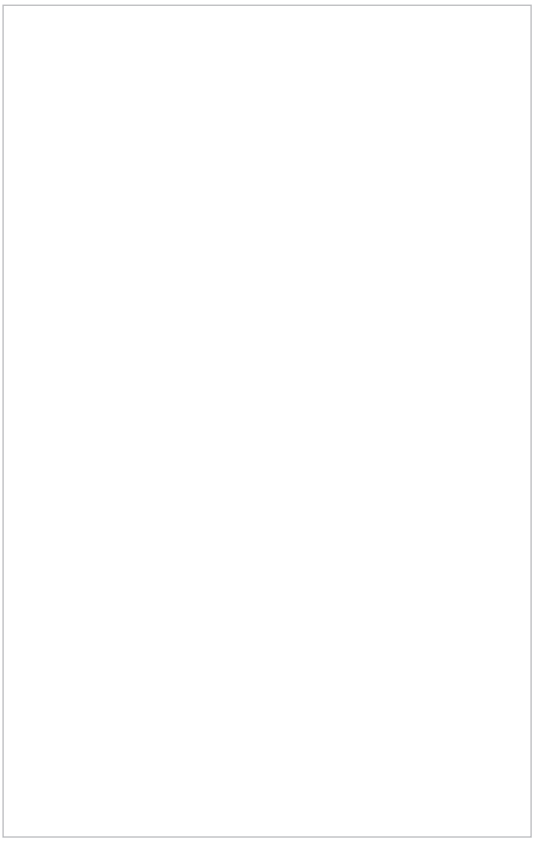
d (mm)	Connection to DC tting, spigot end. Shorter length compared with outer pipe: "f"		Connection to DC tting, socket end. Longer length compared with outer pipe: "g"	
Inner pipe	PVC-U, PVC-C	PP, PE, PVDF	PVC-U, PVC-C	PP, PE, PVDF
	4.0			
	10.1	10.0		
40	14.0		41.0	
50	19.0			
			59.0	
90	41.0			50.0
110		40.0		
140			91.0	
			101.0	
	100.0			
	114.0			

1.6 Fittings for butt and IR fusion and installation

1.6.1 Overview

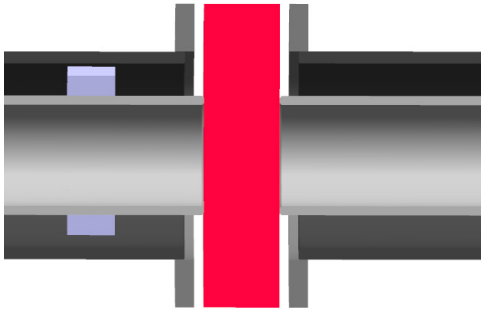
1PTTJDCPVOFDUJPOT

- %JSFDU ÌUUJOH UP ÌUUJOH
- Fitting to intermediate pipe section
- 'JUUJOH UP UFSNJOBUJPO ÌUUJOH



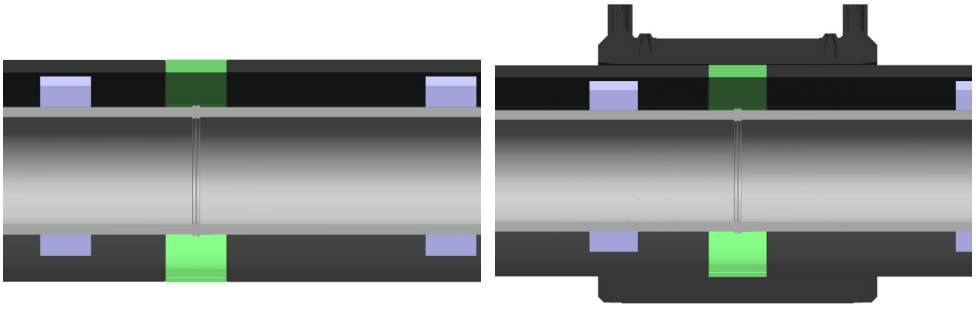
SQJHPU GPS CVUU GVT
SQBDF GPS GVMM &-(&'
electrofusion coupler or
&1%. SVCCFS DPMMBS
SQBDF GPS ˜ &-(&' 1MV
electrofusion coupler or
&1%. SVCCFS DPMMBS

1.6.2 Fusion procedures



1. $MBNQT IPME UIF JOOFS QJQF BOE ÌUUJOH FMFNFOU GPS CVUU GVTJPO 5IF QJQF BOE ÌUUJOH BSF IFBUFE TJNVMUBneously.

)FBUJOH FMFNFOU GPS CVUU GVTJPO PG KPJOU UIFO QSFTTVSF test the inner pipe



5. " TOBQ SJOH JT ÌUUFE CFUXFFO UIF (&I'F1MVETPQV QMFS PS &1%. SVCCFS the outer pips to close the inspection gap collar is used to seal the outer pipe

1.6.3 Various connection examples

CONTAIN-IT Plus: butt fusion

- 4IPSU FOE PG ÌUUJOH 4 XJUI TQBDF GPS ˜ &-(&' 1MVT DPVQMFS NJOVT NN
- -POH FOE PG ÌUUJOH - GPS GVMM &-(&' 1MVT DPVQMFS
- 5FSNJOBUJPO ÌUUJOH 5
- Pipe (P)

-FHFOE

5IF GPMMPXJOH TZNCPMT BSF VTFE UP EFNPOTUSBUF UIF WBSJPVT DPOOFDUJPO GVTJPO DFNFOUJOH BOE CVUU GVTJPO

Abbreviation	Name	Symbol	Example 90° elbow
,	4IPSU FOE PG ÌUUJOH XJUI internal spigot		
-	-POH FOE PG ÌUUJOH XJUI internal spigot.		
&	5FSNJOBUJPO ÌUUJOH		

Case	Symbol	Combination
m) S – P – S		4IPSU FOE PG ÌUUJOH r 1JQF r 4IPSU FOE PG ÌUUJOH
n) 4 r -		4IPSU FOE PG ÌUUJOH r -POH FOE PG ÌUUJOH
o) 4 r 1 r -		4IPSU FOE PG ÌUUJOH r 1JQF r -POH FOE PG ÌUUJOH
p) - r 1 r -		-POH FOE PG ÌUUJOH r 1JQF r -POH FOE PG ÌUUJOH
q) 4 r 5		4IPSU FOE PG ÌUUJOH r 5FSNJOBUJPO ÌUUJOH MPOH
r) 4 r 1 r 5		4IPSU FOE PG ÌUUJOH r 1JQF r 5FSNJOBUJPO ÌUUJOH MPO
s) - r 1 r 5		-POH FOE PG ÌUUJOH r 1JQF r 5FSNJOBUJPO ÌUUJOH MPOH

1.6.4 Dimensions for calculating the cutting lengths

Case m) S – P – S

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\ min}$ / material (mm)			Outer pipe: $Y_{A\ min}$ (mm)
		S – P – S	PP	PE	PVDF	
						190
						190
		505				
50/90						
90/140		910				
			410	410	410	
		1055				405
		1100				440
			500	500	500	
		1415	555	555	555	
		1415				555

Case n) S – L

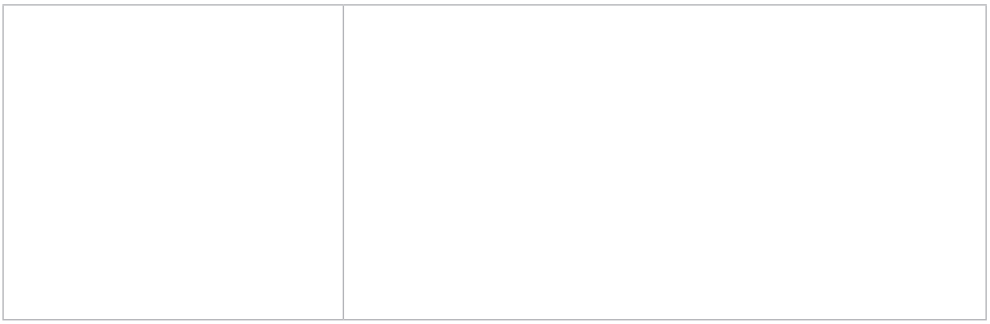
'JUUJOHTFJUF LVS[,
'JUUJOHTFJUF MBOH

Case o) S – P – L

4IPSU FOE PG ÌUUJOH
-POH FOE PG ÌUUJOH

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)			Outer pipe: $Y_{A\,min}$ (mm)
	S – L	S – P – L	PP	PE	PVDF	
		440				100
		440				100
			140	140	140	110
	400	550	150	150	150	
50/90						
	550					155
90/140						
		1010				
	1000					

Case p) L – P – L



d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\ min}$ / material (mm)			Outer pipe: $Y_{A\ min}$ (mm)
		L – P – L	PP	PE	PVDF	
			95	95	95	
			95	95	95	
		515	105	105	105	
		595	115	115	115	
50/90						100
			150	150	150	
90/140						145
						155
		1400				
		1405				

Case q) S – T

4IPSU FOE PG ÌUUJOH
5FSNJOBUJPO ÌUUJOH

Case r) S – P – T

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\ min}$ / material (mm)			Outer pipe: $Y_{A\ min}$ (mm)
	S – T	S – P – T	PP	PE	PVDF	
		440				100
		440				100
			140	140	140	110
			150	150	150	
50/90						
						155
	515					
90/140						
	590					
		915				
		950				
		1045				

Case s) L – P – T

-POH FOE PG ÌUUJOH
5FSNJOBUJPO ÌUUJOH

d/D (mm)	Direct M (mm)	M_{min} (mm)	Inner pipe: $Y_{i\,min}$ / material (mm)			Outer pipe: $Y_{A\,min}$ (mm)
		L – R – E	PP	PE	PVDF	
			95	95	95	
			95	95	95	
		515	105	105	105	
		595	115	115	115	
50/90						100
			150	150	150	
90/140						145
						155
		1400				
		1405				

1.7 Leak detection andleak locating systems

5P NBLF DFSUBJO UIBU B MFBL JO UIF JOOFS QJQF PG B EPVCMF DPOUBJONFOU T
VOOPUJDFE SFOEFSJOH UIF TZTUFN OP CFUUFS UIBO B SFHVMBS TJOHMF QJQF
BSF CFJOH EFUFDUFE 5IFSF BSF TFWFSBM EJËFSFOU TZTUFNT BWBJMBCMF PO U
purpose of monitoring pips.

1.7.1 Di erential pressure monitoring

" EJTUJODUJPO JT NBEF CFUXFFO PWFSQSFTTVSF BOE VOEFSQSFTTVSF NPOJUPS

	Overpressure monitoring	Vacuum monitoring (underpressure monitoring)
General	*O EJËFSFOUJBM QSFTTVSF PWFSQSFTTVSF OJUSPHFO XBTTFS JT QVNQFE JOUP UIF TQBDF CFUXFFO UIF JOOFS BOE PVUFS QJQF the inner and outer pips. *G UIFSF JT B QSFTTVSF MPTT JO UIF JOOFS QJQF BO BMBSN XJMM JOEJDBUF	*O EJËFSFOUJBM QSFTTVSF MPTT JO UIF JOOFS QJQF JT VTFE UP DSFBUF B TQFDJÌD QSFTTVSF JOUP UIF TQBDF CFUXFFO UIF JOOFS BOE PVUFS pipe. If there is a pressure loss in this B WBDVVN QVNQ "U UIF TBNF UJNF B XBSOJOH MJHIU BOE CV[[FS QSPWJEF WJTVBM BOE BDPVTUJD
Advantages	• Inner and outer pipe are monitored for MFBL UJHIUOFTT • 3FUSPÌU JOTUBMMBUJPO JT QPTTJCMF • 5·7 UFTU DFSUJÌDBUF • "VUPNBUJDBMMZ	• /P QSFTTVSF MPBEJOH PO UIF JOOFS QJQF • Inner and outer pipe are monitored for MFBL UJHIUOFTT • 3FUSPÌU JOTUBMMBUJPO JT QPTTJCMF • 5·7 UFTU DFSUJÌDBUF • "VUPNBUJDBMMZ
Disadvantages	5IF OJUSPHFO XIJDI JT QVNQFE JOUP UIF TQBDF CFUXFFO UIF JOOFS BOE PVUFS QJQF at a higher pressure than the medi VN DPOWFZJOH JOOFS QJQF FTTFOUJBM UP DIFDL UIBU OPU DPMMBQTF UBLJOH BDDPVOU PG operating conditions (please refer to the RVFTUJPOOBJSF GPS UIF	• Pumping head of the vacuum pump NVTU CF BU MFBTU NCBS XJUI DMFBS intake *U JT UIFSFGPSF • Where there is a large volume of spac JOOFS BOE PVUFS QJQF UIF WBDVVN QVNQ XJMM OFFE UP CF QPXFSGVM FOPVHI UP PWFSDPNF UIF QSFTTVSF MPTT JO UIF TZTUFN XJMM OFFE UP CF EJWJEFE JOUP MFBLBHF TFDUJPOT FBDI XJUI JUT PXO WBDVVN QVNQ EJWJTJPOT XJUI UFSNJOBUJPO ÌUUJOHT refer to chapter 5FSNJOBUJPO ÌUUJOHT 5PPMT GPS MPDBUJOH MFBLT JO BMM TZTUFNT PO QBHF
Leckortung	• 0VUFS QJQF EJSFDU • Inner pipe through exploratory CPSFIPMF JO UIF PVUFS QJQF	• 0VUFS QJQF EJSFDU • Inner pipe through exploratory CPSFIPMF JO UIF PVUFS QJQF

Suppliers of di erential pressure monitoring systems

4(# 4JDIFSVOHTHFS¿UFCBV (NC)
)PGTUSBTTF
4JFHFO (FSNBOZ
1I
'BY
XXX THC EF

1.7.2 Visual monitoring

'PS PQUJDBM MFBL EFUFDUJPO B E CBMM WBMWF XJUI B USBOTQBSFOU 17$ 6 N NPVOUFE PO UIF 3Q˜o CSBODI PG UIF UFSNJOBUJPO ÌUUJOH PS PO UIF CSBODI TB

Advantages	Disadvantages
• $PTU FÎDJFOU WBSJBOU NBUJD BM • 3FUSPÌU PO UIF CSBODI TBEEMF PTTJCMF	• CSBODI QJQF JT OPU monitored • $BO CF JOTUBMMFE POM UIF MPXFTU QPJOU

Branch saddle with leak monitoring

1.7.3 Optoelectronic monitoring

'PS PQUPFMFDUSPOJD MFBL EFUFDUJPO B ÍVJE TFOTPS BOE B E CBMM WBMWF 17$ 6 NPOJUPSJOH QJQF JT NPVOUFE PO UIF ˜ CSBODI PG UIF UFSNJOBUJPO ÌUU saddle.

Advantages	Disadvantages
• 3FMBUJWFMZ DPTU FÎDJFOU WBSJBOU • 3FUSPÌU PO CSBODI TBEEMF PTTJCMF • "VUPNBUJD BMBSN	• 0VUMFU QJQF JT OPU monitored • $BO CF JOTUBMMFE POMZ BU UIF MPXFTU point

Branch saddle of optoelectronic monitoring

Suppliers of optoelectronic monitoring

CARLO CAVAZZI AG	BAMO-IER GmbH	VEGA Grieshaber
$"3-0 $"7";;* "(7FSLBVG@WFSLBVGXFJ[7FOUF 4VNQGTUSBTTF 4UFJOIBVTFO 4XJU[FSMBOE 1I 'BY WFSLBVG@WFOUFDBSXXXPWJBHBE[I DI XXX DBSMPHBWB[[J DI XXX HBWB[[J BVUPNBUJPO DPN	#".0 *&3 (NC) *OOTUSBTTF .BOOIFJN 1I 'BY infoier.ch	7&(" (SJFTIBCFS ,("N)PIFOTUFJO (FSNBOZ 1I 'BY infode.vega.com XXX WFHB DPN

Sensor cable

*O UIF TQBDF CFUXFFO UIF JOOFS BOE PVUFS QJQF B DBCMF JT MBJE XIJDI SFBD
DPOEVDUJWF ÍVJET PS DIFNJDBMT BOE FNJUT BO BMBSN

Advantages	Disadvantages
• -FBL QPJOU JT JOEJDBUFE XJUIJO{ {N • "VUPNBUJD BMBSN	• 0VUFS QJQF JT OPU NPOJUPSFE • 3FMBUJWFMZ TMPX • 3FUSPÌU JT OPU QPTTJCMF • %FQFOEJOH PO UIF TZTUFN MBSHFS PVUFS EJBNFUFS PG PVUFS QJQF XJMM CF SFRVJSFE • 4VTDFQUJCMF UP DPOEFOTBUFT

i Due to the minimal di erence in dimensions between the inner and outer pipe in the CONTAIN-IT Plus double containment system, sensor cables are not feasible. If this option is required, please contact the local sales representative of GF Piping Systems.

1.7.4 Termination ttings - Tools for locating leaks in all systems

#Z TFQBSBUJOH UIF PVUFS QJQF JOUP MFBL EFUFDUJPO TFDUJPOT XJUI UFSNJOB
BOE UIF MFBL DBO CF FBTJMZ MPDBMJ[FE JO UIF TFDUJPO CFUXFFO UIF CVJMU J

Advantages	Disadvantages
• Fast and safe leak detection • 0OMZ UIF SFTQFDUJWF TF QJQF OFFET UP CF SJOTFE • -FOHUI PG MFBLBHF TFDUJPO CMF	• 0VUFS QJQF JT OPU NPOJUPSFE • 3FMBUJWFMZ TMPX • 3FUSPÌU JT OPU QPTTJCMF • %FQFOEJOH PO UIF TZTUFN MBSHFS PVUFS EJBNFUFS PG PVUFS QJQF XJMM CF SFRVJSFE • 4VTDFQUJCMF UP DPOEFOTBUFT

1.8 Operating and maintenance instructions

Maintenance

- *G UIF MFBLBHF XBSOJOH TZTUFN TJHOBMT BO JODJEFOU UIF TBGFUZ QSPDFE BEWBODF CZ UIF PQFSBUPS PG UIF EPVCMF DPOUBJONFOU TZTUFN r NVTU CF G
- *G UIF JOTUBMMBUJPO JODMVEFT NPSF UIBO POF EPVCMF DPOUBJONFOU MJOF EFUFDUJPO TZTUFN NVTU CF JOTUBMMFE JO FBDI JOEJWJEVBM TFDUPS *G UIJT TQBDF CFUXFFO UIF QJQF CFDPNFT ÌMMFE XJUI UIF NFEJVN CFJOH DBSSJFE UI DPOUBJONFOU TZTUFN FËFDUJWFMZ CFDPNFT B TJOHMF QJQF TZTUFN 5IF MFBI NVTU CF DBQBCMF PG EFUFDUJOH BOE JOEJDBUJOH B MFBL XJUIJO IPVST
- %PVCMF DPOUBJONFOU TZTUFNT NVTU CF QSPUFDUFE GSPN VODPOUSPMMFE UI NFDIBOJDBM JOÍVFODFT

Pressure test

4FF DIBQUFS 1SFTTVSF UFTUJOH UIF JOOFS BOE PVUFS QJQF QBHF JOOFS BOE PVUFS QJQF PO QBHF

Repair

- 1SJPS UP CFHJOOJOH XJUI B SFQBJS JU JT FTTFOUJBM UP UBLF BQQSPQSJBUF DPNQMFUFMZ FNQUZJOH BOE ÍVTIJOH UIF JOOFS BOE PVUFS QJQF QSFWFOUJOI *G{B MFBL DBOOPU CF QSFDJTFMZ MPDBUFE JU JT VTFGVM UP QSPDFFE TFDUJI
- 0OMZ VTF XBUFS UP TFBSDI GPS UIF MFBL
- 0VS NFDIBOJDBMMZ GBTUFOFE UBQQJOH TBEEMF XJUI B ˜ UBQQJOH QPJOU BM CF DBSFGVMMZ NBEF PO UIF VOEFSTJEF PG UIF QSPUFDUJWF QJQF UP TFDUJPO TBEEMF JT MBUFS SFTFBMFE XJUI B 17$ QMVH
- (' 1JQJOH 4ZTUFNT SFDPNNFOET UIF VTF PG UFSNJOBUJPO ÌUUJOHT XIFO UIF QJ CFJOH JOTUBMMFE UP EJWJEF JU VQ JOUP MFBLBHF EFUFDUJPO [POFT
- 5IF QJQF NVTU CF SFQMBDFE JO BDDPSEBODF XJUI UIF QJQF JOTUBMMBUJPO JO ('{1JQJOH 4ZTUFNT

Extension of the installation and retro t installation of a T-piece

#FGPSF TUBSUJOH XPSL JU JT FTTFOUJBM UP UBLF BQQSPQSJBUF QSFDBVUJPOT FNQUZJOH BOE ÍVTIJOH UIF JOOFS BOE PVUFS QJQF QSFWFOUJOH BOZ ESJQQJOH

Safety and re prevention measures

GF Piping Systems refers to the relevant safety datasheets of the plastic materials used.

Fire protection collars

"QQSPWFE ÌSF QSPUFDUJPO DPMMBST GPS EPVCMF DPOUBJONFOU QJQF BSF BWB

Laying pipe in the ground

8IFO MBZJOH QJQF JO UIF HSPVOE DBSF NVTU CF UBLFO UP FOTVSF DPNQMJBOD SFHVMBUJPOT BOE EJSFDUJWFT PG QSPGFTTJPOBM PSHBOJ[BUJPOT BOE QVCMJD SFMBUJOH UP USFODIJOH FNCFEEJOH UIF EPVCMF DPOUBJONFOU TZTUFN BOE C

1.9 Pressure testing the inner and outer pipe

1.9.1 Inner pipe

General

5IF JOUFSOBM QSFTTVSF UFTU JT EPOF XIFO JOTUBMMBUJPO XPSL IBT CFFO DPN
QSFTVQQPTFT BO PQFSBUJPOBM QJQJOH TZTUFN PS PQFSBUJPOBM UFTU TFDUJP
MPBE JT JOUFOEFE UP GVSOJTI FYQFSJNFOUBM QSPPG PG PQFSBUJPOBM TBGFUZ
CBTFE PO UIF PQFSBUJPOH QSFTTVSF CVU SBUIFS PO UIF JOUFSOBM QSFTTVSF M
UIF QJQF XBMM UIJDLOFTT

"EEFOEVN PG %74 GPSNT UIF CBTJT GPS UIF GPMMPXJOH JOGPSNBUJPO 5
EBUB JO %74 FOUJSFMZ 5IF SFBTPOT GPS UIFTF BEKVTUNFOUT BSF MJTUFE

- 5IF SFGFSFODF WBMVF OPNJOBM QSFTTVSF 1/ JT CFJOH VTFE MFTT BOE MFT
  UFTU QSFTTVSF Y 1/ PS Y 1/ BOE JT CFJOH SFQMBDFE CZ 4%3
- " TIPSU UFSN PWFSMPBE PS FWFO B SFEVDUJPO JO UIF TFSWJDF MJGF DBO PDD
  UFNQFSBUVSF 53 ‹$ JT FYDFFEFE CZ NPSF UIBO ‹$ JO UIF DPVSTF PG UIF J
  QSFTTVSF UFTU CBTFE PO UIF OPNJOBM QSFTTVSF

5FTU QSFTTVSFT BSF UIFSFGPSF EFUFSNJOFE JO SFMBUJPO UP 4%3 BOE UIF QJ
5IF I WBMVF GSPN UIF MPOH UFSN CFIBWJPS EJBHSBN JT VTFE GPS UIF UFTU

Test parameters

5IF GPMMPXJOH UBCMF QSPWJEFT SFDPNNFOEFE NFUIPET GPS QFSGPSNJOH UIF
test.

Object	Pre-test	Main test
5FTU QSFTTVSF 1 QQ QFSN EFQFOET PO UIF QJQF XBMM UFNQFSBUVSF BOE UIF QFSNJTTJCMF UFTU QSFTTVSF PG UIF CVJMU JO DPNQPOFOUT TFF UIF TFDUJPO %FUFSNJOJOH UIF UFTU QSFTTVSF	Ç QQ QFSN	Ç QQ QFSN
5FTU EVSBUJPO EFQFOET PO UIF length of the piping system or the piping system sections)	- Ç N I N - Ç N I	- Ç N I N - Ç N I
$IFDLT EVSJOH UIF U'FUTUMFBBTTUU pressure and temperature QSPHSFTTJPO NVTU	EJTUSJCVUFE PWFSUIF UFTU test pressure	EJTUSJCVUFE PWFS UIF UFTU the test pressure

Pre-test

5IF QSF UFTU TFSWFT UP QSFQBSF UIF QJQJOH TZTUFN GPS UIF BDUVBM UFTU N
PG QSF UFTUJOH B UFOTJPO FYQBOTJPO FRVJMJCSJVN JO SFMBUJPO UP BO JOD
EFWFMPQ JO UIF QJQJOH TZTUFN " NBUFSJBM SFMBUFE ESPQ JO QSFTTVSF XJMM
SFRVJSF SFQFBUFE QVNQJOH UP SFTUPSF UIF UFTU QSFTTVSF BOE BMTP GSFRVF
UIF ÍBOHF DPOOFDUJPO TDSFXT

5IF HVJEFMJOFT GPS BO FYQBOTJPO SFMBUFE QSFTTVSF EFDSFBTF JO QJQF BSF

Material	Pressure drop (bar/h)
17$ 6	0.5
17$ $	0.5
"#4	
PP	
1&	
1#	1.4
17%'	

Main test

*O UIF DPOUFYU PG UIF NBJO UFTU B NVDI TNBMMFS ESPQ JO QSFTTVSF DBO CF
QJQF XBMM UFNQFSBUVSFT TP UIBU JU JT OPU OFDFTTBSZ UP QVNQ BHBJO 5IF D
QSJNBSJMZ PO MFBL EFUFDUJPO BU UIF ÍBOHF KPJOUT BOE BOZ QPTJUJPO DIBOH

⚠ When using a valve at the end of a piping system (end or nal valve), the valve and the pipe end should be closed by a dummy ange or cap. This prevents an inadvertent opening of the valve and exit of the medium or any pollution of the inside of the valve.

Filling the piping system

#FGPSF TUBSUJOH XJUI UIF JOUFSOBM QSFTTVSF UFTU UIF GPMMPXJOH QPJOUT

- 8BT JOTUBMMBUJPO EPOF BDDPSEJOH UP UIF BWBJMBCMF QMBOT
- "MM QSFTTVSF SFMJFG EFWJDFT BOE ÍBQ USBQT NPVOUFE JO UIF ÍPX EJSFDUJP
- "MM FOE WBMWFT TIVU
- 7BMWFT PG EFWJDFT BSF TIVU UP QSPUFDU BHBJOTU QSFTTVSF
- 7JTVBM JOTQFDUJPOT PG BMM KPJOUT QVNQT NFBTVSFNFOU EFWJDFT BOE UB
-)BT UIF XBJUJOH QFSJPE BGUFS UIF MBTU GVTJPOJOH DFNFOUJOH CFFO PCTFS

/PX UIF QJQJOH TZTUFN DBO CF ÌMMFE GSPN UIF HFPEFUJD MPXFTU QPJOU 4QFD
CF HJWFO UP UIF BJS WFOU *G QPTTJCMF WFOUT TIPVME CF QSPWJEFE BU BMM
QJQJOH TZTUFN BOE UIFTF TIPVME CF PQFO XIFO ÌMMJOH UIF TZTUFN 'MVTIJOH
at least 1 m/s.

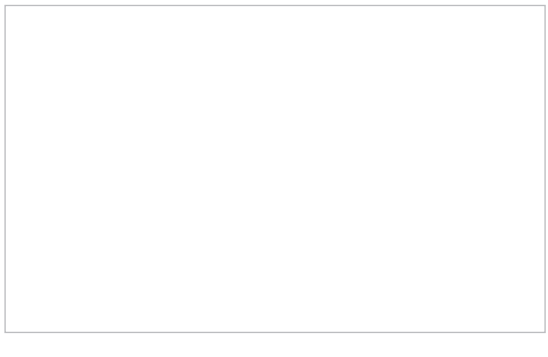
3FGFSFODF WBMVFT GPS UIF ÌMMJOH WPMVNF BSE HJWFO JO UIF GPMMPXJOH UB

DN (mm)	V (l/s)	DN (mm)	V (l/s)
Ç	0.15		
100			
150		400	
	1.5	500	>9.0

ⓘ Adequate time should be allowed between lling and testing the piping system, so that the air contained in the piping system can escape via the vents: approx. 6 - 12 h, depending on the pipe diameter.

1.9.2 Applying the test pressure

⚠ The test pressure is applied according to the diagram. Here it is important that the pressure increase rate does not cause any water hammering!



: 5FTU QSFTTVSF
9 5JNF GPS QSFTTVSF J
(min)
1) Pressure increase rate up
UP %/
3BOHF PG QSFTTVSF
SBUFT CFUXFFO %/ E
%/
7BMVFT GPS QSFTTVS
JODSFBTF SBUF %/ E
HSFBUFS JT %/
CBS {NJO

Determining the test pressure

5IF QFSNJTTJCMF UFTU QSFTTVSF JT DBMDVMBUFE BDDPSEJOH UP UIF GPMMPXJC

$$P_{p(zul)} = \frac{1}{SDR} \quad \frac{20}{S_p \; A_G}^{v(T,\,100\,h)}$$

VW 5 I-POH UFSN DSFFQ TUSFOHUI GPS QJQF XBMM UFNQFSBUVSF 51 BU U I
Sp .JOJNVN TBGFUZ GBDUPS GPS MPOH UFSN DSFFQ TUSFOHUI
"G 1SPDFTTJOH PS HFPNFUSZ TQFDJÌD GBDUPS UIBU SFEVDFT UIF BMMPXBCM
JG UIF "(GBDUPS JT MFTT UIBO [FSP ZPV OFFE UP VTF UIF SFDJQSPDBM
58 1JQF XBMM UFNQFSBUVSF BWFSBHF WBMVF PG UFTU NFEJVN UFNQFSBUVS
surface temperature

If the piping system contains diaphragm valves, the maximum allowable test pressure is limited to the nominal pressure of the diaphragm valves.

5P NBLF UIJOHT FBTJFS UIF QFSNJTTJCMF UFTU QSFTTVSFT DBO CF UBLFO EJSFD
diagrams.

1 1FSNJTTJCMF UFTU QSFTTVSF CBS
5 1JQF XBMM UFNQFSBUVSF ‹$

Checks during testing

5IF GPMMPXJOH NFBTVSFNFOU WBMVFT NVTU CF SFDPSEFE DPOTJTUFOUMZ EVSJ
- *OUFSOBM QSFTTVSF BU UIF BCTPMVUF MPXFTU QPJOU PG UIF QJQJOH TZTUFN
- .FEJVN BOE BNCJFOU UFNQFSBUVSF
- Water volume input
- Water volume output
- Pressure drop rates

Leak test

*G JU JT OPU QPTTJCMF UP EP BO JOUFSOBM QSFTTVSF UFTU XJUI XBUFS F H Q
ESZ B MFBL UFTU DBO CF DBSSJFE PVU XJUI TMJHIU PWFSQSFTTVSF 'PS TBGFU
QSFTTVSF NVTU UIFO CF MJNJUFE UP NBYJNVN CBS PWFSQSFTTVSF

%VSJOH UIF MFBL UFTU BMM KPJOUT NVTU CF TQSBZFE XJUI B GPBN CVJMEJOH
UIF FÎDJFODZ PG UIF MFBL UFTU JT TJHOJÌDBOUMZ MJNJUFE EVF UP UIF MPX MPB
VTF JU QSFGFSBCMZ GPS TZTUFNT XJUI PQFSBUJOH QSFTTVSFT CFMPX CBS

1.9.3 Outer pipe

General

0ODF UIF UFTU PG UIF JOOFS QJQF JT DPNQMFUF UIF PVUFS QJQF JT UFTUFE XJ
VOEFS JOUFSOBM QSFTTVSF UIF JOUFSOBM QSFTTVSF PG UIF JOOFS QJQF NVTU
greater than the internal pressure of the outer pipe) to avoid loading the inner pipe as a result
PG FYUFSOBM QSFTTVSF 5P DBSSZ PVU UIF QSFTTVSF UFTU TVJUBCMF ÌMMJOH
NVTU CF QSPWJEFE PO UIF PVUFS QJQF

"GUFS UIF JOTUBMMBUJPO PG UIF EPVCMF DPOUBJONFOU TZTUFN IBT CFFO DPNQ
DPOOFDUJPO QSFTTVSF KPJOU GPS UIF MFBLBHF JOEJDBUPS PS B UFTU VOJPO
PQFSBUJPO PG UIF MFBLBHF JOEJDBUPS JT JOTUBMMFE BT OFBS BT QPTTJCMF U
GSPN PS EJSFDUMZ JOTJEF UIF UFSNJOBUJPO ÌUUJOH BOE BU UIF FOE PG FBDI M
MFBL UJHIUOFTT UFTU PG UIF TQBDF CFUXFFO UIF QJQF JT DBSSJFE PVU BU SPP

⚠ Thin-walled inner pipe in particular can collapse under excess pressure in the space between the pipe. The maximum permissible test and/or overpressure in the space between the pipe depend on the load capacity of the medium-conveying inner pipe. Care should be taken here to ensure that the internal pressure load on the pipe (PN stage) is not the same as the external pressure load.

8BUFS JT UIF QSFGFSSFE UFTU NFEJVN)PXFWFS DPNQMFUF ESBJOBHF NVTU CF
DBTFT BJS PS JOFSU HBT BSF BMTP TVJUBCMF UFTU NFEJB

5IF GPMMPXJOH QPJOUT TIPVME CF OPUFE
- $PNQSFTTPS PJMT DBO DPOUBJO EBNBHJOH FMFNFOUT GPS UIF QJQF
- %FQFOEJOH PO UIF UFNQFSBUVSF TPNF NBUFSJBMT UFOE UP DIJQ BOE CSFBL
  JOÍVFODF BOE JOOFS QSFTTVSF PG DPNQSFTTFE NFEJB
- 5IF BQQSPQSJBUF TBGFUZ QSFDBVUJPOT TIPVME CF UBLFO UP QSFWFOU B DSB
  FTQFDJBMMZ USBOTQBSFOU 17$ 6
- 5IF NBYJNVN HBT QSFTTVSF EFQFOET PO UIF NBUFSJBM BOE TIPVME OPU FYDFF
  UIF PMM

CONTAIN-IT Plus test parameters

Test medium for piping systems	PE100 outer pipe, pressure-resistant welded with ELGEF Plus coupler		PVC-U outer pipe, spray protection with EPDM rubber collar (not to be applied when there are axial forces)	
	SDR11, SDR17, SDR17.6			
	1SF UFTU	Main test	1SF UFTU	Main test
Water	Ç 1Q QFSNÇ	1Q QFSNS	CBS	
Inert gas	CBS	CBS	CBS	CBS

Testing time

5IF QJQJOH TZTUFN JT LFQU VOEFS UIF UFTU QSFTTVSF VOUJM BMM DPOOFDUJPO
TZTUFN MJLF ÍBOHFT VOJPOT WBMWFT FUD BSF JOTQFDUFE GPS UJHIUOFTT VT
BHFOU " TPBQ TPMVUJPO XIJDI DBO CF SFNPWFE TJNQMZ XJUI XBUFS BGUFS UIF

⚠ Commercial leak detection sprays can cause stress cracks in plastics. If these sprays are used, remove any residues after testing.

No overloading of the components

1MFBTF DPOTJEFS UIBU UIF UFTU QSFTTVSF IBT UP CF BEBQUFE UP UIF JOTUBMM
FYBNQMF XIFSF ÌUUJOH PS WBMWFT BSF JOTUBMMFE B NBYJNVN UFTU QSFTTVSF
for the protective pipe.

Test medium for double containment valves	PE100 outer pipe, pressure-resistant welded with ELGEF Plus coupler		PVC-U outer pipe, spray protection with EPDM rubber collar (not to be applied when there are axial forces)	
	SDR11, SDR17, SDR17.6			
	1SF UFTU	Main test	1SF UFTU	Main test
Water	CBS	CBS	CBS	CBS
Inert gas	CBS	CBS	CBS	CBS

1.10 Static evidence

5IF RVFTUJPOOBJSF GPS TUBUJD FWJEFODF JT VTFE CZ (' 1JQJOH 4ZTUFNT UP EF
TFMFDUFE QJQJOH TZTUFN JT SFTJTUBOU VOEFS UIF HJWFO PQFSBUJOH DPOEJUJ
JOTUBMMBUJPO JOIJCJUFE MPOHJUVEJOBM FYQBOTJPO JU JT OFDFTTBSZ UP DE
GPSDFT PO UIF PVUFS QJQF ÌUUJOHT XIJDI UIF ÌY QPJOU QJQF CSBDLFUT BSF SF

5IÑYFE QPJOU GPS UIF JOOFS QJQF JT BMSFBEZ CVJMU JOUP FBDI ÌUUJOH CZ NFI
*G {IF DBMDVMBUFE TUSFTT PO UIF QJQF JT UPP HSFBU UIF PQFSBUJOH DPOEJUS
CF DIBOHFE 5IF DBMDVMBUJPO BMTP JOEJDBUFT UIF EJTUBODFT CFUXFFO TQBDI
BOE UIF EJTUBODFT CFUXFFO QJQF CSBDLFUT GPS UIF PVUFS QJQF BT XFMM BT U
QPJOUT &YQBOTJPO JO UIF QJQJOH TZTUFN OFFE OPU CF UBLFO JOUP DPOTJEFS
FYQBOTJPO MPPQT PS DPNQFOTBUPST BSF BMMPXFE 5P QSFWFOU UIF QJQF GSPI
CFOEJOH PS OPU FYBDUMZ BMJHOFE JOTUBMMBUJPO JU JT BEWJTBCMF UP JOTU
UIF ÌYFE QPJOUT EFTJHOFE GPS MBUFSBM GPSDFT PG BSPVOE PG UIF BYJBM
ÌYFE QPJOUT

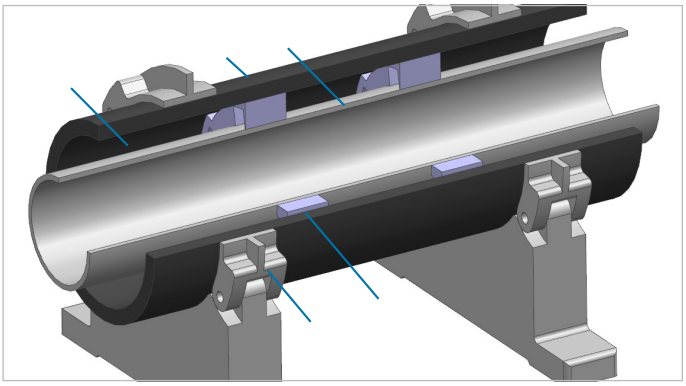
Double containment system
xed point

5IF GPMMPXJOH GBDUPST DBO JOÍVFODF UIF TUBCJMJUZ PG UIF $0/5"*/ *5 1MVT T

- .FEJVN QSFTTVSF UFNQFSBUVSF UJNF
- Stresses resulting from impeded thermal expansion
- ,JOEFTJTUBODF
- &YUFSOBM QSFTTVSF TUBCJMJUZ
- Intermittent stressing
- 4QFDJBM DBTF PG &1%. DPMMBS

1.10.1 CONTAIN-IT Plus system

$PNQPOFOUT PG UIF $0/5"*/ *5 1MVT TZTUFN



Monitoring space
0VUFS QJQF
Inner pipe
1JQF CSBDLFU
Spacer

The double containment system must be a xed installation (no expansion loop or compensator is allowed)!

Background: There are di erent expansions by using di erent materials for inner and outer pipe.

Fixed point
Guide supports

1.10.2 Questionnaire for static evidence

GF Piping Systems

CONTAIN-IT Plus System

Questionnaire for Static Evidence

Please fill in all data and send it to GSS, gss@georgfischer.com

General project information

Project _____

SC _____

Customer _____

Operating Conditions

Flow media _____

Concentration _____

Density _____ g/cm³

Max. working temperature _____ °C

Min. working temperature _____ °C

Max. working pressure _____ bar

Min. working pressure _____ bar

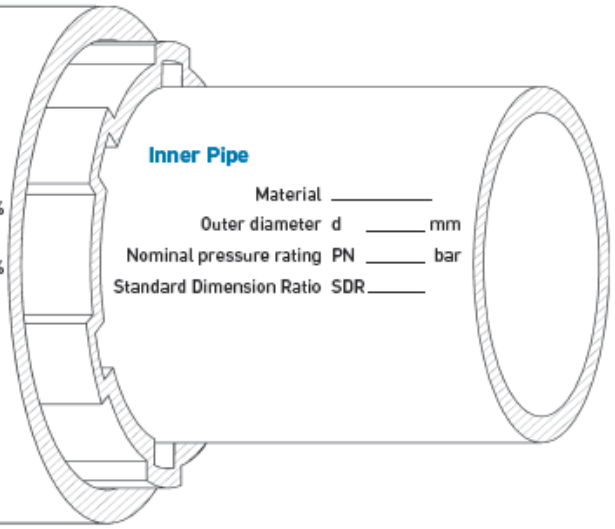
Proportional Load Period

_____ % } Σ= 100%

_____ % } Σ= 100%

_____ %

_____ %



Inner Pipe

Material _____

Outer diameter d _____ mm

Nominal pressure rating PN _____ bar

Standard Dimension Ratio SDR _____

Outer Pipe

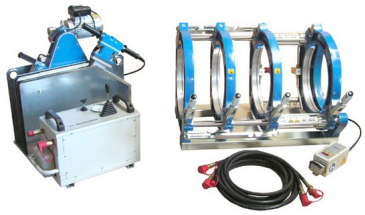
Material* PE100 ○ PVC-U transparent ○

Leak detection information*	optical ○	other ○	
Installation location*	Underground ○	Above ground	Indoor ○ Outdoor ○
Ambient temperature	Max. ____ °C	Min. ____ °C	
Installation temperature	Max. ____ °C	Min. ____ °C	

*Please mark if applicable.

0O UIF CBTJT PG UIF DVTUPNFS EBUB FOUFSFE JO UIF RVFTUJPOOBJSF UIF DBMD
QSPWJEFT TUBUJD FWJEFODF 5IF TUBUJD FWJEFODF JT TFOU UP UIF DVTUPNFS

1.11 Welding machines for butt and socket fusion

Fusion machine	Application	Dimension range (mm)
SG 160 	Socket fusion	E r E
	#VUU GVTJPO	E r E
IM 250 / IM 315 	#VUU GVTJPO	*. E r E
		*. E r E
GF400 	#VUU GVTJPO	E
IR-63 Plus / IR-225 Plus 	*OGSBSFE GVTJPO8 *31MVT /PUF 6TF TQFDJBM IBMG TIFMMT GPS UIF EPVCMF containment system	E r E *3 1MVT E r E

1.12 Double containment special components

%PVCMF DPOUBJONFOU WBMWFT BSF BWBJMBCMF JO UIF GPMMPXJOH WFSTJPOT

- Pneumatic actuator
- &MFDUSJD BDUVBUPS
-)BOE PQFSBUFE
- 17$ 6 1/ QSPUFDUJWF DBTF
- *OUFSOBM CBMM WBMWF DBO CF SBEJBMMZ JOTUBMMFE BOE SFNPWFE
- .BOVBM PWFSSJEF XJUI SBUDIFU TFUUJOH

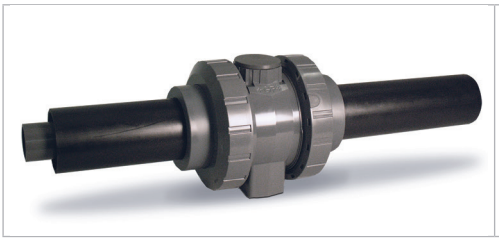
%PVCMF DPOUBJONFOU WBMWFT GSPN (' 1JQJOH 4ZTUFNT BSF TVQQMJFE BT B SF VOJU BOE UIF KPJOUJOH UFDIOPMPHZ VTFE JT TJNJMBS UP UIBU GPS B EPVCMF D QSJODJQMF VTFE CZ (' 1JQJOH 4ZTUFNT JT UIBU UIF JOOFS QJQF JT ÌSTU KPJOFE KPJOUJOH UFDIOPMPHZ XIJDI ZPV IBWF TFMFDUFE

5IF GPMMPXJOH KPJOUJOH NFUIPET BOE NBUFSJBMT DBO CF TFMFDUFE

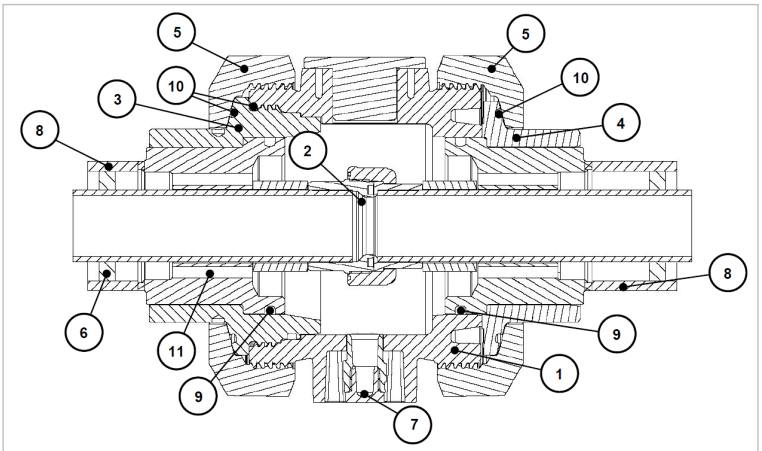
Jointing method inner pipe	Material
#VUU GVTJPO	1& 11) 17%'
*3 GVTJPO	1& 11) 17%'
Socket fusion	1& 11) 17%'
Socket cementing	17$ 17 6

1.12.1 CONTAIN-IT Plus mechanical joint

5IF $0/5"*/ *5 1MVT NFDIBOJDBM KPJOU JT VTFE GPS SFUSPÌU FYUFOTJPO PS SFQ



Design



Protective housing
6OJPO
6OJPO CVTI
6OJPO FOE
6OJPO OVU PG QSPUFD
housing
Spacer
"EBQUPS GPS ~ MFBL
EFUFDUJPO PS 17$ 6 ~
1& TVQQPSU QJFDFT
0 SJOH 1& DPOOFDUJO
element
0 SJOHT GPS VOJPO CV
union end
#PSF IPMF GPS MFBL E
of inner pipe

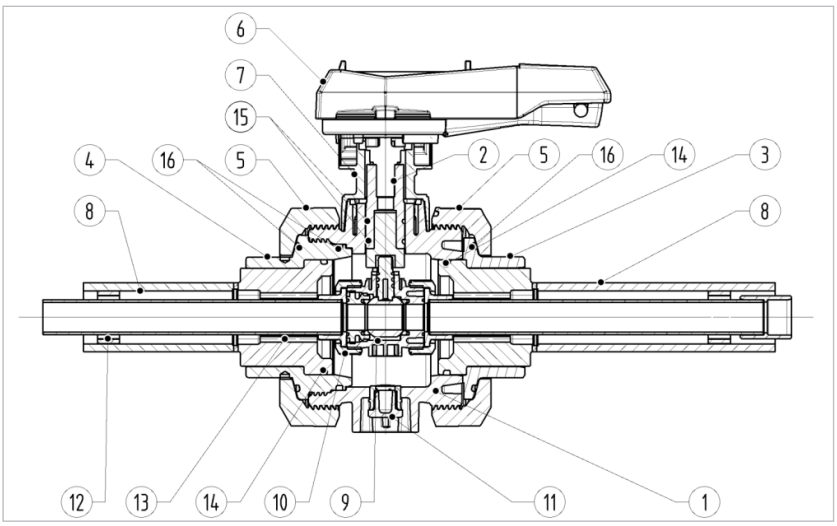
Jointing methods inner pipe

Dimension (mm)		Socket cementing		Socket fusion			Butt fusion		
		PVC-U Tangit/Dytex	PVC-C Tangit/Dytex	PP-H	PE	PVDF	PP-H	PE	PVDF
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9

Installation, pressure test and maintenance must be performed according to the corresponding installation manual. The installation manual is part of the product, see also the online product catalog at www.gfps.com

1.12.2 CONTAIN-IT Plus double containment ball valve

Design



Protective housing
Stem
6OJPO FOE
6OJPO CVTI
6OJPO OVU PG QSPUFD
housing
)BOE MFWFS
/VUT BOE TDSFXT UP
hand lever)
1& TVQQPSUT
#BMM WBMWF UZQF
(central part)
#BMM WBMWF UZQF
nut
"EBQUPS GPS ~ MFBL
EFUFDUJPO PS 17$ 6 ~
Spacer
#PSF IPMF GPS MFBL E
of inner pipe
0 SJOH 1& DPOOFDUJO
element
0 SJOHT GPS TUFSO
0 SJOHT GPS VOJPO CV
union end

Jointing methods inner pipe

Dimension (mm)		Socket cementing		Socket fusion			Butt fusion		
		PVC-U Tangit/Dytex	PVC-C Tangit/Dytex	PP-H	PE80	PVDF	PP-H	PE100	PVDF
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9
E	%	9	9	9	9	9	9	9	9

Ball valve installation notes

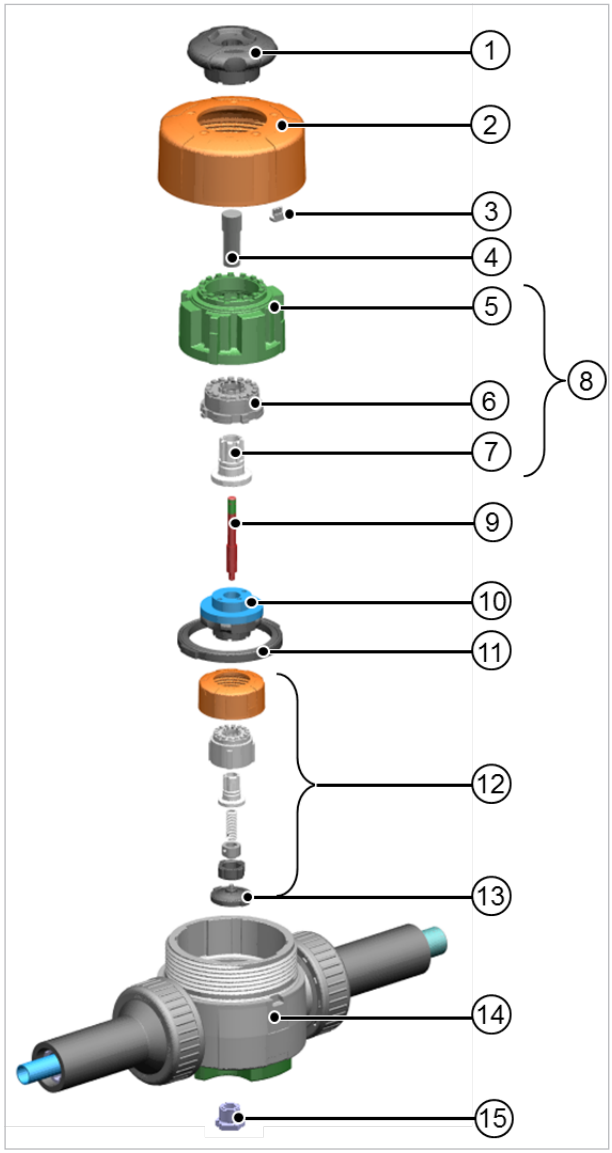
.BYJNVN JOTFSUJPO EFQUI PG UIF TDSFXT JOUP UIF CBMM WBMWF

Dimension (mm)		Screw	Insertion depth H (mm)
E	% /	.	
E	% /	.	
E	% /	.	15
d50		.	15

Installation, pressure test and maintenance must be performed according to the corresponding installation manual. The installation manual is part of the product, see also the online product catalog at www.gfps.com

1.12.3 CONTAIN-IT Plus diaphragm valve

Design



)BOE XIFFM XJUI MPDL
device
)ousing nut
Index plate
Sightglass
Outer housing
Inner housing
Spindle nut
SQJOEMF BTTFNCMZ
Indicator pin
Flange
Gasket
Inner diaphragm valve
%iaphragm
$0/5"*/ *5 1MVT IPVTJO
diaphragm valve
-eak plug

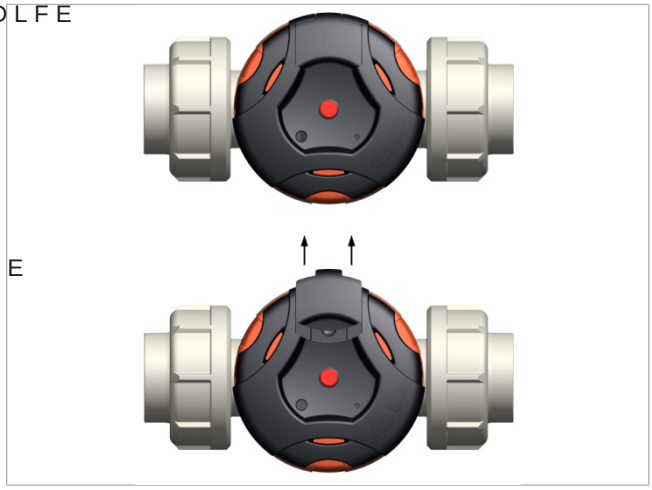
Jointing method inner pipe

Dimension (mm)		Socket cementing		Socket fusion		Butt fusion	
		PVC-U Tangit/Dytex	PVC-C Tangit/Dytex	PP-H	PVDF	PP-H	PVDF
E	%	9	9	9	9	9	9
E	%	9	9	9	9	9	9

Manual locking

)BOE XIFFM VOMPDLFE

)BOE XIFFM MPDLFE



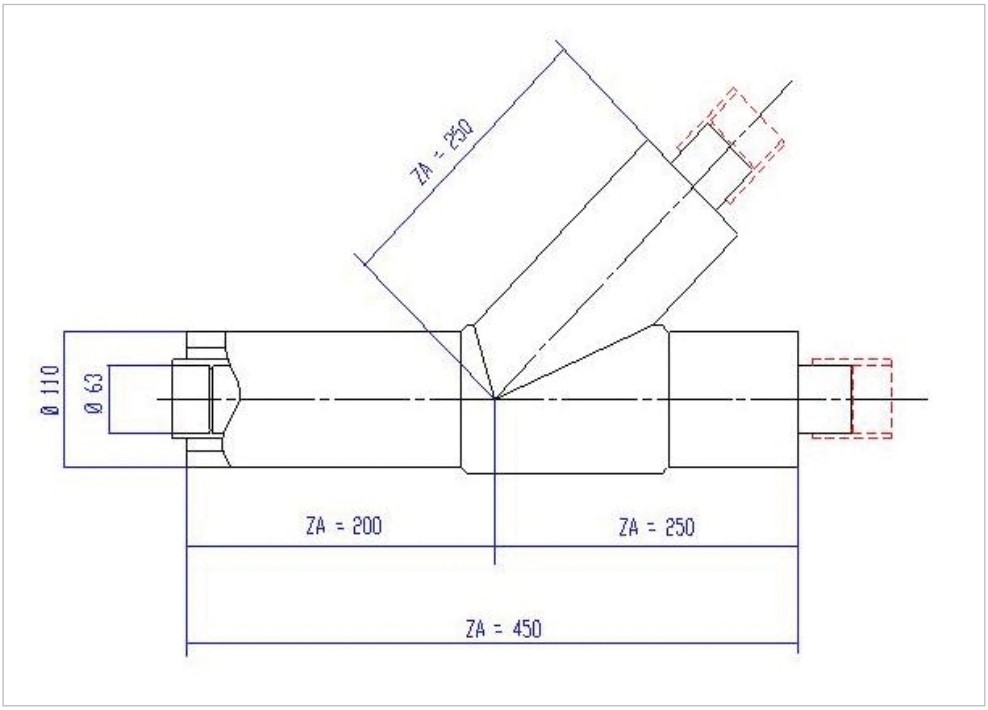
Installation, pressure test and maintenance must be performed according to the corresponding installation manual. The installation manual is part of the product, see also the online product catalog at www.gfps.com

1.12.4 Customized ttings

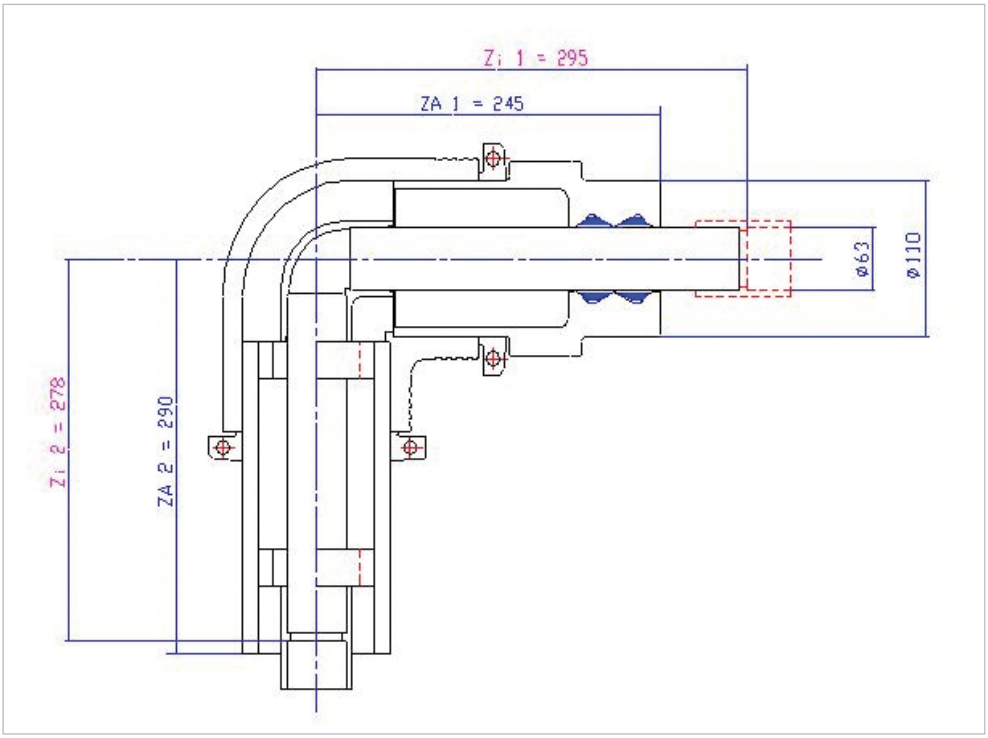
" MBSHF OVNCFS PG DPNQPOFOUT JO UIF EPVCMF DPOUBJONFOU SBOHF BSF NBO
DVTUPNFS SFRVJSFNFOUT 1SFGBCSJDBUFE UBQQJOH QJFDFT SFEVDJOH 5 QJFDI
JOUFHSBUFE JOUP UIF QSFGPSN PS UIF QSFGBCSJDBUJPO PG FOUJSF TVC BTTFN
installation on the construction site.

⚠ Customized ttings may require the inclusion of a reduction factor.
Contact your GF Piping Systems representative for additional information.

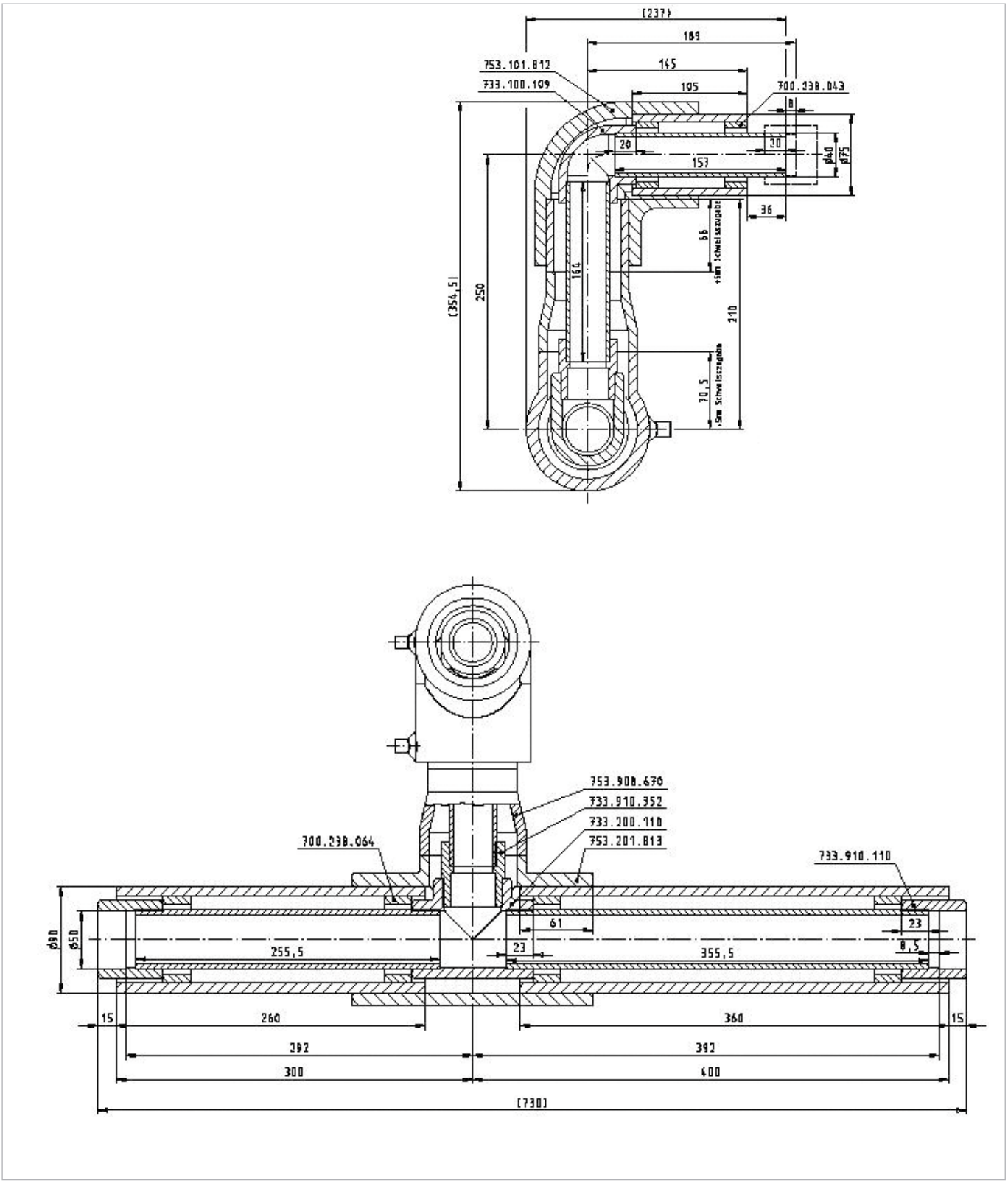
T-piece with 45° tapping point



90° elbow including termination tting



Double containment T 90° reduced with elbow



Installation, pressure test and maintenance must be performed according to the corresponding installation manual. The installation manual is part of the product, see also the online product catalog at www.gfps.com

2 COOL-FIT 2.0/2.0M

2.1 General Information

$00- '*5 JT B QSF JOTVMBUFE QJQJOH TZTUFN GPS UIF EFMJWFSZ PG TFDPOEB
5IBOLT UP JUT JOTVMBUJPO UIJDLOFTT PG NN UIF TZTUFN DBO CF VTFE JO BJ
TZTUFNT XJUI TFDPOEBSZ SFGSJHFSBOU UFNQFSBUVSFT BCPWF ‹$ $00- '*5 J
FTUBCMJTIFE JNQBDU SFTJTUBOU BOE DPSSPTJPO GSFF 1& QJQF BOE ÌUUJOHT
TVSGBDF PG UIF ÍVJE QJQF QSPWJEFT NJOJNBM MPTTFT PG QSFTTVSF 5IF MPX U
BOE IJHI RVBMJUZ JOTVMBUJPO HVBSBOUFF MPX PQFSBUJOH DPTU PWFS UIF FOU
TZTUFN 5IBOLT UP UIF JO EFTJHO r 'MVJE QJQF *OTVMBUJPO +BDLFU UVCF
kept very short.

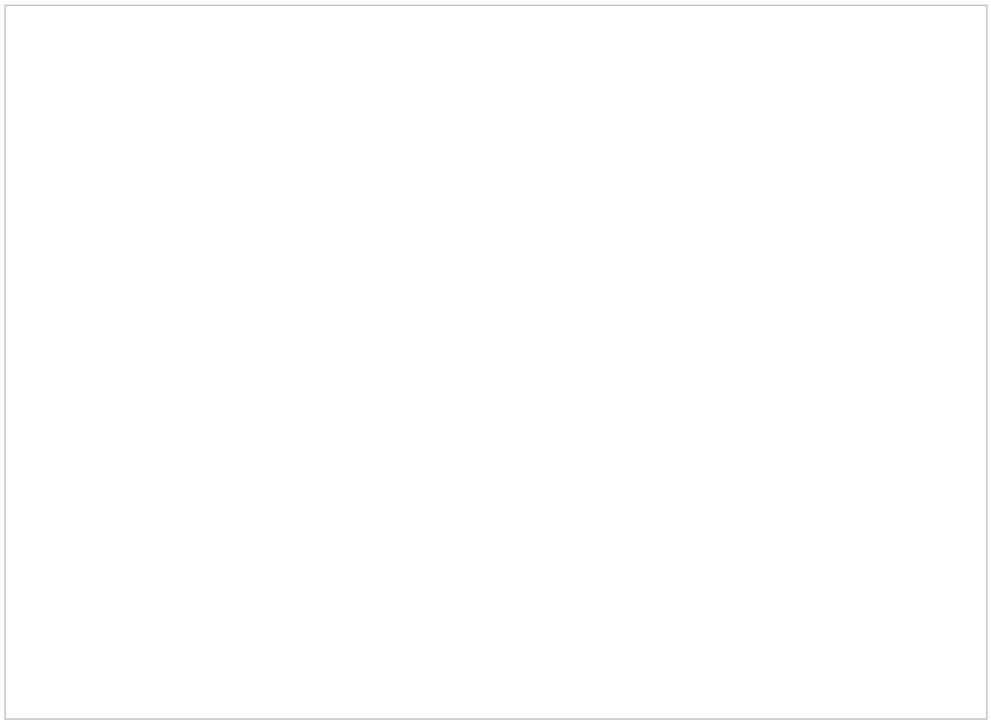
5IF TZTUFN DPOTJTUT PG QJQF ÌUUJOHT WBMWFT ÍFYJCMF IPTFT BOE USBOTJU
DPNQPOFOUT BSF QSF JOTVMBUFE PS TVQQMJFE XJUI NPVOUBCMF JOTVMBUJPO T
UPPMT BMMPX GPS GBTU BOE TBGF JOTUBMMBUJPO PG UIF TZTUFN

5IF $00- '*5 TZTUFN JT B DPNQMFUFMZ QSF JOTVMBUFE QMBTUJD QJQJOH TZTU
SFGSJHFSBOU DJSDVJUT SVO XJUI XBUFS CSJOF PS (MZDPM CBTFE TPMVUJPOT

5IF $00- '*5 TZTUFN JT TVJUBCMF GPS VTF JO BQQMJDBUJPOT MJLF

Comfort Cooling	Safe Cooling
• "JSDPOEJUJPOJOH	• %BUB DFOUFST
• "JSQPSUT	•)PUFMT
• "QBSUNFOUT	• Shopping centers
•)PTQJUBMT	• Sports center / leisure center
• *OEVTUSJBM CVJMEJOHT	• 6OJWFSJUJFT
	• #BOL QVCMJD JOTUJUVUJPOT

2.2 System Speci cation



Medium		COOL-FIT 2.0	COOL-FIT 2.0M
Materials[1]	Pipe	1&	1&
	Insulation	(')& GPBN IBMPHFO GSPDMPTFE DFMM	1*3HGPBN IBMPHFO GSPDMPTFE DFMM
	0VUFS KBDLFU	Pipe 1&)%	4UBJOMFTT TUFFM
		Fitting (')&	"MVNJOVN &/ "8
4J[F		E %/ r E %/ NN	E %/ r E %/ NN
$POOFDUJPOUFDIOPlogy		&MFDUSPGVTJPOUFDIOPLPHZ	&MFDUSPGVTJPO[4]
/PNJOBM QSFTTVSF		CBS 4%3	CBS 4%3
5FNQFSBUVSF	Medium	‹$ CJT ‹$	‹$ CJT ‹$
	&OWJSPONFOU	‹$ CJT ‹$	‹$ CJT ‹$
Insulation	5IFSNBM DPOEVDUJWJUZ O‹$	8 N,	8 N,
	)& 'PBN	8 N,	8 N,
	1& KBDLFU 4UBJOMFTT TUFFM KBDLFU	JOOFS QJQF	8 N,
	%FOTJUZ	È LH NŽ	È LH NŽ
	'PBN DFMM TJ[F	max. Ø 0.5 mm	max. Ø 0.5 mm
	/PNJOBM UIJDLOFTT	NN	NN
Mechanical strength (from insulation)	"YJBM TIFBS TUSFO/H	È / NN•	/ NN•
	$PNQSFTTJWF strength	È / NN•	È / NN•
$PNQVS	0VUFS KBDLFU	#MBDL	Metal
Weight	1JQF E XJUIPVU	1.14 kg/m	LH N
	Pipe d110	LH N	LH N
0YZHFO EJËVTJPO BU Ç ‹$		Ç NH N•	E NH N• E
'JSF DMBTTJDBUJPO[4]		&	# r T E

[1] "MM UISFF NBUFSJBMT ÌSNMZ CPOEFE UPHFUI "U ‹$ NFEJVN XBU UIF TQFDJÌFE WBMVF J GPS BMM TZTUFN DPNC XJUI UIF FYDFQUJPO P CVUUFSÍZ WBMWFT 1/ applies to the nominal pressure.

1JQF XJUI B DMPTFE N PVUFS KBDLFU

[4] "EEJUJPOBM JOGPSNB chapter

Medium		COOL-FIT 2.0	COOL-FIT 2.0M
&OWJSPONFOU4UBCJMJUZ		Moisture and WBQPS UJHIUWBQPS UJHIU	Moisture and
	0[POF %FQMFUJPO Potential		;FSP
Standards and Guidelines	&/ *40	Plastic piping systems for industrial BQQMJDBUJPOT r QPMZCVUFOF 1# QPMZFUIZMFOF 1& BOE QPMZQSPQZMFOF 11 r TQFDJÌDBUJPOT for components and the piping system – metric series	
	*40	5ISFBEFE +PJOUT	
	&/ *40	Industrial valves … r #BMM WBMWFT NBEF PG UIFSNPQMBTUJDT	
	&/ *40	r #VUUFSÍZ WBMWFT NBEF PG UIFSNPQMBTUJDT	
	&/ *40	r #BDLÍPX QSPUFDUJPO NBEF PG UIFSNPQMBTUJDT	
	&/ *40	r %JBQISBHN WBMWF NBEF PG UIFSNPQMBTUJDT	
	&/ *40	Plastic piping and ducting systems – Plastic QJQF BOE ÌUUJOHT r .FUIPE GPS FYQPTVSF UP EJSFDU OBUVSBM XFBUIFSJOH	
	&/ *40	'JSF DMBTTJÌDBUJPO PG DPOTUSVDUJPO QSPEVDUT BOE EVJMEJOH NBUFSJBMT	

2.3 Technical Details

2.3.1 COOL-FIT 2.0

COOL-FIT 2.0 pipe

$00- '*5 QJQF BSF NBEF GSPN 1& 5IF IJHI FÎDJFODZ (')& IBSE GPBN JOTVMBUJPO FYIJCJUT PBGUIFSNBM, DPFQDIQF WBSUZ QSPUFDUFE CZ B JNQBDU SFTJTUBOU 1& KBDLFU

"MM UISFF NBUFSJBMT BSF ÌSNMZ CPOEFE JO PSEFS UP FOTVSE HPPE JOTVMBUJP QSPQFSUJFT BOE MPX UIFSNBM FYQBOTJPO PS DPOUSBDUJPO GPS UIF TZTUFN

5IF QJQF BSF BWBJMBCMF JO N MFOHUIT

Pipe d x e (mm)	Pipe d_i (mm)	Outer jacket D x e1 (mm)	Free pipe ends (mm)	Weight (kg/m)	Volume (l/m)	Insulation thickness (mm)	Heat transfer coe cient (U) (W/m K)
Y		Y			0.54		0.19
Y		Y	40	1.45			
Y		Y	44				
Y	51.4	110 x 4				19.5	
Y		Y	55				
Y		140 x 4		4.09			
110 x 10	90.0	Y					0.44
Y		Y					

E /PNJOBM PVUFS EJ PG UIF 1& QJQF

d_i /PNJOBM JOTJEF diameter of the pipe

% /PNJOBM PVUTJEF diameter of the outer 1& KBDLFU

F F /PNJOBM XBMM UI

COOL-FIT 2.0 ttings

General

5IF NFEJB ÌUUJOH BOE JOTVMBUJPO VTFE GPS $00- '*5 ÌUUJOHT GVMÌMM UIF T
BT UIF $00- '*5 QJQF 5IF $00- '*5 ÌUUJOHT BSF CBTFE PO &-(&' FMFDUSPGV
XIJDI IBWF CFFO JO VTF TVDDFTTGVMMZ GPS ZFBST 5IFZ QSPWJEF BO FBTZ BOE

5IF QSF JOTVMBUFE $00- '*5 ÌUUJOHT BSF BWBJMBCMF JO UXP UZQFT

Type A: ‹ FMCPX BT BO FYBNQM

&MFDUSPGVTJPO ÌUUJOH XJUI JOUF DF XJSFT GPS
EJSFDU FMFDUSPGVTJPO JOUPDÌUUJOHT

Type B: ‹ FMCPX BT BO FYBNQM

4QJHPU ÌUUJOH XJUI GSFF FOET GP FMFDUSPGVTJPO
XJUI $00- '*5 FMFDUSPGVTJPO ÌU

Usefull functions - Fittings type A:

Fusion indicators

"GUFS XFMEJOH DIFDL XIFUIFS UIF GVTJPO
JOEJDBUPST "GUFS UIF XFMEJOH Q DBUPS QJO
TIPXT DMFBSMZ UIBU FOFSHZ IBT C IF XFMEJOH
[POF

Sealing lip

5IF TFBMJOH MJQ DBO CF VTFE UP JOTVMBUJPO
IBT CFFO QSPQFSMZ TFBMFE *G UI UIF ÌUUJOH IBT
CFFO QVTIFE VQ UP UIF FOE TUPQ OTUBMMBUJPO
JT DPSSFDU #Z MBCFMMJOH UIF M F BOZ DIBOHFT
JO QPTJUJPO PG UIF ÌUUJOH DBO C

'PS EJSFDU ÌUUJOH UP ÌUUJOH PS DPOOFDUJPOT
UIF TFBMJOH MJQ DBO CF SFNPWFE OH FMFDUSP
GVTJPO JOH

Label

5IF ÌUUJOHT IBWF BCSBTJPO SFTJT

Trace code

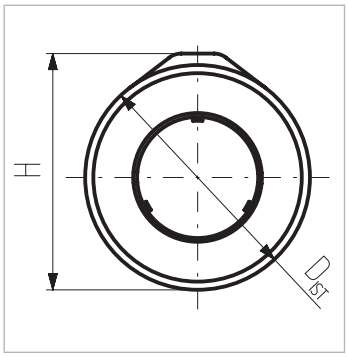
3FMFWBOU QSPEVDU EBUB DBO CF USBDFE CBDL UP QSPEVDUJPO WJB USBDFBCJMJUZ

Angle marking

#Z NBSLJOH UIF FOET PG UIF ÌUUJO CFUXFFO QJQF BOE ÌUUJOHT DBO CF PQUJNB

"MM 5ZQF " ÌUUJOHT GFBUVSF B EPNF TVSSPVOEJOH UIF XFMEJOH DPOOFDUPST EJBNFUFS PG B ÌUUJOH UIVT JODSFBTFT UIF UPUBM IFJHIU) PG B ÌUUJOH JO U PVUFS EJBNFUFS $ JT BT MUJUHJOM Z % MBSHFS UIBO UIF OPNJOBM PVUFS EJBNFUFS % TZTUFN 4FF EJNFOTJPO UBCMF GPS 5ZQF " ÌUUJOHT

d/D [mm]	D_{st} [mm]	H [mm]
40/90		99
50/90		105
90/140		154



E % /PNJOBM JOOFS EJBNFUFS $00- '*5 System

%st &ËFDUJWF PVUFS EJBNFUFS ÌUUJOH 5

) 'JUUJOH IFJHIU BU XFMEJOH DPOOFDUP section

Jointing

Pipe and Fitting

5ZQF " ÌUUJOHT IBWF JOUFHSBUFE SFTJTUBODF XJSFT XIJDI BSF QVU VOEFS FMF UIF XFMEJOH PQFSBUJPO UISPVHI XFMEJOH DPOUBDUT PO UIF ÌUUJOHT 5IJT IFBU ÌUUJOH BOE CPOET UIF NFMUJOH [POF XJUI UIF QJQF

5ZQF # ÌUUJOHT GFBUVSF OPO JOTVMBUFE TQJHPU FOET 5IFZ BSF DPOOFDUFE X DPVQMFS UP B QJQF TFF DIBQUFS CFMPX DPNQPOFOUT

Fitting-to- tting

5XP $00- '*5 ÌUUJOHT BSF VTVBMMZ DPOOFDUFE CZ VTJOH B QJFDF PG $00- '*5 GSFF FOET PS B TIPSU QJFDF PG FDP'*5 1& QJQF BOE BO JOTVMBUJPO SJOH F H GPBN SFNPWBM UPPM 5IF TIPSUFTU DPOOFDUJPO CFUXFFO UXP $00- '*5 5ZQF BDIJFWFE CZ DVUUJOH PË UIF TFBMJOH MJQT BOE VTJOH B CBSSFM OJQQMF BOE vapor seal (see components).

5XP $00- '*5 5ZQF # ÌUUJOHT DBO CF KPJOFE VTJOH BO FMFDUSPGVTJPO DPVQ components).

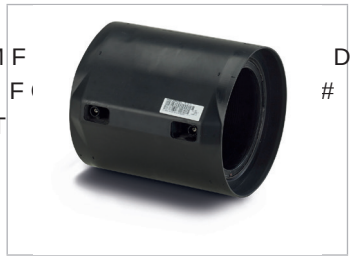
5IF DPOOFDUJPO PG B $00- '*5 ÌUUJOH 5ZQF " BOE 5ZQF # JT BMTP QPTTJCMF

Components

'JUUJOHT DBO CF DPOOFDUFE UP FJUIFS QJQF PS PUIFS ÌUUJOHT VTJOH UIF QBS

COOL-FIT 2.0 Electrofusion coupler

$00- '*5 FMFDUSPGVTJPO DPVQMF DPOOFDU
QJQF BOE DPNQPOFOUT XJUI GSFF F # ÌUUJOHT
WBMWFT BOE USBOTJUJPO ÌUUJOHT



COOL-FIT 2.0 Elbows 45° and 90°

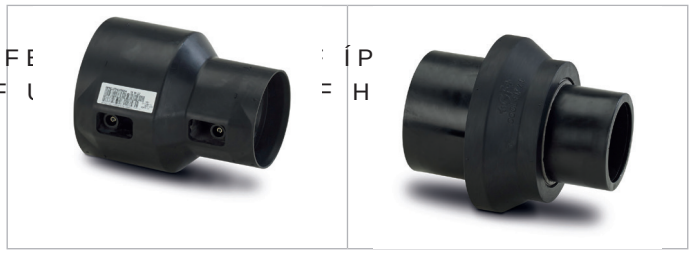
3FGFS UP c(FOFSBMo DIBQUFS BCPW

COOL-FIT 2.0 T90 ° equal and COOL-FIT T90 ° reduced

5IF FRVBM BOE SFEVDFE UZQF " ‹ U UI
DPVQMFS SFTJTUBODF XJSFT GPS FI 5II
PVUMFUT DBO CF DPOOFDUFE UP UIF TF
DPNCJOBUJPOT BSF QPTTJCMF
5IF UZQF # ÌUUJOHT XJUI GSFF GVTJ) C
DPOOFDUFE UP BMM UZQF " ÌUUJOHT

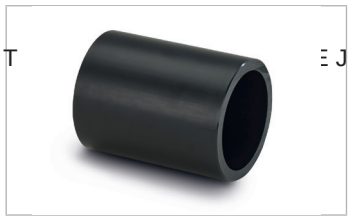
COOL-FIT 2.0 reducer

5IF $00- '*5 SFEVDFS DBO CF VTFE ÍP
UIF TUBSUJOH TJ[F CZ VQ UP UISFF U F H
VQ UP E PS GSPN E VQ UP E



COOL-FIT 2.0 barrel nipple

$00- '*5 CBSSFM OJQQMF TFSWFT EJSFDU
DPOOFDUPS GPS UZQF " ÌUUJOHT



Combination of T90° and Reducer

*G B SFEVDUJPO TUFQ TIPVME CF EPOF BGUFS UIF CSBODI PG B 5 ‹ FJUIFS B $0
SFEVDFE PS B $00- '*5 5 ‹ SFEVDFE FRVBM DPOOFDUFE UP B SFEVDFS TIPVM

Branch \ Run	40	50	63	75	90	110	140
	X	X	X	X	X	X	X
40		X	X	0	0	0	0
50			X	0	0	0	0
				—	—	—	—
					—	—	—
90						—	—
110							—

9 5 ‹ FRVBM SFEVDFS
0 5 ‹ SFEVDFE SFEVD
— 5 ‹ SFEVDFE

Accessories

Insulation for fusion contacts

4VQQMJFE XJUI FBDI ÌUUJOH 1SFWFO PG B DPME
CSJEHF BU UIF GVTJPO DPOUBDUT *C SUT DBO BMTP
TFSWF BT BO JOEJDBUPS UIBU B DPO(FFO XFMEFE
*OTUBMM JOTVMBUJPO BGUFS XFMEJ 3U UIF XFMEJOH
IBT CFFO DPNQMFUFE

Adhesive ring

8JUI B DPNQBDU DPOOFDUJPO XJUI B MF ÌU
UJOH UP ÌUUJOH UIJT BEIFTJWF SJO FOTVSF UIBU UIF
DPOOFDUJPO JT XBUFS BOE WBQPS U. F SFNPWBM PG UIF
sealing lip.

Cement

'PS GSPOUBM CPOEJOH PG UIF JOT)TJUJPO ÌUUJOHT
BOE ÍFYJCMF IPTFT

Adhesive tape

0QUJPOBM GPS DPWFSJOH IBOE DVU GBDFT

Y-Cable kit for COOL-FIT Fixpoints

$VUT UIF XFMEJOH UJNF CZ BOE JO SFRVJSFE
XFMEJOH BEBQUFST

"SUJDMF OP

COOL-FIT 2.0 valves

$00- '*5 WBMWFT BSF CBTFE PO UJJD
WBMWFT 5IF WBMWFT BSF TVQQMJ & JOTVMBUJPO
TIFMMT XJUI B QSPUFDUJWF 1& KBD GBDFT
CFUXFFO UIF TIFMMT BOE UIF WBMV IU CZ UIFJS
EFTJHO /P BEEJUJPOBM UBQF PS T FE

3FMFBTBCMF QMBTUJD CBOET GPS / BOE
NFUBM TUSBQT XJUI UFOTJPO MPDL r
E %/ QFSNJU UIF QSF JOTVMBUF UFE UP
BOE SFNPWFE GSPN UIF WBMWFT FE FBTZ
maintenance.

5IF JOTVMBUFE CBMM WBMWF JO 17$ 6 JT BWBJMBCMF JO TJ[FT E %/ r E %/
WBMWF JO TJ[FT E %/ r E %/ .BOVBM WFSTJPOT PS TVDI *40 JOUFSGBD
BWBJMBCMF 5IF JOUFSGBDF JT TVJUBCMF GPS Spany FDUSJD BDUVBUPST GSPN (' BT
actuators.

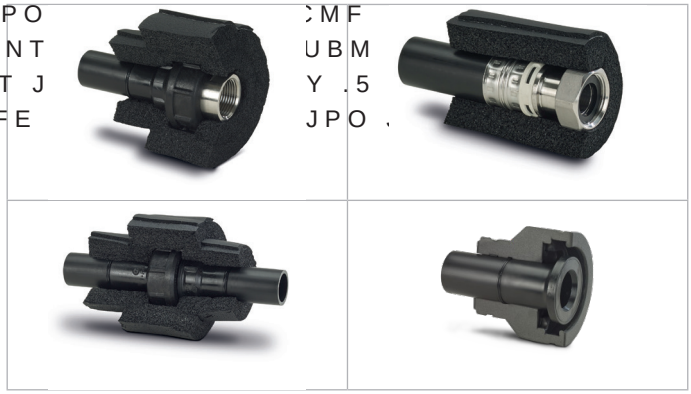
Interfaces:

' BOE ' GPS CBMM WBMWFT E %/ r E %/

' GPS BMM CBMM BOE CVUUFSÍZ WBMWFT E %/ r E %/

COOL-FIT 2.0 transition ttings, ange connectors

5SBOTJUJPO ÌUUJOHT BOE ÍBOHF DPO CMF
DPOOFDUJPOT UP EJËFSFOU TZTUFNT UBM
TVDI BT UIF (FPSH 'JTDIFS TZTUFNT J Y .5
MJTUFE DPNQPOFOUT BSF TVQQMJFE JPO .
GPBN



Thread type/connector/ pitch circle	Size	Material	Thread type/connector/ pitch circle
5SBOTJUJPO ÌUUJOHT GPS 1&T BUMBJOMFT 3 ~or ™osteel 'FNBMF UISFBE 3Q 1& r CSBTT-PPTF VOJPO OVU (	EET	1&UrBTU	BMF
5SBOTJUJPO ÌUUJOHT UP J'T 4BOJQFY .5	EET	Stainless steel	J'*5 4BOJQFY .5
6OJPO QMBTUJD	QEMBrTUEJD	1& r 1&	Welding spigots
"EBQUPS VOJPO UPENFtUBEM TUBJO		1& r	*MFUTOBM UISFBE 3Q
'MBOHF	E r E	1&	#PMU DJSDMF 1/

/#3 GPBN JOTVMBUJP

** Insulation half shells similar to valve insulations

COOL-FIT 2.0 ex hoses

5IF ÍFYJCMF IPTFT JO &1%. QFSNJU NPCJMF BDDFTT UP EFWJDFT TVDI BT GBODPJMT DPNQFOTBUJOH GPS FYQBOTJ PS DPOUSBD UJPO XJUIJO UIF TZTUFN 5IF UFBS SFTJTUBOU C UFDUJWF UJTTVF KBDLFU BOE /#3 JOTVMBUJPO8 NN ensure the temperature of the cooling medium remains VODIBOHFE BDDPSEJOH UP UIF DPOWFOUJPOBM UBCMFT DPOOFDUJPO JT FOTVSFE (UISFBE FYUFSOBM UISFBE MPPTF OVU

d (mm)	DN (mm)	Thread	Length (mm)	Max. compensation L (mm)	R_{min} (min. bending radius) (mm)
		™ o	1000		
		o	1000		90
40		— o	1000		
50	40	˜ o	1500		155

COOL-FIT 2.0 Installation ttings type 313

*OTUBMMBUJPO ÌUUJOHT BSF VTFE PVT UZQFT PG sensors to the system. Pressure or temperature sensors DBO CF DPOOFDUFE VTJOH UIF ˜ P SFBE 5IF JOTVMBUJPO JT DPNQSJTFE PG)& GPBN XJUI FYDFMMFOU JOTVMBUJOH DBQ

2.3.2 COOL-FIT 2.0M

COOL-FIT 2.0M pipe

$00- '*5 . JOOFS QJQF BSF NBEF foam insulation has a thermal conductivity Oof 8 N, 5IF QJQF BSF QSPUFDUFE EVDJOH TUFFM KBDLFU "MM UISFF NBUFSJBMT BSF ÌSNMZ C P FOTVSF HPPE JOTVMBUJPO QSPQFSUJFT BO QBOTJPO PS contraction for the system. 5IF QJQF BSF BWBJMBCMF JO N MI

Inner Pipe d x e (mm)	Inner Pipe d_i (mm)	Outer jacket stainless steel d x e1 (mm)	Weight (kg/m)	Volume (l/m)	Insulation thickness (mm)	Heat transfer coe cient (U) (W/m K)
Y		Y		0.54		
Y		Y	0.9			0.19
Y		Y			19.5	
Y	51.4	Y				
Y		Y				
Y		Y				
110 x 10	90.0	Y				0.40

E /PNJOBM PVUFS EJBNFUFS PG UIF 1& $

d_i /PNJOBM JOTJEF diameter of the pipe

% /PNJOBM PVUTJEF diameter of the outer 1& KBDLFU

F F /PNJOBM XBMM UI

COOL-FIT 2.0M ttings

5IF QJQF NBUFSJBM GPS $00- '*5 . ÌUUJOHT UIF JOTVMBUJPO JO IJHI FÎDJFODZ UIF 163 QSPUFDUJWF KBDLFU BOE UIF TVQQMFNFOUBSZ NFUBM IBMG TIFMMT BSF UIF SFTQFDUJWF $00- '*5 . QJQF BOE NFFU UIF TBNF TQFDJÌDBUJPOT

$00- '*5 . ÌUUJOHT IBWF BO JOUFHSBUFE TFBMJOH MJQ XIJDI FOTVSFT XBUFS B DPOOFDUJPO 5IF ÌUUJOHT IBWF IBMG TIFMMT BOE QJQF DMBNQT JO NFUBM BOE IJHIFS ÌSF DMBTTJÌDBUJPOT

COOL-FIT 2.0M coupler

COOL-FIT 2.0M elbow 90 °

COOL-FIT 2.0M T 90 ° equal

2.3.3 COOL-FIT tools

Electrofusion Machines

&MFDUSPGVTJPO NBDIJOFT BSF SFRVJSFE UP KPJO $00- '*5 DPNQPOFOUT 5IF SBOHF JODMVEFT EFEJDBUFE BOE NVMUJQVSQPTF FMFDUSPGVTJPO NBDIJOFT XIJDI BSF SFMJBCMF and easy to use.

(' SFDPNNFOET .4" 4FSJFT FMFDUSPGVTJPO NBDIJOFT

Foam removal tool

5IF GPBN SFNPWBM UPPM JT VTFE U 5 QJQF GPS FMFDUSPGVTJPO 5IF UPPM SF OE DVUT PVUFS KBDLFU BOE BMTP QFFMT UIF TVSC QJQF "OZ PYJEF MBZFS QSFTFOU JT SFNPWFE H [POF JT treated.

5IF UPPM JT BWBJMBCMF JO UXP WI

GPS TJ[FT E r E GPS TJ[FT E r E

Clamping tool

5IF GVTJPO QSPDFTT HJWFT SJTF UP GPSDFT UIBU DBO QVMM UIF QJQF PVU PG UIF DPVQMFS 5IFSFGPSF JU JT SFDPNNFOEFE UIBU UIF BTTFNCMZ TIPVME CF ÌUUFE XJUI $00- '*5 JOTUBMMBUJPO DMBNQT 5IJT QSFWFOUT NPWFNFOU EVSJOH UIF XFMEJOH BOE DPPM EPXO QSPDFTT

5IF DFOUSBM IJOHF BMMPXT UIF VTF PG UIF DMBNQT PO FMCPXT BOE SFEVDFST %FQFOEJOH PO UIF MFOHUI PG UIF QJQF PS PG UIF HMBTT SFJOGPSDFE QMBTUJD IPMEFST DBO CF VTFE 5IF MJOLBHF JT NBEF PG HBMWBOJ[FE TUFFM 5FOTJPO CBOET BSF JODMVEFE BOE B 5 BEBQUFS JT PQUJPOBM BWBJMBCMF

2.4 Dimensioning anddesign

5IF GPMMPXJOH TFDUJPO EFTDSJCFT POMZ UIF $00- '*5 TQFDJÌD QMBOOJOH GVOE
prevailing information see general GF planning fundamentals.

2.4.1 General information about the dimensioning and installation of plastic piping

1MBTUJDT IBWF EJËFSFOU QIZTJDBM DIBSBDUFSJTUJDT UP NFUBMT 8IFO EFTJHO
UIFSNPQMBTUJD QJQJOH TZTUFNT UIJT OFFET UP CF UBLFO JOUP BDDPVOU "MU
BSF WFSZ SPCVTU TZTUFNT DBSF TIPVME CF UBLFO UP BWPJE EBNBHF EVSJO
transportation.

'PS PWFS ZFBST (' 1JQJOH 4ZTUFNT IBT EFWFMPQFE BOE TPME B WBSJFUZ PG
TZTUFNT XIJDI BSF TVCKFDUFE UP WFSZ SJHPSPVT EFNBOET TVDI BT PQUJNJ[FE
QSPQFSUJFT JO DPPMJOH BQQMJDBUJPOT &YQFSJFODF IBT TIPXO UIBU QMBTUJD
BOE SFMJBCMF BMUFSOBUJWF UP NFUBM XIFO EFTJHOFST BOE JOTUBMMFST UBLF
recommendations in the technical documentation. In the professional production of plastic
QJQJOH TZTUFNT GPS FYBNQMF QJQJOH TZTUFNT NVTU CF BCMF UP NPWF UP BD
JO MFOHUI DBVTFE CZ UFNQFSBUVSF BOE QSFTTVSF DIBOHFT 5P BMMPX GPS UIF
the use of pipe holders that permit this movement is vital.

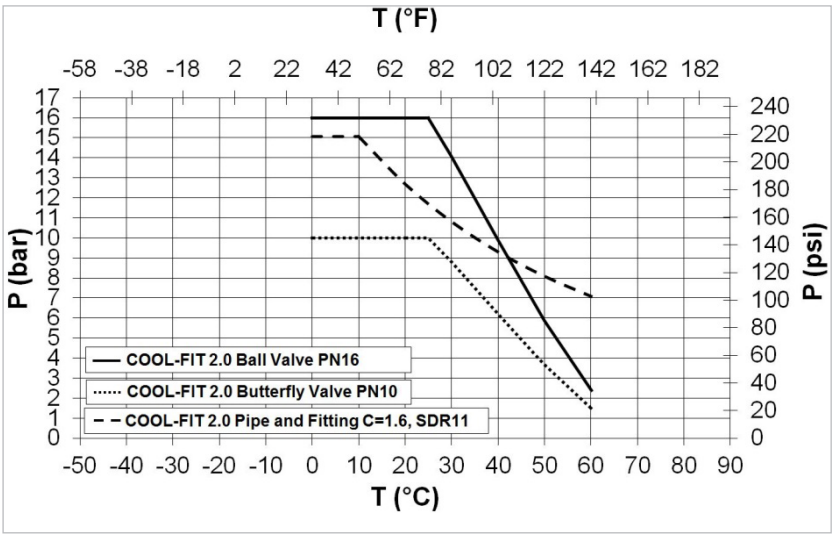
5IF GPMMPXJOH UFDIOJDBM JOGPSNBUJPO DPOUBJOT UIF CBTJD JOGPSNBUJPO O
FDPOPNJDBM BOE USPVCMF GSFF JOTUBMMBUJPO)PXFWFS UIJT DIBQUFS EPFT
EFUBJMT 'PS NPSF JOGPSNBUJPO PS JG ZPV IBWF TQFDJÌD RVFTUJPOT QMFBTF
1JQJOH 4ZTUFNT SFQSFTFOUBUJWF "EEJUJPOBM JOGPSNBUJPO JT BWBJMBCMF P
4ZTUFNXFTC TJUF

2.4.2 COOL-FIT 2.0pressure-temperature diagram

5IF QSFTTVSF SFTJTUBODF GPS UIFSNPQMBTUJD QJQF GPS XBUFS JT BMXBZT TQF
IJHIFS UFNQFSBUVSFT BMMPXBODF NVTU CF NBEF GPS B MPXFS NBYJNVN PQFSBU
5IF HSBQI TIPXT UIF NBYJNVN QFSNJTTJCMF QSFTTVSF GPS $00- '*5 QJQF ÌUU
WBMWFT BU WBSJPVT UFNQFSBUVSFT VQ UP UIF NBYJNVN QFSNJTTJCMF NFEJB U
{‹$ 5IF UBCMF JT CBTFE PO BO BNCJFOU UFNQFSBUVSF PG ‹$ " TBGFUZ GB
NJOJNVN MJGFTQBO PG ZFBST IBWF CFFO BMMPXFE GPS JO BMM DBMDVMBUJPO
5IF WBMVFT HJWFO JO UIJT DIBQUFS BQQMZ UP CPUI $00- '*5 BOE $00- '*5 .

Pressure/temperature limits for COOL-FIT 2.0 ttings, pipe, valves – water coolant

-JNJUT GPS $00- '*5 ZFBS WBMVFT BMMPXJOH GPS UIF TBGFUZ GBDUPS XJU
coolant).



1 "MMPXBCMF QSFTTVSF
5 5FNQFSBUVSF ‹$ ‹'
$ 4BGFUZ GBDUPS

5IF CVUUFSÍZ WBMWFT VTFE GPS UIF $00- '*5 TZTUFN FYIJCJU MPXFS QSFTTVS
SBUJOHT UIBO UIF SFTU PG UIF DPNQPOFOUT *G WBMWFT BSF VTFE JU JT OFDF
JO UIF EJBHSBN BCPWF

In uence of secondary refrigerants with antifreeze additives

"U BNCJFOU UFNQFSBUVSFT CFMPX ‹$ BOUJGSFF[F NVTU CF VTFE JO UIF XBUFS
GSFF[JOH EVSJOH B QMBOU TIVU EPXO

$00- '*5 JT HFOFSBMMZ SFTJTUBOU UP TFDPOEBSZ DPPMBOUT TVDI BT HMZDPM
secondary coolants a reduction factor is necessary depending on the type and mixing ratio.
5IF QFSNJTTJCMF PQFSBUJOH QSFTTVSF JT DPSSFDUFE EPXOXBSET GSPN UIF QS
DVSWF GPS XBUFS

Reduction factors[1]

[1] WBMJE GPS NBUFSJBM
&1%. 17$ 6 NFUBMT

Inorganic salt solutions F = 1
0SHBOJD TBMU TPMVUJPOT '
(MZDPM TPMVUJPOT NBY '

'PS UIF DBMDVMBUJPO UIF GPMMPXJOH GPSNVMB JT VTFE

$$P_{AF} = \frac{P_w}{AF}$$

P_{AF} 1FSNJTTJCMF QSFTTVSF XJUI SFEVDUJPO GBDUPS
P_W 1FSNJTTJCMF QSFTTVSF GPS XBUFS
"' 3FEVDUJPO GBDUPS

Glycol solutions

$00- '*5 . DBO CF VTFE XJUI HMZDPM TPMVUJPOT XJUI DPODFOUSBUJPOT VQ
DIFNJDBM SFTJTUBODF PG $00- '*5 TZTUFNT JT TVJUBCMF GPS UIF GPMMPXJOH

Brand name	Hersteller	Typ
"OUJGSPHFO /	$MBSJBOU	&UIZMFOHMZDPM
"OUJGSPHFO -	$MBSJBOU	Propylene glycol
4IPXCSJOF #MVF 44IPXBSJOF TUBOEBSE &(CSJOF	&UIZMFOHMZDPM
4IPXCSJOF #MVF 44IPXBSJOF &$ CSJOF	&UIZMFOHMZDPM
5ZGPDPS -	5ZGP	Propylene glycol
5ZGPDPS	5ZGP	&UIZMFOHMZDPM
%08'3045	%08	Propylene glycol
;ZUSFD '$	"SUFDP	Propylene glycol
;ZUSFD -$	"SUFDP	Propylene glycol
;ZUSFD .$	"SUFDP	Propylene glycol
/FVUSPHHFM	$MJNBMJGF %FIPO	&UIZMFOHMZDPM
'SJPHFM /FP	$MJNBMJGF %FIPO	Propylene glycol
%085)&3. 43	%08	&UIZMFOHMZDPM

8IFO VTJOH PUIFS DPPMB
DPNQBUJCJMJUZ XJUI $0
TIPVME CF DMBSJÌFE XJU
Piping Systems.

Example – glycol dissolved in water

'PS XBUFS HMZDPM NJYUVSF Ç UIF SFEVDUJPO GBDUPS GPS UIF QSFTTVSF
EJBHSBN JT 5IVT BU ‹$ XJUI B NJOJNVN MJGF PG ZFBST UIF NBYJNV
XPSLJOH QSFTTVSF JT SFEVDFE BT GPMMPXT

$$P_{AF} = \frac{15\ \text{bar}}{1.1} = 13.6\ \text{ba}$$

Organic salt solutions

5IFTF NFEJB BSF VTVBMMZ QPUBTTJVN GPSNBUFT PS QPUBTTJVN BDFUBUFT BRV
MPX WJTDPTJUZ BU MPX UFNQFSBUVSFT $00- '*5 DBO CF VTFE XJUI UIF NFEJB
NBOVGBDUVSFS T JOTUSVDUJPOT NVTU CF GPMMPXFE

Brand name	Manufacturer	Type
"OUJGSPHFO ,'	$MBSJBOU	#SJOF
;ZUSFD 4	Frigol	#SJOF
5FNQFS	5FNQFS	#SJOF
)ZDPPM	"EEDPO	#SJOF

For detailed information on resistance and reduction factors, see Planning Funda mentals "Material selection – Chemical resistance".

2.4.3 Polyethylene (PE)

5IF EPNJOBOU NBUFSJBM GPS UIF $00- '*5 . TZTUFN JT QPMZFUIZMFOF 1& QJQF XIJDI DPNFT JOUP DPOUBDU XJUI UIF NFEJB JT NBEF PG 1& JUT QSPQFS
particularly high relevance.

Properties of PE (approximate)

Property	PE 100-value[1]	Unit	Testing standard
%FOTJUZ	0.95	H DNŽ	&/ *40
:JFME TUSFTT BU ‹ $		/ NN•	&/ *40
5FOTJMF NPEVMVT BU -90$		/ NN•	&/ *40
$IBSQZ OPUDIFE JNQBDU TUSFOHUI L-BU		/ NN•	&/$*40 F"
$IBSQZ OPUDIFE JNQBDU TUSFOHUI LB U		/ NN•	&/$*40 F"
$SZTUBMMJOF NPEVMVT		‹$	%*/
5IFSNBM DPOEVDUJWJUZ BU ‹ $		8 N ,	&/
8BUFS BCTPSQUJPO BU ‹ $			&/ *40
$PMPS			3"-
0YZHFO *OEFY -0*			

[1] 5ZQJDBM NFBTVSFE F
NBUFSJBM DIBSBDUFSJ
TIPVME OPU CF VTFE G
calculations.

General information

"MM QPMZNFST NBEF GSPN IZESPDBSCPO QSPQZMFOF CVUFOF JTPCVUFOF BSF SFGFSSFE UP DPMMFD
CPOE FUIZMFOF QSPQZMFOF CVUFOF JTPCVUFOF BSF SFGFSSFE UP DPMMFD
"NPOH UIFN JT QPMZFUIZMFOF 1& *U JT B TFNJ DSZTUBMMJOF UIFSNPQMBTUJD
QSPCBCMZ UIF CFTU LOPXO QMBTUJD $) Fn.Polyethylene Disam GPSNVMB JT $)
FOWJSPONFOUBMMZ GSJFOEMZ IZESPDBSCPO QSPEVDU 1& MJLF 11 JT B OPO
5IFSFGPSF JU JT JOTPMVCMF BOE TDBSDFMZ TXFMMBCMF JO DPOWFOUJPOBM TP
UIFSFGPSF CF BEIFTJWFMZ CPOEFE UP ÌUUJOHT 8FMEJOH JT UIF BQQSPQSJBUF
the material.

*O JOEVTUSJBM QJQJOH IJHI NPMFDVMBS XFJHIU UZQFT IBWF SFTVMUFE JO NFE
UZQFT BSF DMBTTJÌFE CZ UIFJS DSFFQ SVQUVSF TUSFOHUI JOUP 1& .34 .1B
.1B 5IF MBUUFS BSF BMTP DBMMFE SE HFOFSBUJPO UZQFT PG 1& XIJMF 1&
BTTPDJBUFE XJUI UIF OE HFOFSBUJPO 5IFSF BSF CBSFMZ BOZ ÌSTU HFOFSBUJP
VOEFS UIF NPEFSO DMBTTJÌDBUJPO r SFNBJOJOH PO UIF NBSLFU $SFFQ SVQUVS
UFTUFE CZ MPOH UFSN UFTUT BT QFS *40 BOE DBMDVMBUFE JO BDDPSEBODF
NPTU XJEFTQSFBE JO QJQJOH TZTUFN DPOTUSVDUJPO JT 1& GPS VTF JO VOEFSH
QJQF *O UIJT BSFB QPMZFUIZMFOF IBT CFDPNF UIF EPNJOBOU NBUFSJBM JO NBO
the advantages of this material mean that it is also used in domestic installations and industrial piping.

Advantages of PE

- -JHXUF JHIU
- &YDFMÍFMMFOUJOCUJMJUZ
- (PPXEFBSSFTJTUBBOSDEFSTFFOTUBODF
- $PSSPTJTFFOTUBODF
- %VDUJMF GSBDUVSF QSPQFSUJFT
-)JHI JNQBDU TUSFOHUI FWFO BU WFSZ MPX UFNQFSBUVSFT
- 7FSZ HPPE DIFNJDBM SFTJTUBODF
- 8FMEBCMF

Mechanical properties, chemicals, weathering and abrasion resistance

Chemical resistance

1PMZFUIZMFOF FYIJCJUT HPPE SFTJTUBODF UP B XJEF SBOHF PG NFEJB 'PS EFU QMFBTF TFF UIF EFUBJMFE DIFNJDBM SFTJTUBODF MJTU GSPN (' 1JQJOH 4ZTUFNT QFSTPO SFTQPOTJCMF BU (' 1JQJOH 4ZTUFNT EJSFDUMZ

Abrasion resistance

1& IBT FYDFMMFOU SFTJTUBODF UP BCSBTJWF XFBS :PV DBO UIFSFGPSF ÌOE 1& in numerous applications for transporting solids and media containing solids. For many BQQMJDBUJPOT 1& IBT QSPWFO FTQFDJBMMZ BEWBOUBHFPVT XJUI NFUBMT

Thermal properties and electrical properties

Operating limits

5IF BQQMJDBUJPO MJNJUT PG UIF NBUFSJBM EFQFOE PO CPUI FNCSJUUMFNFOU B UFNQFSBUVSFT BOE PO UIF NBOOFS BOE NFUIPE PG BQQMJDBUJPO %FUBJMT BSF SFMFWBOU QSFTTVSF UFNQFSBUVSF DIBSUT

Electrical properties

1PMZFUIZMFOF MJLF NPTU UIFSNPQMBTUJDT JT OPO DPOEVDUJWF 5IJT NFBOT OPU TVËFS GSPN FMFDUSPMZUJD DPSSPTJPO)PXFWFS UIF OPO DPOEVDUJWF QS JOUP DPOTJEFSBUJPO BT FMFDUSPTUBUJD DIBSHFT DBO CVJME VQ JO UIF QJQF FMFDUSJDBM JOTVMBUJPO QSPQFSUJFT˜ DSNIFUWPMTVSGBDFJT Y resistance 101 ˜ 5IJT NVTU CF UBLFO JOUP BDDPVOU JO BQQMJDBUJPOT XIFSF UIFSF J ÌSF PS FYQMPTJPO

2.4.4 Fire behavior and re prevention measures

Fire load

d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160	140/200
Fire load $00- '*5 Pipe (kWh/m)								99.14

Fire prevention classes EN13501-1, VKF and British building codes

	COOL-FIT 2.0	COOL-FIT 2.0M	COOL-FIT 2.0/ mineral wool [2]
&/	&	# T E	" .
7,'	3'	3'	3'
#4 [1]	/BUJPOBM $MBTTJGJDBUJPOBM $MBTTJGJDBUJPOBM $MBTT

[1] 5FTU NFUIPE BDDPSE #4 BOE #4 5ZQF 3PDLXPPM E E BOE $00- '*5 E E NN

Fire collars

**O PSEFS UP DBSSZ ÍBNNBCMF QJQF UISPVHI ÌSF QSPUFDUJPO CVMLIFBET XJUIPVU DPNQSPNJTJOH JUT TBGFUZ GVODUJPO ÌSF QSPUFDUJPO DPMMBST NVTU CF VTFE JO BDDPSEBODF XJUI MPDBM requirements and legislation.

5IF GPMMPXJOH ÌSF DPMMBST IBWF CFFO UFTUFE XJUI $00- '*5 1JQF

Product	Company	Approval
CP 644	)JMUJ	&5"
BIS Pacifyre‰ "8.	Walraven	&5"
ROKU‰ "8. **	3PME ,VIO (Xi'an)	&5"

System description

5IF BCPWF MJTUFE DPMMBST DPOTJTU PG B NFUBM FODMPTVSF MJOFE XJUI NVMUJMBZFS IJHIMZ FËFDUJWF JOUVNFTDFOU NBUFSJBM *O UIF FWFOU PG ÌSF UIF NBUFSJBM FYQBOET XJUI IJHI QSFTTVSF UIVT TFBMT UIF PQFOJOH IFSNFUJDBMMZ BHBJOTU ÍBNFT BOE TNPLF 'PS XBMM JOTUBMMBUJPOT POF QJQF DPMMBS FBDI TJEF PG UIF XBMM for ceiling installations one collar at the underside of the DPMMBS NVTU CF QSPWJEFE

Applications

- 4FBMJOH PG QMBTUJD QJQF VQ UP NBY NN PVUTJEF EJBNFUFS JO TPMJE XB partitions and solid ceilings
- 4VTUBJOBCMF GPS QMBTUJD QJQF ÌCSF SFJOGPSDFE QMBTUJD BOE QMBTUJD
- 4VJUBCMF GPS JOTVMBUFE BOE VOJOTVMBUFE QMBTUJD QJQF BOE TPVOE JTPM

Minimal distances

Opening size	20 x 20 cm	40 x 40 cm	> 40 x 40 cm
against other pipe penetration systems	10 cm	10 cm	D N
against other openings	10 cm	D N	D N

Solutions for emergency corridors

8JUIJO FNFSHFODZ DPSSJEPST UIF DPNCVTUJCMF NBUFSJBMT JT BMMP S 3PDLXPPM PËFST XJUI 3PDLXPPM B QSPUFD EF PG NJOFSBM XPPM XIJDI BMMPXT UIF NCVTUJCMF QJQF XJUIJO FNFSHFODZ BSFBT 5I QQSPWFE PO QJQF PVUFS EJBNFUFST PG VQ UP

'PS EFUBJMFE JOGPSNBUJPO BCPV XXX SPDLXPPM EF

2.4.5 Hydraulic design

Determination of pipe diameter based on ow rate

"T B ÌSTU BQQSPYJNBUJPO UIF SFRVJSFE QJQF DSPTT TFDUJPO GPS B DFSUBJO DBMDVMBUFE VTJOH UIF GPMMPXJOH GPSNVMB

$$d_i = 18.8 \sqrt{\frac{Q_1}{v}} \quad \text{or} \quad d_i = 35.7 \sqrt{\frac{Q_2}{v}}$$

W ÍPX WFMPDJUZ N T
di Pipe internal diameter (mm)
2 'MPX SBUF N
2 'MPX SBUF M T
$POWFSTJPO GBDUPS GPS VOJUT 2
$POWFSTJPO GBDUPS GPS VOJUT 2

Example calculation of an internal diameter d

$00- '*5 QJQF 4%3
'MPX SBUF 2 M T
6TVBM ÍPX WFMPDJUZ W 1.5 m/s

$$d_i = 35.7 \sqrt{\frac{8}{1.5}} = 82.4 \text{ mm}$$

" QJQF XJUI E E JT VTFE "GUFS UIF JOUFSOBM EJBNFUFS IBT CFFO EFUFSN XBZ UIF BDUVBM ÍPX SBUF JT EFUFSNJOFE XJUI UIF GPMMPXJOH GPSNVMB

$$v = 354 \frac{Q_1}{d_i^2} = 1.9 \frac{m}{s} \quad \text{or} \quad v = 1275 \frac{Q_2}{d_i^2} = 1.9 \frac{m}{s}$$

W 'MPX WFMPDJUZ W N T
di Pipe internal diameter (mm)
2 'MPX SBUF N
2 'MPX SBUF M T
$POWFSTJPO GBDUPS GPS VOJUT 2
$POWFSTJPO GBDUPS GPS VOJUT 2

Determination of pipe diameter based on cooling capacity (kW)

"T B ÌSTU BQQSPYJNBUJPO UIF SFRVJSFE QJQF DSPTT TFDUJPO GPS B DFSUBJO DBMDVMBUFE VTJOH UIF GPMMPXJOH GPSNVMB

$$di = 18.8 \sqrt{\frac{\left(\frac{Q \cdot 3600}{T \; c}\right)}{v}}$$

di Pipe inner diameter (mm)
2. $PPMJOH DBQBDJUZ JO L8
—5 5FNQFSBUVSF EJËFSFODF TVQQMZ SFUVSO ,
D 4QFDJÌD IFBU DBQBDJUZ L8 T LH ,
U %FOTJUZ PG UIF)NFEJVN LH N
W 'MPX WFMPDJUZ N T

Example for calculating the inner diameter di based on cooling capacity with water medium water

$PPMJOH D.BQBDJUZ 2 L8
4QFDJÌD IFBU DBQBDJUZ ‹$ D+ LH ,
8BUFS EFOTJUW Z ‹$ LH N
5FNQFSBUVSF EJËFSFODF —5 ,
'MPX WFMPDJUZ W 1.5 m/s

$$di = 18.8 \sqrt{\frac{\left(\frac{200 \quad 3600}{10 \quad 4.187 \quad 998.2}\right)}{1.5}} = 18.8 \sqrt{\frac{17.227}{1.5}} = 63.71 \text{ mm}$$

5IF ÍPX SBUF TIPVME CF FTUJNBUFE PO UIF CBTJT PG UIF JOUFOEFE QVSQPTF PG GPS UIF ÍPX SBUF UIF GPMMPXJOH TQFDJÌDBUJPOT BQQMZ

Liquids

v = 0.5 – 1.0 m/s for the suction side

W r N T GPS UIF QSFTTVSF TJEF

Gases

W r N T

5IJT NFUIPE PG DBMDVMBUJPO PG QJQF EJBNFUFS EPFT OPU BMMPX GPS IZESBVM DBMDVMBUFE TFQBSBUFMZ 5IF GPMMPXJOH TFDUJPOT TFSWF UIBU QVSQPTF

(m³/h)	(l/min)	(l/s)	(m³/s)
1.0			Y
	1.0		Y
		1.0	1.00 x 10
		1000	1.0

$POWFSTJPO UBCMF XJUI ÍPX SBUF

Correlation of outer diameter - inner diameter

5P EFUFSNJOF UIF PVUFS EJBNFUFS CBTFE PO UIF JOUFSOBM EJBNFUFS BOE 4%3 GPSNVMB DBO CF VTFE

$$d = d_i \frac{SDR}{SDR - 2}$$

Correlation between pipe external and internal diameter

d_i (mm)			41			90	115
d (mm)		40	50		90	110	140

2.4.6 Nomogram for easy calculation of diameter and pressure loss

5IF OPNPHSBN CFMPX DBO CF VTFE UP TJNQMJGZ UIF EFUFSNJOBUJPO PG UIF EJ
QSFTTVSF MPTT JO UIF QJQF DBO CF SFBE PË QFS NFUFS PG UIF QJQF MFOHUI

⚠ The pressure loss calculated using the nomogram only applies to ows of substances with density 1000 kg/m³, i.e. water. Further pressure losses from ttings, valves, etc. also need to be considered using the instructions that follow.

Using the nomogram

#BTFE PO B ÍPX WFMPDJUZ PG N T B MJOF JT ESBXO UISPVHI UIF EFTJSFE ÍPX
UP UIF BYJT XIJDI TIPXT BO JOUFSOBM EJBNFUFS EJ Å NN)FSF B DMPTFMZ N
NN GPS 4%3 BOE B TFDPOE MJOF JT ESBXO CBDL UISPVHI UIF EFTJSFE ÍPX S
QSFTTVSF ESPQ BYJT —Q NCBS QFS NFUFS PG QJQF

Nomogram for COOL-FIT 2.0 pipe (PE, SDR11) using the metric system.

ℹ For detailed information on the determination of diameter and pressure loss, see Planning Fundamentals "Hydraulic calculation and pressure losses of metric industrial piping systems".

2.4.7 Pressure loss

Pressure loss in straight pipe

*O EFUFSNJOJOH QSFTTVSF MPTTFT JO TUSBJHIU QJQF TFDUJPOT B EJTUJODUJP
MBNJOBS BOE UVSCVMFOU ÍPXT 5IF 3FZOPMET OVNCFS 3F EFUFSNJOFT UIJT 5I
MBNJOBS UP UVSCVMFOU PDDVST BU$crit UIF DSJUJDBM 3FZOPMET OVNCFS 3F

*O QSBDUJDF MBNJOBS ÍPXT PDDVS QBSUJDVMBSMZ GPS UIF NPWFNFOU PG WJTD
MVCSJDBUJOH PJMT *O NPTU BQQMJDBUJPOT UIVT JODMVEJOH ÍPXT PG BRVFPVT
UVSCVMFOU ÍPX XJUI B TVCTUBOUJBMMZ NPSF VOJGPSN WFMPDJUZ EJTUSJCVUJP
TFDUJPO UIBO JO MBNJOBS ÍPX

5IF QSFTTVSF MPTT JO B TUSBJHIU QJQF TFDUJPO JT JOWFSTFMZ QSPQPSUJPOBM
JT DBMDVMBUFE BT GPMMPXT

$$p_R = \frac{L}{d_i} \frac{}{2\ 10^2} v^2$$

— Q3 1SFTTVSF MPTT JO UIF TUSBJHIU QJQF SVO CBS
1JQF GSJDUJPO GBDUPS
- -FOHUI PG UIF TUSBJHIU QJQF TFDUJPO N
d_i Inner diameter of the pipe (mm)
U %FOTJUZ PG UIF ÍPX NBUFSJBM LH NŽ H DNŽ LH NŽ
W 'MPX WFMPDJUZ W N T

⚠ In practice, when making a rough calculation (i.e. smooth plastic pipe and turbulent ow) it is enough to use the value G= 0.02 to represent the hydraulic pressure loss.

Pressure losses in ttings

Coe cient of resistance

5IF QSFTTVSF MPTTFT EFQFOE VQPO UIF UZQF PG ÌUUJOH BT XFMM BT PO UIF ÍPX
TP DBMMFE DPFÎDJFOU PG

resistance (] WBMVF JT VTFE GPS DBMDVMBUJPOT

Fitting type	Coe cient of resistance]
&MCPX ‹	
&MCPX ‹	
5 [1]	
3FEVDFS	0.5
3FEVDFS	1.0
$PONFDUJPOT DPVQMFS E VOJPOT ÍBOHFT E E E	E E E E

[1] 'PS B NPSF EFUBJMFE EJËFSFOUJBUF CFUXFF coalescence and separa UJPO 7BMVFT GPS [V NBYJNVN PG DBO CF found in the respective MJUFSBUVSF 6TVBMMZ of a tee in the overall QSFTTVSF MPTT JT WF therefore in most cases] DBO CF VTFE

Calculation of the pressure loss

5P DBMDVMBUF UIF UPUBM QSFTTVSF MPTT JO BMM ÌUUJOHT JO B QJQJOH TZTUFN JOEJWJEVBM MPTTFT J F UIF TVN PG

all the] WBMVFT 5IF QSFTTVSF MPTT DBO UIFO CF DBMDVMBUFE BDDPSEJOH UP UIF

$$p_{Fi} = \frac{v^2}{2 \cdot 10^5}$$

—FiQ 1SFTTVSF MPTT PG BMM ÌUUJOHT CBS
6] Sum of all individual losses
W 'MPX WFMPDJUZ W N T
U %FOTJUZ PG UIF NFEJVN JO LH NŽ H DNŽ LH NŽ

Pressure losses in valves

5IFv LGBDUPS JT B DPOWFOJFOU NFBOT PG DBMDVMBUJOH UIF IZESBVMJD ÍPX SBU for all internal

SFTJTUBODFT BOE GPS QSBDUJDBM QVSQPTFT JT SFHBSEFE BT SFMJBCMF *U JT XBUFS JO MJUFST QFS

NJOVUF XJUI B QSFTTVSF ESPQ PG CBS BDSPTT UIF WBMWF 5IF UFDIOJDBM EBU Systems valves contains

the k_v WBMVFT BT XFMM BT QSFTTVSF MPTT DIBSUT 5IF MBUUFS NBLF JU QPTTJCMF QSFTTVSF MPTT EJSFDUMZ #VU

UIF QSFTTVSF MPTT DBO BMTP CF DBMDVMBUFE GSPN UIF LW WBMVF BDDPSEJOH

$$p_{Ar} = \left(\frac{Q}{k_v}\right)^2 \frac{}{1000}$$

—"Q 1SFTTVSF MPTT GPS UIF WBMWF CBS
2 'MPX SBUF NŽ I
U %FOTJUZ PG UIF DPOWFZFE NFEJVN LH NŽ H DD LH NŽ
k_v 7BMWF DIBSBDUFSJTUJD WBMVF NŽ I

Pressure di erence between the static pressure

*G UIF QJQJOH TZTUFN JT JOTUBMMFE WFSUJDBMMZ UIFO B HFPEFUJD QSFTTVSF DBMDVMBUFE GPS JU 5IJT QSFTTVSF EJËFSFODF JT DBMDVMBUFE BT GPMMPXT

$$p_{geod} = H_{geod} \cdot 10^{-4}$$

—geodQ (FPEFUJD QSFTTVSF EJËFSFODF CBS
—)geod %JËFSFODF JO FMFWBUJPO PG UIF QJQJOH TZTUFN N
U %FOTJUZ PG UIF NFEJVN LH NŽ H DNŽ LH NŽ

Sum of pressure losses

5IF TVN PG BMM QSFTTVSF ESPQT GPS B QJQJOH TZTUFN JT DBMDVMBUFE BT GPM

$$p = p_R + p_{Fi} + p_{Ar} + p_{geo}$$

Example for pressure drop calculations

5IF GPMMPXJOH FYBNQMF JMMVTUSBUFT UIF DBMDVMBUJPO QSPDFTT GPS EFU loss of a piping system.

		Number of Fittings
$00- '*5 QJQF	d40 mm	Y ‹ BOHMF
4%3 r ÍPX SBUF	1.5 l/s	Y ‹ BOHMF
Medium	Wasser	Y 5 QJFDF
%FOTJUZ PG UIF NFEJVN	1000 kg/m³	Y TDSFXT
-FOHUI TUSBJHIU QJQF	15 m	Y ÍBOHF DPOOFDUJPOT
)FJHIU EJËFSFODF	N	Y CBMM WBMWF PQFOFE

5IF XBMM UIJDLOFTT PG UIF QJQJOH TZTUFN DBO CF DBMDVMBUFE BT GPMMPX

$$e = \frac{d}{SDR} = \frac{40\ mm}{11} = 3.6\ mm$$

5IF JOOFS EJBNFUFS PG UIF QJQJOH TZTUFN JT BT GPMMPXT

$$d_i = d - 2\ e = d - \frac{2\ d}{SDR} = 32.8\ mm$$

8JUI UIF EFTJSFE ÍPX SBUF PG M T UIF ÍPX WFMPDJUZ JT BT GPMMPXT

$$v = 1275\ \frac{Q_2}{d_i^2} = 1275\ \frac{1.5}{32.8^2}\ \frac{m}{sec} = 1.78\ \frac{m}{sec}$$

Formulas for calculating pressure losses

Pressure loss	Formula
Pressure loss for straight pipe sections	$p_R = 0.02\ \frac{15}{32.8}\ \frac{1000}{2\ \ 10^2}\ 1.78^2 = 0.14$ bar
1SFTTVSF MPTT GPS connections	ì = (2 1.2) + (4 0.3) + (3 1.3) + (5 0.7) = $p_{Fi} = 23\ \frac{1.78^2}{2\ \ 10^5}\ 1000 = 0.36$ bar
1SFTTVSF MPTT GPS UIF PQFOFE 8JUI UIF ÍPX SBUF PG UJDT EJBHSBN GPS CBMM WBMWFT UZQF{ GSPN BO PQFO BOHMF B QFSDFOUJMF LW WBMVF PG DBO CF SFBE PVU UIBU NFBOT PG UIF LW WBMVF / lN ÍPX SBUF Mh)T N	$p_A = \left(\frac{54}{0.5\ \ 60}\right)^2 \frac{1000}{1000} = 0.03$ bar
1SFTTVSF MPTT PG IFJHIU $p_{geod} = 2.0 \cdot 1000 \cdot 9.81 \cdot 15 = 0.2$ bar	
Whole pressure loss of the piping	p = 0.14 bar + 0.36 bar + 0.03 bar + 0.2 bar = 0.73 ba

2.4.8 Dimension comparison COOL-FIT 2.0 / 2.0M vs metal

COOL-FIT 2.0 / 2.0M			Stainless steel		Copper pipe
d (mm)	d_i (mm)	DN	Inch	da (mm	da (mm)
			1		
40			1¼		
50		40	~		
	51.4	50			54
			~		
90					
110	90.0	100	4		
140			5		

E /PNJOBM FYUFSOBM E
PG 1& QJQF
d_i /PNJOBM JOUFSOBM EJ
of pipe

2.4.9 Z-dimension method

Overview

5IF QSFTTVSF PG DPNQFUJUJPO BOE IJHI DPTUT PO TJUF NBLFT JU FTTFOUJBM U
TZTUFNT FÎDJFOUMZ 5IF (' 1JQJOH

4ZTUFNT NFUIPE PG BTTFNCMZ JT IJHIMZ TVJUFE UP UIJT UBTL *U SFQMBDFT UIF
DPOTVNJOH DVUUJOH UP TJ[F PG POF QJQF BU B UJNF CZ B GBTU BOE QSFDJTF X
HSPVQT PG QJQF BDDPSEJOH UP QMBOT PS KJHT

5IF SFTQFDUJWF QJQF HSPVQ XJUI UIF DPSSFTQPOEJOH EFTJHO EJNFOTJPOT BOE
entered in the isometric paper of GF Piping Systems.

1MFBTF BEIFSF UP UIF GPMMPXJOH HVJEFMJOFT GPS ESBXJOH

Pipe running perpendicular to one another	Pipe running diagonally

) P S J [P O U B M M Z
left and right

7F S U J D B M

) P S J [P O U B M M Z
front and rear

5IF [EJNFOTJPOT PG UIF ÌUUJOHT BSF OFFEFE GPS EFUFSNJOJOH UIF BDUVBM DV
QJQF 5IF UBCMFT JO PVS QSPEVDU SBOHFT BOE JO UIF POMJOF DBUBMPHVFT DP
EBUB GPS UIF ÌUUJOHT 5IF MFOHUI PG QJQF UP CF DVU JT HJWFO BT JO UIF GPM
EJTUBODF CFUXFFO UIF DFOUFS PG BEKPJOJOH ÌUUJOHT MFTT UIF TVN PG UIF [E
ÌUUJOHT

Procedure

Electrofusion

Formula for determining the required pipe length

$L_0 = M – Z_{F1} – Z_{F2}$

-0 1JQF MFOHUI UP CF DVU
. $FOUFS UP DFOUFS EJTUBODF CFUXFFO ÌUUJOHT
[F1 [NFBTVSFNFOU GPS ÌUUJOH
[' [NFBTVSFNFOU GPS ÌUUJOH

Example

%JNFOTJPO E %
$FOUFS UP DFOUFS EJTUBODF .
[NFBTVSFNFOU GPS ‹ FMNCNPX [
[NFBTVSFNFOU GPS ‹ FMNCNPX [
. NN0 -

L_0 = 1000 mm – 20 mm – 20 mm = 960 mm

Measuring sheet

2.4.10 Length changes and exible sections

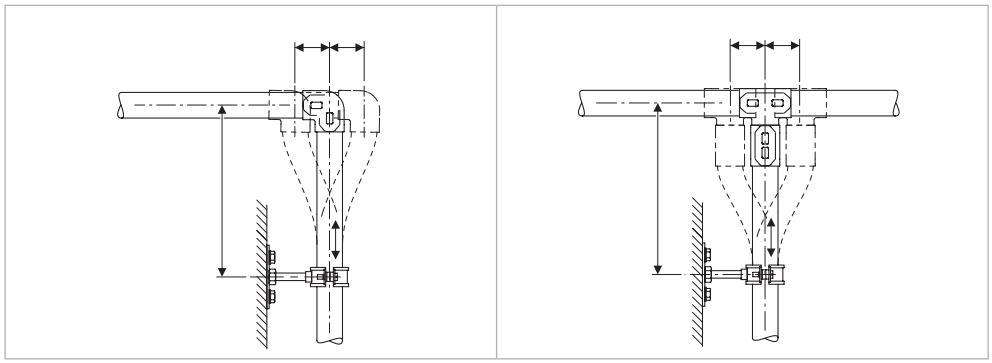
Overview

Length changes L and expansion bend L_B - General

5IFSNPQMBTUJDT BSF TVCKFDU UP HSFBUFS UIFSNBM FYQBOTJPO BOE DPOUSBDU
NBUFSJBMT 1JQF JOTUBMMFE BCPWF HSPVOE BHBJOTU XBMMT PS JO EVDUT SF
CF UBLFO VQ JO PSEFS UP QSFWFOU BOZ TVQFSJNQPTFE FYUSB TUSBJO PO UIF Q
especially to pipe exposed to operating temperature variations.

5P BDDPNNPEBUF B DIBOHF JO MFOHUI UIF GPMMPXJOH PQUJPOT DBO CF DPOTJE
" 'MFYJCMF TFDUJPOT
'MFYJCMF IPTFT
$ $PNQFOTBUPST

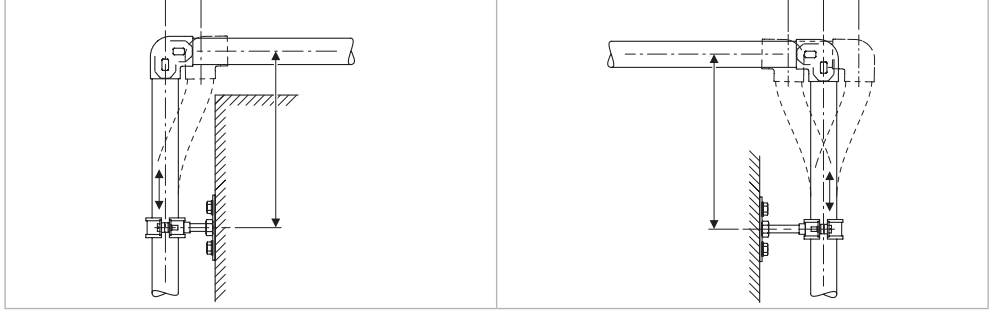
'MFYJCMF TFDUJPOT BSF UIF NPTU DPNNPO UIF TJNQMFTU BOE UIF NPTU FDPOPN
DBMDVMBUJPOT GPS BOE UIF QPTJUJPOJOH PG ÍFYJCMF TFDUJPOT BSF UIFSFGPS



—- $IBOHF JO MFOHUI
-# 'MFYJCMF TFDUJPO

Fundamentals

5IF MPX FMBTUJDJUZ PG UIFSNPQMBTUJDT BMMPXT DIBOHFT JO MFOHUI UP CF UB
TFDUJPOT XIFSF QJQF TVQQPSUT BSF QPTJUJPOFE TP UIBU UIFZ DBO UBLF BEWE
ÍFYJCJMJUZ PG UIF NBUFSJBM 5IF MFOHUI PG TVDI TFDUJPOT JT EFUFSNJOFE CZ
QJQJOH TZTUFN BOE UIF FYUFOU PG UIF UIFSNBM FYQBOTJPO UP CF DPNQFOTBUI

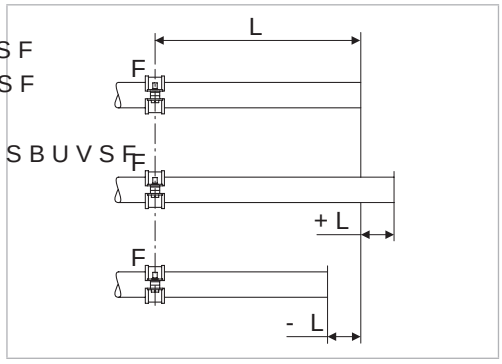


'MFYJCMF TFDUJPOT BSJTF OBUVSBMMZ BU BOZ CSBODIJOH PS DIBOHF JO EJSFDU
5IF NPWFNFOU -# PG UIF ÍFYJCMF TFDUJPO BT B SFTVMU PG B DIBOHF —- JO UIF
SFTUSBJOFE CZ ÌYFE QJQF CSBDLFUT XBMM QSPUSVTJPOT HJSEFST PS UIF MJLF

Calculation of length changes

5P EFUFSNJOF UIF change in length due to temperature — - NN PG $00- '*5 QJQF UIF GPMMPXJOH UFNQFSBUVSFT NVTU CF LOPXO

1. Installation temperature
- .JOJNVN ÍPX UFNQFSBUVSF
- .BYJNVN ÍPX UFNQFSBUVSF
- .JOJNVN BNCJFOU UFNQFSBUVSF
- .BYJNVN BNCJFOU UFNQFSBUVSF



F Fixpoint
- -FOHUI PG QJQF TFDU

The following tables show changes in length at di erent media temperatures for certain conditions. To determine the change in length for other conditions, the Cooling Calculation Tool can be used. Contact your local GF representative or at Global Sales Support: gss@georg scher.com

Example of use:

*OTUBMMBUJPO UFNQFSBUVSF $
.JO BNCJFOU UFNQFSBUVSF ‹$ LPOTUBOU
.BY BNCJFOU UFNQFSBUVSF ‹$ LPOTUBOU
.JO ÍPX UFNQFSBUVSF 4JFIF 5BCFMMF
.BY ÍPX UFNQFSBUVSF ‹$

- MBJE QJQF MFOHUI

Length change L (mm) at 20° C ow temperature					Length change L (mm) at 15° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E					E				
d40					d40				
d50					d50				
E					E				
E					E				
d90					d90				
d110					d110				
d140					d140				

- MBJE QJQF MFOHUI

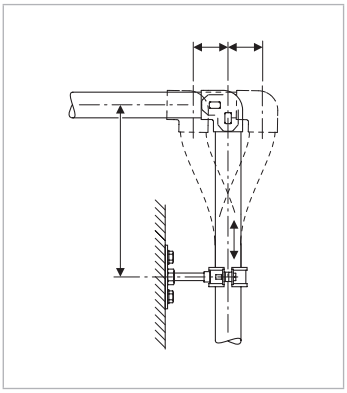
Length change L (mm) at 10° C ow temperature					Length change L (mm) at 5° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E					E				
d40					d40				
d50					d50				
E					E				
E					E				
d90					d90				
d110					d110				
d140					d140				

Flexible sections for COOL-FIT 2.0

Flexible Section L_B

5IF WBMV#F TDNPSSPN UIJT UBCMF DBO CF VTFE GPS B HJWFO —- NN BOE UIF SFM TJ[F

Flexible section L_B (cm)													
L (mm)	10	20	30	40	50	60	70	80	90	100	150	200	300
E		101			159								
d40		110				191							
d50		110				191							
E			149										
E			159									411	
d90				195									
d110	104												
d140											450		

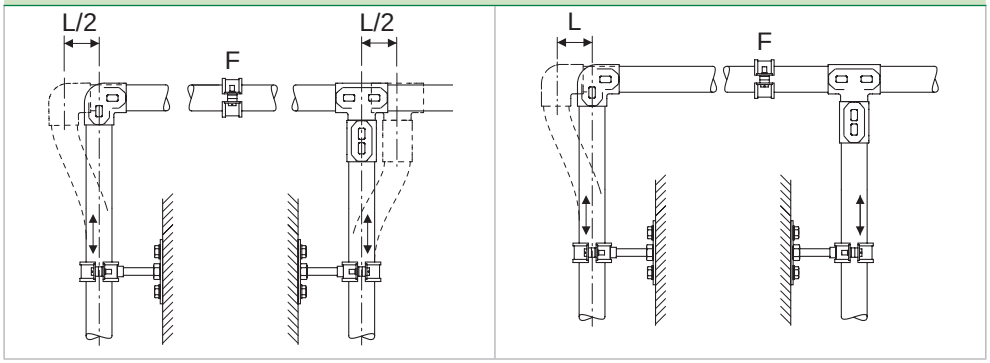


2.4.11 Installation

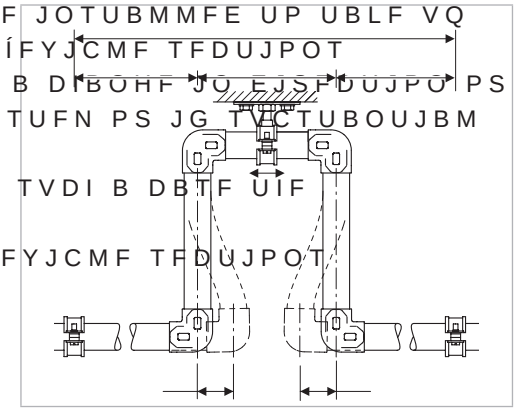
Recommendations for installation

-FOHUI DIBOHFT JO QJQF TFDUJPOT TIPVME BMXBZT CF BDDPNNPEBUFE UISPVHI U PG ÌYFE CSBDLFUT 5IF GPMMPXJOH FYBNQMFT TIPX IPX UIF DIBOHFT DBO CF EJT TFDUJPOT CZ TVJUBCMF QPTJUJPOJOH PG ÌYFE CSBDLFUT

3FDPNNFOEFE JOTUBMMBUJPOU SFDPNNFOEFE JOTUBMMBUJPO



&YQBOTJPO MPPQT DBO CF JOTUBMMFE UP UBLF VQ DIBOHFT JO MFOHUI XIFO ÍFYJCMF TFDUJPOT DBOOPU CF JODMVEFE BU B DIBOHF JO EJSFDUJPO PS CSBODI JO UIF QJQJOH TZTUFN PS JG TVCTUBOUJBM changes in the length of a straight section OFFE UP CF UBLFO VQ *O TVDI B DBTF UIF compensation for changes in length is EJTUSJCVUFE PWFS UXP ÍFYJCMF TFDUJPOT



⚠ Bending stress can lead to leaks in mechanical joints.

Do not use any unions or anged connections close to expansion bends and loops.

Pre-tensioning

*O QBSUJDVMBSMZ EJÎDVMU TJUVBUJPOT XJUI MBSHF DIBOHFT JO POF EJSFDUJPO QSF UFOTJPOJOH UIF ÍFYJCMF TFDUJPO EVSJOH J#OTUBMMBUJPO BOE UIFSFCZ TIF JMMVTUSBUFE JO UIF OFYU FYBNQMF

Example

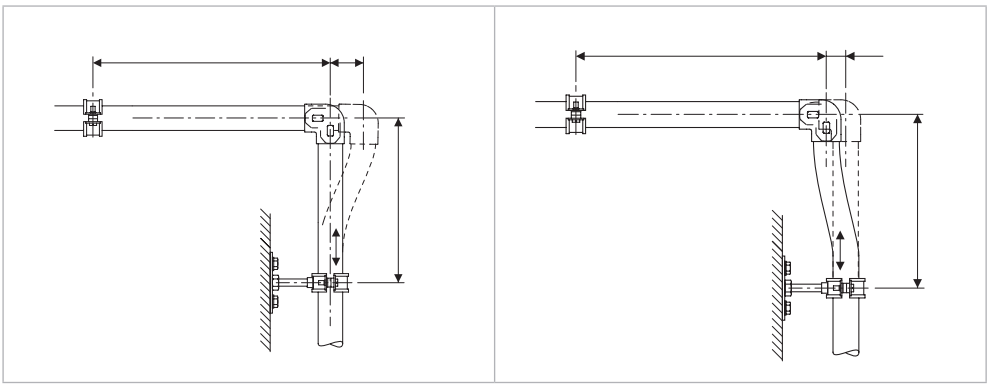
1JQF MFOHUI - N
%JBNFUFS E % NN
*OTUBMMBUJPO UFNQFSBUVSF ‹$
.JO BNCJFOU UFNQFSBUVSF ‹$ LPOTUBOU
.BY BNCJFOU UFNQFSBUVSF ‹$ LPOTUBOU
.JO ÍPX UFNQFSBUVSF ‹$
.BY ÍPX UFNQFSBUVSF ‹$

$IBOHF JO MFOHUI GSPN UIF UBCMF PS $PPMJOH $BMDVMBUJPO 5PPM
—- NN

" ÍFYJCMF TFDUJPO UP UBLF VQ B DIBOHF JO MFOHUI PG —- NN OFFET
_ NN MPOH BDDPSEJOH UP UIF UBCMF

*G UIF ÍFYJCMF TFDUJPO JT QSF UFOTJPOFE UP —- UIF ÍFYJCMF TFDUJPO SFRV
_ DN 5IF DIBOHF JO MFOHUI TUBSUJOH GSPN UIF QPTJUJPO JT UIFO —-

#Z QSF UFOTJPOJOH UIF ÍFYJCMF TFDUJPO NBLFT JU QPTTJCMF UP SFEVDF JUT S JOTUBMMBUJPOT XIFSF TQBDF JT SFTUSJDUFE 1SF TUSFTTJOH BMTP SFEVDFT UI TFDUJPO JO TFSWJDF JNQSPWJOH UIF BQQFBSBODF PG UIF QJQJOH TZTUFN



2.4.12 Pipe bracket spacing and support of piping systems

Overview

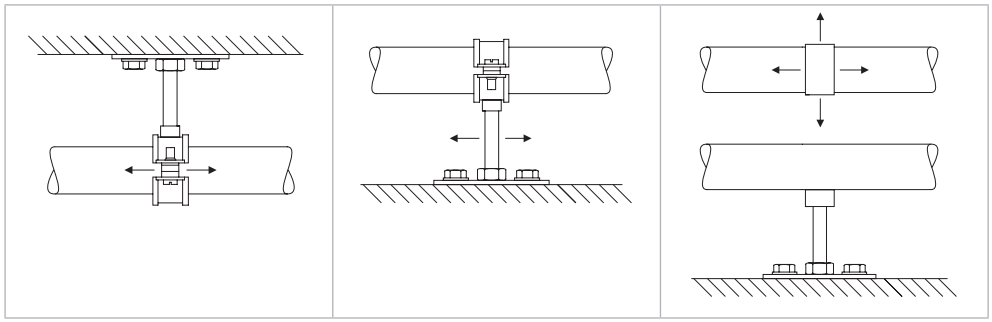
Installation of plastic pipe

$00- '*5 QJQF TIPVME CF JOTUBMMFE VTJOH TVQQPSUT EFTJHOFE GPS VTF XJU
TIPVME UIFO CF JOTUBMMFE UBLJOH DBSF OPU UP EBNBHF PS PWFSTUSFTT UIF Q
5IBOLT UP UIF FYDFMMFOU JOTVMBUJOH QSPQFSUJFT PG UIF
$00- '*5 QJQF BOE JUT IBSE JNQBDU SFTJTUBOU PVUFS
KBDLFU TUBOEBSE QJQF DMBNQT NBZ CF VTFE 4QFDJBM
insulation pipe clamps or cold clamps are not necessary.

Arranging loose brackets

What is a loose bracket?

" MPPTF CSBDLFU JT B QJQF CSBDLFU XIJDI BMMPXT BYJBM NPWFNFOU PG UIF QJ
TUSFTT GSFF DPNQFOTBUJPO PG UFNQFSBUVSF DIBOHFT BOE DPNQFOTBUJPO PG
condition changes.



"YJBM EJTQMBDFNFOU PG UIF QJQF JO UIF QJQF CSBDLFU
pipe in the clamp.

EJTQMBDFNFOU PG UIF QJQF BYJBM EJTQMBDFNFOU JO UIF QJQF CSBDLFU
in the suspension of the pipe clamp.

5IF JOOFS EJBNFUFS PG UIF CSBDLFU NVTU CF MBSHFS UIBO UIF PVUFS EJBNFUF
GSFF NPWFNFOU PG UIF QJQF 5IF JOOFS FEHFT PG UIF CSBDLFUT TIPVME CF GS
contours to avoid damaging the pipe surface.

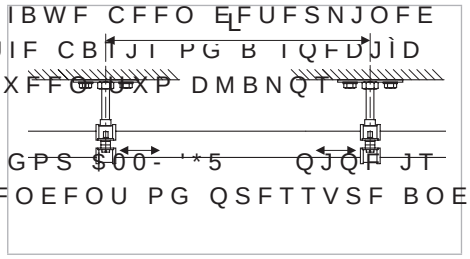
"OPUIFS NFUIPE JT UP VTF CSBDLFUT XJUI TQBDFST JO Spacers prevent pinching the
XIJDI BMTP BWPJET DMBNQJOH UIF CSBDLFU PO UIF QJQF pipe

5IF BYJBM NPWFNFOU PG UIF QJQJOH NBZ OPU CF IJOEFSFE CZ
ÌUUJOHT BSSBOHFE OFYU UP UIF QJQF CSBDLFU PS PUIFS EJBNFUFS
changes.

4MJEJOH CSBDLFUT BOE IBOHJOH CSBDLFUT QFSNJU UIF QJQF UP
NPWF JO EJËFSFOU EJSFDUJPOT "UUBDIJOH B TMJEJOH CMPDL UP UIF
CBTF PG UIF QJQF CSBDLFU QFSNJUT GSFF NPWFNFOU PG UIF QJQF
BMPOH B ÍBU TVQQPSUJOH TVSGBDF 4MJEJOH BOE IBOHJOH
CSBDLFUT BSF OFFEFE JO TJUVBUJPOT XIFSF UIF QJQJOH TZTUFN
DIBOHFT EJSFDUJPO BOE GSFF NPWFNFOU PG UIF QJQF NVTU CF
BMMPXFE

Pipe bracket spacing

5IF QJQF CSBDLFU TQBDJOH IBWF CFFO EFUFSNJOFE - 1JQF DMBNQ TQBDJOH GPS DPOWFZJOH XBUFS PO UIF CBTJT PG B TQFDJÌD EFÍFDUJPO PG UIF QJQF CFUXFFO UXP DMBNQT DPOTJEFSFE QUBCMF



5IF QJQF CSBDLFU TQBDJOH GPS $00- '*5 QJQF JT BMXBZT DPOTJTUFOU JOEFQFOEFOU PG QSFTTVSF BOE temperature.

Pipe clamp intervals L for COOL-FIT 2.0

d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160	140/200
- N N					1950			

Pipe clamp intervals L for COOL-FIT 2.0M

d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160
- N N							

5IF QJQF DMBNQ JOUFSWBMT GSPN UIF UBCMF DBO CF JODSFBTFE CZ GPS WFS WBMVFT HJWFO CZ JO UIJT DBTF

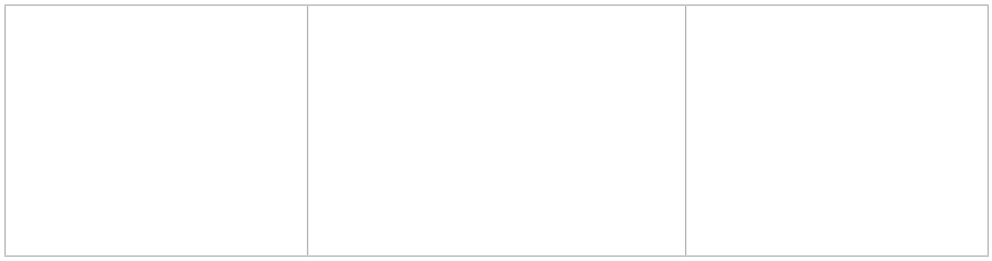
⚠ Pipe which are axially clamped and rigidly fixed must be tested for their resistance to kinking. In most cases, this test results in a reduction of the maximum internal pressure and more tightly spaced supports. The forces acting on the fixed points should be considered.

KLIP-IT pipe brackets

5IFTF SPCVTU QMBTUJD QJQF CSBDLFUT DBO CF VTFE OPU POMZ VOEFS SJHPSPV CVU BMTP XIFSF UIF QJQFXPSL JT TVCKFDU UP BHHSFTTJWF NFEJB PS BUNPTQIFS CSBDLFUT BOE QJQF DMBNQT GSPN (' 1JQJOH 4ZTUFNT BSF TVJUBCMF GPS BMM Q

%P OPU VTF ,-*1 *5 QJQF CSBDLFUT BT ÌYFE QPJOUT

⚠ From d90 upwards KLIP-IT pipe clamps must be mounted upright, as in the installation examples below.



Arranging fixed points

" ÌYFE QPJOU JT B CSBDLFU XIJDI QSFWFOUT UIF QJQF GSPN NPWJOH JO BOZ EJS PG B ÌYFE QPJOU JT UP DPOUSPM UFOTJPO DBVTFE CZ UFNQFSBUVSF DIBOHFT BO certain direction.

⚠ Fixed point design

5IF QJQF NVTU OPU CF ÌYFE CZ DMBNQJOH JU JO UIF QJQF CSBDLFU 5IJT DBO EFGPSNBUJPO BOE QIZTJDBM EBNBHF UP UIF QJQF EBNBHF UIBU TPNFUJNFT E until very much later.

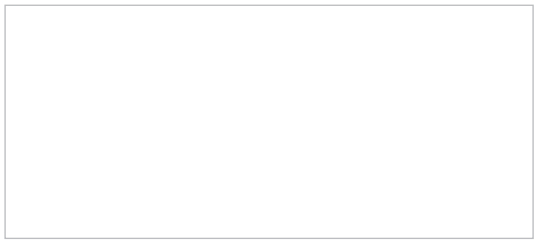
⚠ Pipe brackets must be robust and mounted firmly to be able to take up the forces arising from changes in length in the piping system. Hanging brackets or KLIP-IT pipe brackets are unsuitable for use as fixed points.

COOL-FIT 2.0 / 2.0M xed point
'JYFE QPJOUT GPS $00- '*5 $00- '*5 "#4 1MVT BOE
$00- '*5 1& 1MVT BSF FTUBCMJTIFE XJUI UIF TQFDJBM $00- '*5
1MVT ÌYFE QPJOUT 5IF QSPEVDU DPOTJTUT PG GVTJPO CBOET BOE
QJQF CSBDLFUT &MFDUSPGVTJPO CBOET BT QFSNBOFOU KPJOUT
USBOTNJU UIF GPSDFT UIBU PDDVS JO UIF QJQF UP UIF ÌYFE QPJOU
5IF TVQQMJFE QJQF CSBDLFUT TFSWF UP CVJME VQ UIF GVTJPO
QSFTTVSF EVSJOH JOTUBMMBUJPO PG UIF GVTJPO CBOET BOE QSPWJEF
TUBCJMJUZ EVSJOH PQFSBUJPO 'PS GVTJPO VTF BO .4" Y
.4"{ Y .4" PS DPNNFSDJBMMZ BWBJMBCMF
7 FMFDUSPGVTJPO VOJU *G ZPV VTF BO .4" FMFDUSPGVTJPO
VOJU CZ (' 1JQJOH 4ZTUFNT VTF UIF BEBQUPS XJUI DPEF /P
PS UIF Z DBCMF LJU XJU DPEF /P
1MFBTF UBLF OPUF PG UIF NBYJNVN BMMPXFE GPSDFT JO UIF
UBCCMFFMPX

Diameter (mm)	E %	d40/ %	d50/ %	E %	E %	d90/ %	d110 / %	d140 / %
Maximum force F (kN)			5.0		10.0	10.0	10.0	10.0

COOL-FIT 2.0 xed points must be calculated on the basis of the application. Fixed point brackets and cross braces are not included.

Scope of delivery



$MBNQT UP NBJOUBJO
pressure
&MFDUSPGVTJPO CBOE

Y-cable kit for COOL-FIT xed points

5IF $00- '*5 : DBCMFT DBO CF VTFE GPS B GBTUFS JOTUBMMBUJPO PG $00- '*5
FMFDUSPGVTJPO CBOET BMXBZT DPNF JO QBJST : DBCMFT BMMPX GPS B TJNVMU
cutting fusion time in half.

2.4.13 Hoses

Installation of elastomer hoses

5P FOTVSF UIF VTBCJMJUZ PG IPTF MJOFT BOE UP BWPJE TIPSUFOJOH UIFJS TFSV
BEEJUJPOBM TUSFTTFT QMFBTF OPUF UIF GPMMPXJOH

-)PTF MJOFT NVTU CF JOTUBMMFE TP UIBU UIFJS OBUVSBM QPTJUJPO BOE NPWF
- %VSJOH PQFSBUJPO IPTF MJOFT NVTU JO QSJODJQMF OPU CF TVCKFDUFE UP F UFOTJPO UPSTJPO BOE DPNQSFTTJPO VOMFTT UIFZ IBWF CFFO TQFDJBMMZ NB
- 5IF NJOJNVN SBEJVT PG DVSWBUVSF TQFDJÌFE CZ UIF NBOVGBDUVSFS NVTU CF
- #VDLMJOH JT UP CF BWPJEFE QBSUJDVMBSMZ CZ UIF KPJOU
- #FGPSF QVUUJOH UIF TZTUFN JOUP PQFSBUJPO DIFDL UIBU UIF NFDIBOJDBM DI properly tightened.
- *G UIFSF JT WJTJCMF FYUFSOBM EBNBHF UIF IPTF MJOF NVTU OPU CF QVU JOU
- 5IF DPOOFDUJPO ÌUUJOHT TIPVME CF ÌSNMZ TDSFXFE UPHFUIFS

Proper use of the hose line

- 1SFTTVSF EP OPU FYDFFE NBYJNVN QFSNJUUFE XPSLJOH QSFTTVSF BOE PQFSB
- 5FNQFSBUVSF EP OPU FYDFFE NBYJNVN QFSNJUUFE UFNQFSBUVSF GPS UIF NFB

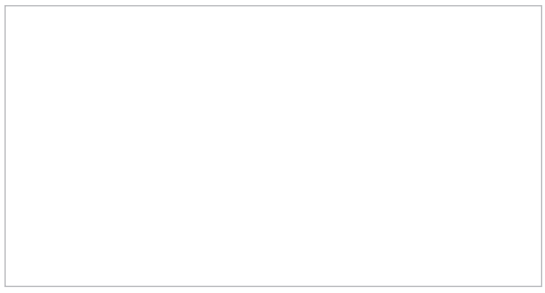
Storage

- 4UPSF JO B DPPM ESZ BOE EVTU GSFF BSFB BWPJE EJSFDU TVOMJHIU PS VMUS QSPUFDU GSPN OFBSCZ IFBU TPVSDFT 1JQJOH NVTU OPU DPNF JOUP DPOUBDU can cause damage.
-)PTFT BOE IPTF BTTFNCMJFT NVTU CF TUPSFE IPSJ[POUBMMZ GSFF PG UFOTJPO

Maintenance

*O UIF FWFOU PG NBKPS UFNQFSBUVSF ÍVDUVBUJPOT XF SFDPNNFOE SFHVMBS W the hose line.

- *O UIF FWFOU PG MFBLT TQJMMT UIF DMBNQT TIPVME CF UJHIUFOFE FWFOMZ D KBXT TIPVME XIFOFWFS QPTTJCMF MFBWF B HBQ BOE OPU CF DMPTFE ÍVTI 5IF QBSBMMFM BOE UIF TBNF XJEUI PO FBDI TJEF



2.4.14 COOLING Tool-Box

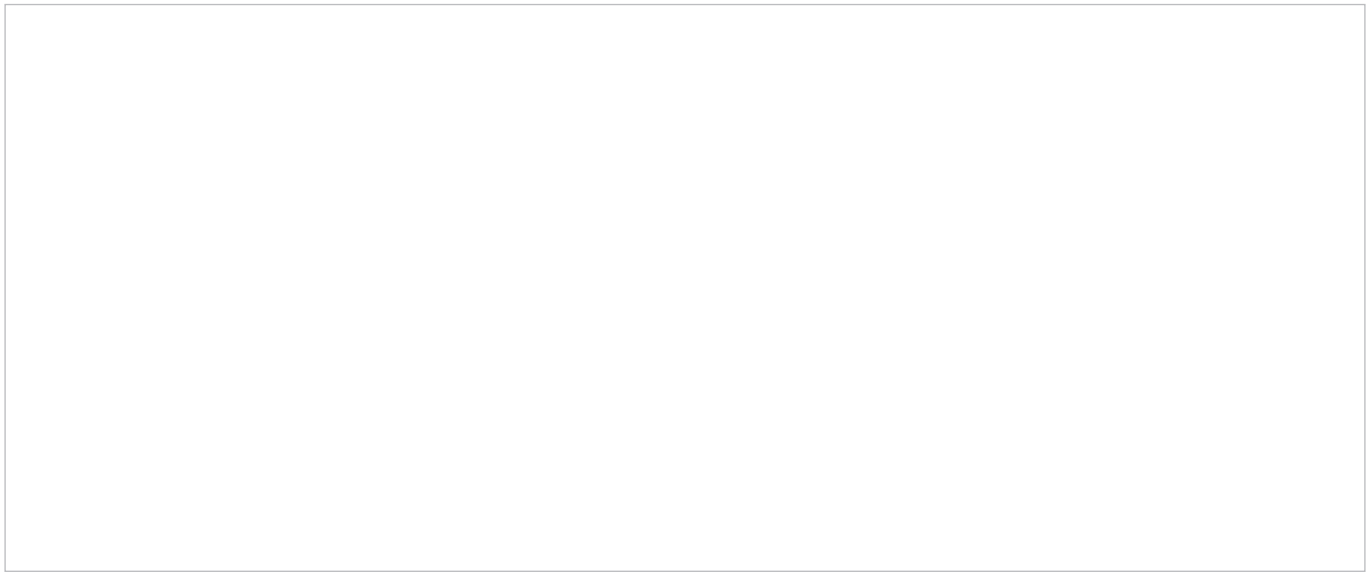
5IF (' 1JQJOH 4ZTUFNT $PPMJOH $BMDVMBUJPO 5PPM JT VTFE UP IFMQ JO UIF EJN
design of cooling systems.

5IF $PPMJOH $BMDVMBUJPO 5PPM IBOEMFT

- &YQBOTJPO DPOUSBDUJPO
- 'MFYJCMF TFDUJPO EFTJHO
- &OFSHZ TBWJOHT
- Pipe exterior temperature
- Pipe dimensioning
- Pressure loss
- %FX QPJOU JOTVMBUJPO UIJDLOFTT
- 1JQF CSBDLFU TQBDJOH
- 'SFF[JOH UJNF
- Weight comparison
- $ 0footprint

5IF NPTU DPNNPO DPPMBOUT BSF BMSFBEZ TUPSFE JO UIF DBMDVMBUJPO UPPM
DPNQPOFOUT TVDI BT QJQF ÌUUJOHT BOE WBMWFT *UT NFOV CBTFE OBWJHBUJP
MBOHVBHFT BOE BMMPXT GPS FÎDJFOU BOE PQUJNJ[FE EJNFOTJPOJOH PG B TZTU
commonly used coolants are already stored in the calculation tool. It calculates all system
DPNQPOFOUT TVDI BT QJQF ÌUUJOHT BOE WBMWFT 5IF NFOV JT BWBJMBCMF JO
MBOHVBHFT *U BMMPXT TZTUFN EFTJHO UP CF FÎDJFOU BOE PQUJNJ[FE

5IF DPNQBSJTPO GVODUJPO DPNQBSFT B $00- '*5 TZTUFN UP B TUFFM TUBJOMF
system.



Cooling Calculations Tool: Get it contact with your GF representative or Global Sales Support: gss@georg scher.com

2.5 Jointing and Installation

2.5.1 Jointing of COOL-FIT 2.0/2.0M

For general notes and information on electrofusion, see Planning Fundamentals Chapter “Jointing technology", section "Electrofusion joints".

General advice

5IF RVBMJUZ PG B XFME JT MBSHFMZ EFUFSNJOFE CZ DBSFGVM QSFQBSBUJPO 5I CF QSPUFDUFE GSPN BEWFSTF XFBUIFS DPOEJUJPOT TVDI BT SBJO TOPX PS XJO UFNQFSBUVSF SBOHF GPS GVTJPO JT ‹$ UP ‹$ /BUJPOBM SFHVMBUJPOT NVT EJSFDU TVOMJHIU TIJFMEJOH PG UIF XFMEJOH BSFB DBO IFMQ UP DSFBUF BO FW BSPVOE UIF XIPMF DJSDVNGFSFODF PG UIF QJQF *U JT QBSUJDVMBSMZ JNQPSUB DMJNBUF DPOEJUJPOT BSF UIF TBNF GPS CPUI UIF FMFDUSPGVTJPO NBDIJOF BOE

Executing electrofusion

Protect the welding area

5IF TVSGBDFT UP CF XFMEFE PO UIF QJQF BOE UIF ÌUUJOH NVTU CF DBSFGVMMZ HSFBTF PJMT BOE MVCSJDBOUT 0OMZ DMFBOJOH BHFOUT TVJUBCMF GPS 1& NVT

No fats (i.e. hand cream, oily rags, silicone, etc.) must be introduced into the fusion zone!

Without touching the surface, remove product immediately before the installation from packaging

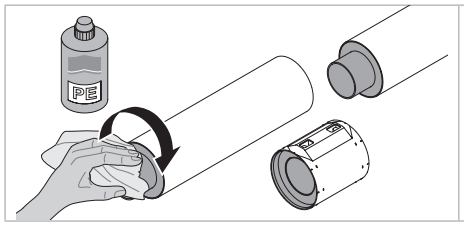
*G OFDFTTBSZ QSFQBSF UIF QJQF GPS GVTJPO KPJOUT VTJOH UIF 'PBN SFNPWBM DVUUJOH UIF KBDLFU BOE QFFMJOH UIF NFEJB QJQF BOE DIFDL BGUFSXBSET UIE UIJDLOFTT JT r NN BOE UIBU UIF NJOJNVN QFSNJTTJCMF FYUFSOBM EJBNFU JT NFU

- COOL-FIT 2.0 valves and COOL-FIT 2.0 ttings (type B and barrel nipple) do not need to be peeled.

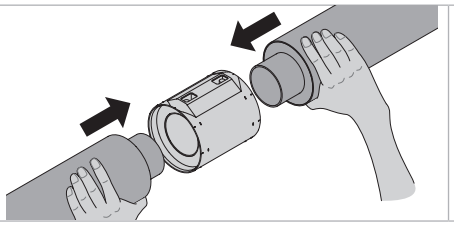
Minimum permitted pipe external diameter after peeling for COOL-FIT 2.0/2.0M:

d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160	140/200
Min. d (mm)			49.5				109.4	

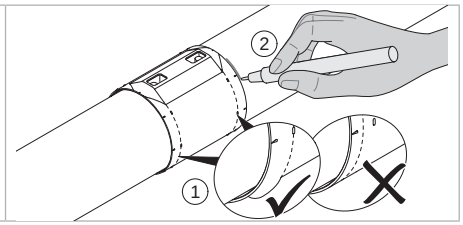
Cleaning and installation for welding preparation



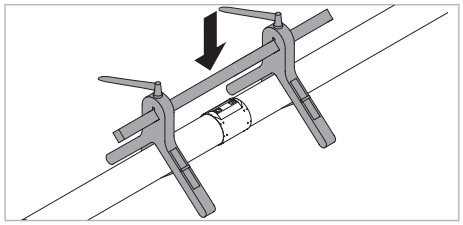
Step 1
$MFBO UIF GVTJPO BSFB XJUI 1& DMFBOFS BOE MJOU GSFF DMPUI
and clean cloth in circumferential direction.



Step 2
Insert pipe in clamping tool. Align free on the pipe.

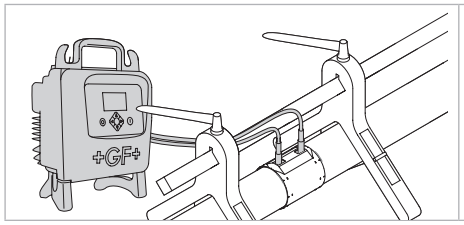


Step 3
Pay attention that the sealing lip arches check the change in position during XFMEJOH

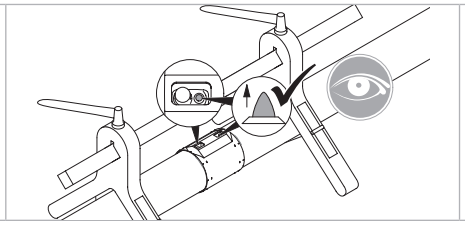


Step 4
5BLF DBSF GPS MPX TUSFTT JOTUBMMBUJPO BOE TFDVSF UIF QJQF BOE ÌUUJOH BHBJOTU EJTMPDBUJPO 5JHIU DMBNQT PG DMBNQJOH
tool.

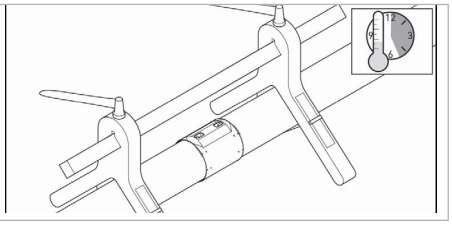
Fusion process



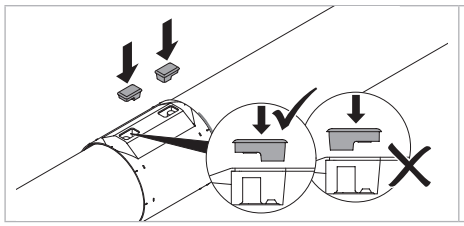
Step 5
Fuse in accordance to the operating instructions of the fusion unit.



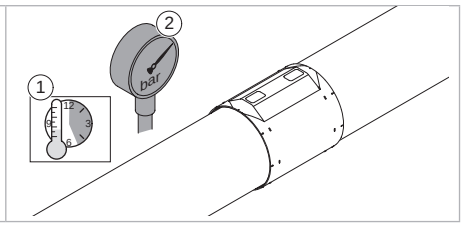
Step 6
%VSJOH BOE BGUFS GVTJPO QBZ BUUFOUJPO UP UIF EJTQMBZT PO UIF FMFDUSPGVTJPO NBDIJOF
note the messages on the display of the electrofusion machine.
"GUFSXBSET NBSL UIF ÌUUJOH XJUI GPMMPXJOH JOGPSNBUJPO
- %BUF
- 8FMEFS 8FME OVNCFS
- 5JNF BU UIF FOE PG DPPMJOH UJNF



Step 7
Pay attention to the cooling time and avoid stress until cooling time has elapsed.



Step 8
"GUFS GVTJPO QSPDFTT UIF XFME QJOT POUP UIF GFTUJPO BSFBT BSF SFNPWFE
and remove retaining device



Step 9
"GUFS DPPMJOH UJNF IBT FMBQTFE SFNPWF UIF DMBNQJOH UPPM

Cooling times before removing retention device and pressure/leak testing

d (mm)	Cooling time before Remove retention device [min.]	Cooling time before internal pressure test at 6 bar [min.]	Cooling time before internal pressure test at 18 bar [h]
	10	15	
40	10	15	5
50	10	15	4
	10		5
	15		
90			
110			
140	45		

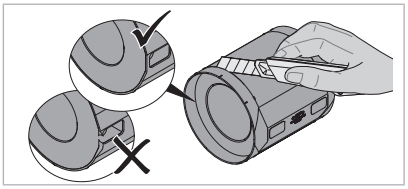
5IF WBMVFT BSF WBMJE GPS QSFTTVSF UFTUT VTJOH B MJRVJE BU Ç ‹ $ 'PS UI
UJNF PG IPVST JT SFDPNNFOEFE

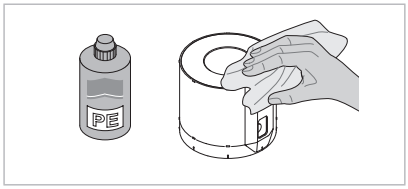
Valves and ange joints

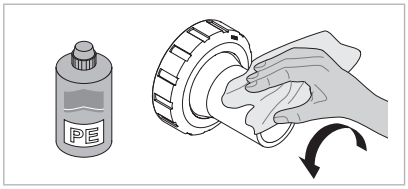
'PMMPXJOH JOTFSUJPO EFQUIT BSF WBMJE GPS $00- '*5 . DPNQPOFOUT

d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160	140/200
- NN		40	44		55			

Preparation of tting – remove sealing lip on one side, clean the sealing surfaces



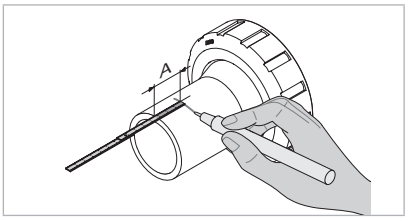


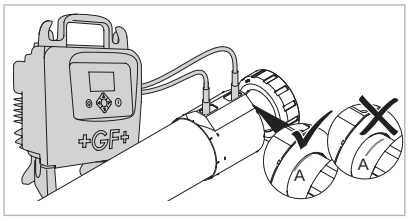


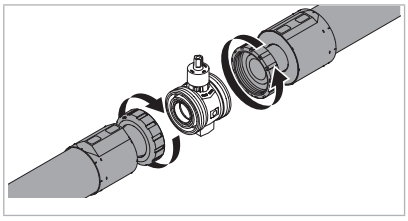
'PS UIF KPJOUJOH UP B WBMWF PS ÍBOHF BEBQUPS UIF TFBMJOH MJQ PG UIF ÌUU
UIF WBMWF PS ÍBOHF BEBQUPS TJEF BOE TFBMJOH BOE GVTJPO TVSGBDFT IBWF U

Standard fusion

'VTF CPUI WBMWF FOET XJUIPVU WBMWF NPVOUFE



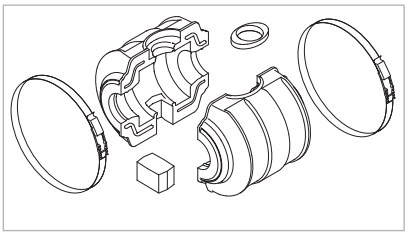


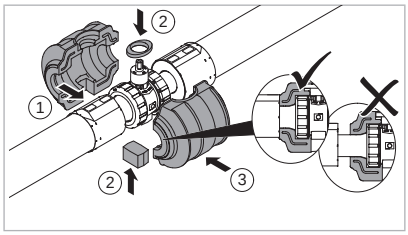


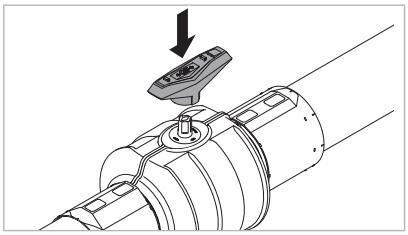
'PMMPXJOH JOTFSUJPO EFQUIT BSF .WDBMNJQEGPGSUS$00- '*5

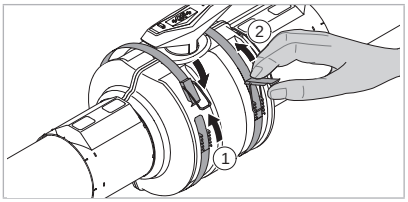
d/D (mm)	32/75	40/90	50/90	63/110	75/125	90/140	110/160	140/200
- NN		40	44		55			

Mounting the valve insulation









i Further information can be found in the assembly instructions. "Insalation for Ball Valve" and "Isalation for Butter y Valve and Flange Adapter".

Compact connection tting-to- tting

8IFO UIFSF JT FOPVHI TQBDF 'JUUJOH UP 1JQF UP 'JUUJOH DPOOFDUJPOT DBO C
TIPSU $00- '*5 QJQF 5IF GPBN SFNPWBM UPPM FOBCMFT UIF GPBN SFNPWBM P
_ NN GPS UIF EJNFOTJPOT E E PS SFTQFDUJWFMZ _ NN GPS UIF EJNFOTJPO

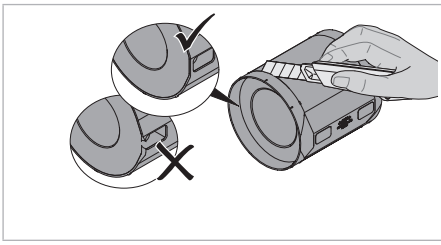
- Shorter connections Fitting-to-Pipe-to-Fitting can be realized using an un-insulated PE100 SDR11 pipe in combination with a piece of insulation that results of an foam removal process of the foam removal tool.

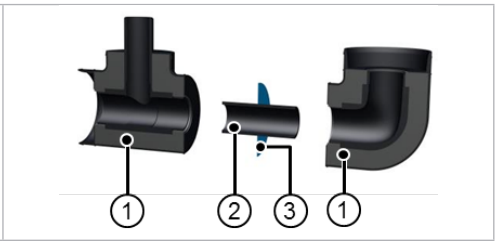
After the peeling of the oxid layer of the un-insulated PE pipe, the insulation ring is pulled over the pipe and the pipe is welded with the tting.

d	d32	d40	d50	d63	d75	d90	d110	d140
- NN				144				

- -FOHUI PG VO JOTVM
1& 4%3 QJQF OFFE

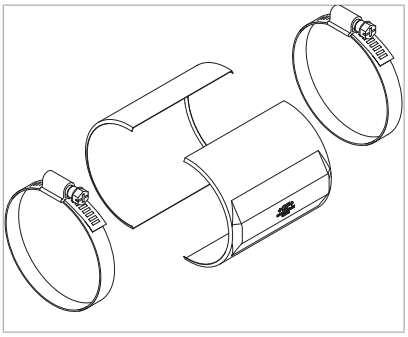
'PS TJUVBUJPOT XJUI WFSZ MJNJUFE TQBDF UIF TFBMJOH MJQ BU UIF ÌUUJOHT DE
SFTQFDUJWF TJEF 5IF KPJOUJOH PG UIF 'JUUJOH UP 'JUUJOH JT QFSGPSNFE VTJ
TFBMJOH PG UIF JOTVMBUJPO JT CFJOH EPOF XJUI BO BEIFTJWF SJOH XIJDI JT U
DMFBOFE TVSGBDF PG UIF ÌUUJOHT

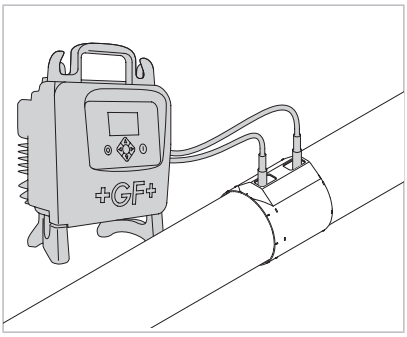


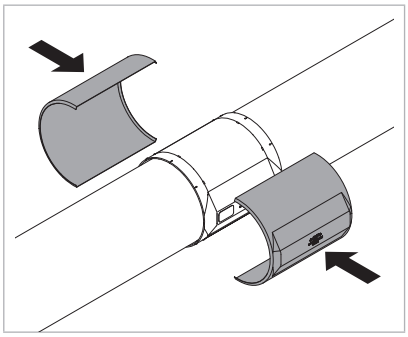


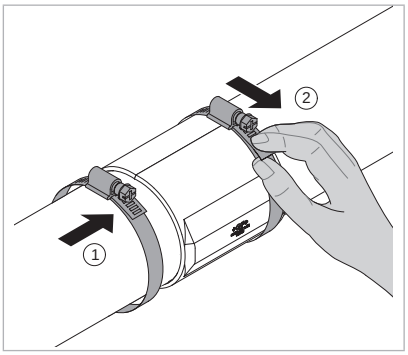
Fittings
#BSSFM OJQQMF
"dhesive ring

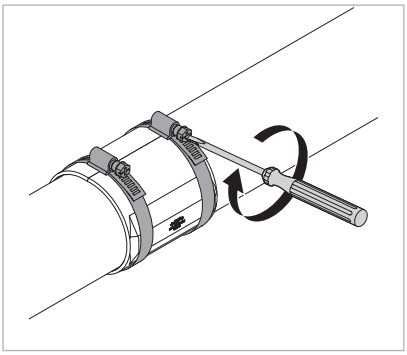
COOL-FIT 2.0M half shells





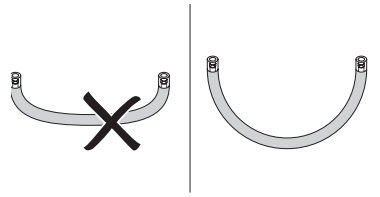
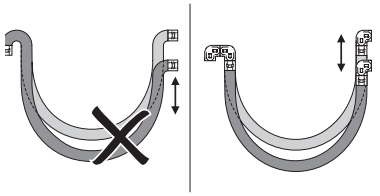
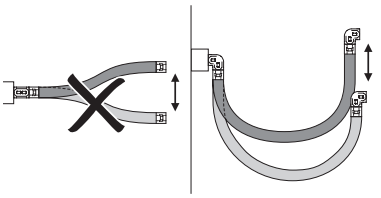
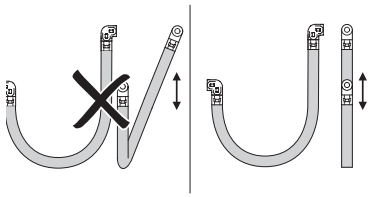
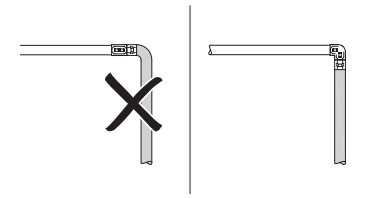
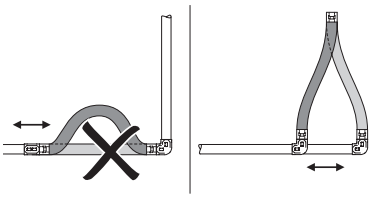
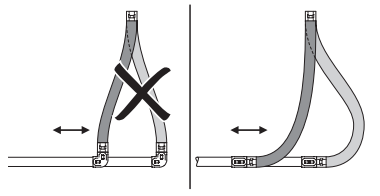
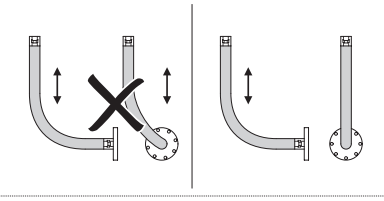
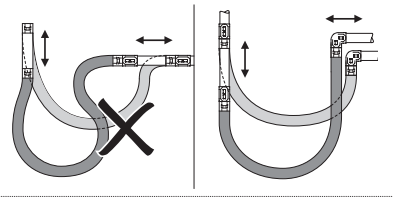






Further information can be found in the installation instructions "COOL-FIT 2.0M – metal half shells".

Hoses

Installation and handling instructions (false/correct)	Description
	&OTVSF IPTF JT MPOH FOPVHI UP PCTFSWF UIF NJOJNVN radius of curvature.
	"WPJE FYDFTTJWF CFOEJOH PG IPTFT VTF FMCPXT
	"WPJE ÍVDUVBUJOH CFOEJOH TUSFTT BOE FYDFTTJWF DVSWBUVSF CFIJOE UIF ÌUUJOH VTF FMCPXT
	8IFSF UIFSF JT TJHOJÌDBOU BYJBM FYQBOTJPO UIF direction of movement and hose axis must lie in the same plane in order to avoid torsion.
	"WPJE FYDFTTJWF CFOEJOH TUSFTT CZ VTJOH FMCPXT
	*G UIF IPTF BCTPSCT FYQBOTJPO JU NVTU CF JOTUBMMFE transversally to the direction of expansion.
	'PS MBSHF MBUFSBM NPWFNFOUT B ‹ BOHMF TIPVME CF BMMPXFE
	&YQBOTJPO UBLF VQ NVTU CF JO UIF QMBOF PG UIF QJQF UPSTJPO TIPVME CF BWPJEFE
	'PS NBKPS BYJBM FYQBOTJPO UIF QJQF NVTU CF JOTUBMM JO B 6 TIBQF UP BWPJE LJOLJOH

Transition Fittings

5IF (' 1JQJOH 4ZTUFNT SBOHF PG ÌUUJOHT QSPWJEFT B WBSJFUZ PG USBOTJUJPO UP DPOOFDU QMBTUJD QJQJOH DPNQPOFOUT UP QJQF ÌUUJOHT PS WBMWFT JO NFUBM UISFBET 3Q BOE 3 DBO CF TFBMFE XJUI IFNQ PS 15'& UBQF BT MPOH BT UI OPU NBEF PG QMBTUJD .BMF BOE GFNBMF (UISFBET NVTU CF TFBMFE XJUI ÍBU H BEWBOUBHF PG B UISFBEFE (DPOOFDUJPO JT SBEJBM BOE UPSTJPO GSFF QPTTJ uninstalling.

/FYU UP UIF USBEJUJPOBM USBOTJUJPO UP NFUBM QJQJOH UIFTF ÌUUJOHT DBO E manometers.

⚠ To prevent electrochemical corrosion, stainless steel connecting elements should preferably be used for steel transitions and brass connecting elements for transitions to non-ferrous metals.

Combining G and R threads

5IF DPOOFDUJPO PG B NBMF QBSBMMFM QJQF UISFBE (JO BDDPSEBODF XJUI &/ * GFNBMF QBSBMMFM QJQF UISFBE 3Q JO BDDPSEBODF XJUI *40 JT OPU JOUFOE TUBOEBSET " UJHIU DPOOFDUJPO JT QPTTJCMF VOEFS GBWPSBCMF DPOEJUJPOT FTUBCMJTIFE SFMJBCMZ

Connecting the insulations of Transition Fittings and jointing elements of Flexible Hoses

5IF /#3 JOTVMBUJPO PG UIF $00- '*5 5SBOTJUJPO 'JUUJOHT JT BQQMJFE GPMM UIF $00- '*5 5SBOTJUJPO 'JUUJOHT XJUI UIF $00- '*5 'JUUJOH 5ZQF " BOE U KPJOUJOH PG UIF UISFBEFE DPNQPOFOUT PG)PTF BOE 5SBOTJUJPO 'JUUJOH 5IF 5SBOTJUJPO 'JUUJOHT BOE PG UIF 'MFYJCMF)PTFTn KPJOUJOH FMFNFOUT BSF CF BEIFTJWF UBQFT 5IF BEIFTJWF UBQFT BSF VTFE GPS B DPOEFOTBUJPO QSPPG BY /#3 JOTVMBUJPO 5IF SBEJBM KPJOUJOH PG UIF KPJOUJOH GBDF PG UIF /#3 JOTVM FJUIFS CZ BEIFTJWF DFNFOU PG CZ BEIFTJWF UBQF

Jointing Instructions for the adhesive cement

5IF BEIFTJWF TIPVME CF UIPSPVHIMZ TUJSSFE CFGPSF VTF " UIJO ÌMN JT BQQMJ CSVTI UP CPUI TVSGBDFT UP CF CPOEFE %PJOH.UIJT UIF DPOTVNQUJPO JT _

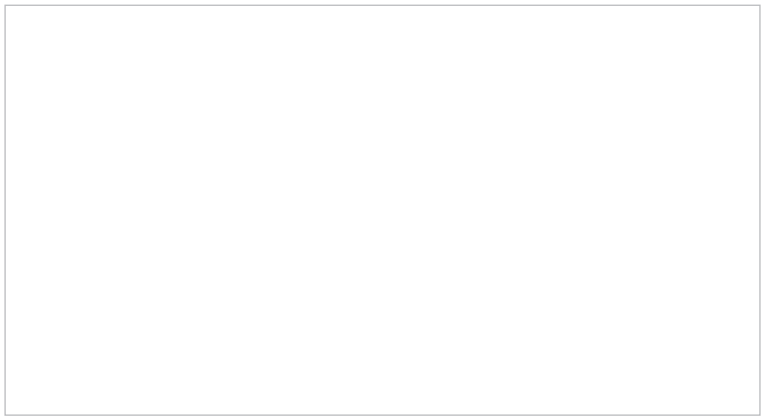
5IF PQFO KPJOU UJNF JT BCPVU NJOVUFT EFQFOEJOH PO UFNQFSBUVSF BOE I

#FGPSF UIF DPBUFE TVSGBDFT BSF CSPVHIU UPHFUIFS UIF UIF BEIFTJWF NVTU T TIPVME OPU USBOTGFS UP UIF TLJO XIFO ÌOHFS UFTUFE 5IF TVSGBDFT TIPVME C RVJDLMZ BOE ÌSNMZ BOE TIPVME CF IFME UPHFUIFS GPS B GFX TFDPOET

5IF SFDPNNFOEFE UFNQFSBUVSF BOE GPS TUPSBHF BOE QSPDFTTJOH JT JO UIF S ‹$ BOE ‹$ 5IF BEIFTJWF TIPVME OPU CF VTFE CFMPX ‹$

Flange connections

'MBOHFT XJUI TVÎDJFOU UIFSNBM BOE NFDIBOJDBM TUBCJMJUZ NVTU CF VTFE 5I
UZQFT CZ (' 1JQJOH 4ZTUFNT GVMÌMM UIFTF SFRVJSFNFOUT 5IF HBTLFU EJNFOTJ
UIF PVUFS BOE JOOFS EJBNFUFS PG UIF ÍBOHF BEBQUFS PS WBMWF FOE %JËFSF
JOOFS EJBNFUFST PG HBTLFU BOE ÍBOHF UIBU BSF HSFBUFS UIBO NN NBZ SFTV
NBMGVODUJPOJOH ÍBOHF DPOOFDUJPOT



Pipe
#PMU
Washer
#BDLJOH 'MBOHF
'MBOHF "E7BQUFS FOE
Flange gasket
/ut

Comparison of ange connections

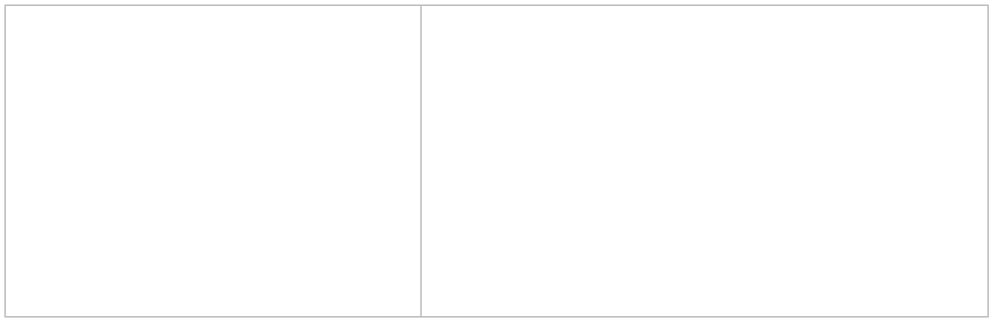
Flange connection	Properties
PP-V ange	• $PSSPTJPO GSFF BMM QMBTUJD ÍBOHF NBEF PG QPMZQSPQZMFOF 1 ÌCFS HMBTT SFJOGPSDFE •)JHDIFNJSBTJTUBZEESPMZTJT SFTJTUBOU • .BYJNVN QPTTJCMF CSFBL SFTJTUBODF EVF UP FMBTUJDJUZ EFGPS tightened too much) • 6TF GPS BNCJFOU UFNQFSBUVSFT VQ UP ‹$ • 67 TUBCJMJ[FE • 8JUIOUFHSBMUEÌYJOH • 4FMG DFOUFSJOH BJE PG UIF CBDLJOH ÍBOHF PO UIF ÍBOHF BEBQU • 4ZNNFUSJD EFTJHO BMMPXT BTTFNCMZ PO FJUIFS TJEF " SFWFSTI JOTUBMMBUJPO JT OFWFS QPTTJCMF "MM JNQPSUBOU JOGPSNBUJP • 7 HSPPVBFUFOUFE • &WFO EJTUSJCVUJPO PG GPSDFT BDSPTT UIF CBDLJOH ÍBOHF DPC components) • 4VQQPSUT B MPOHFS MBTUJOH UPSRVF GPS B TBGF KPJOU
PP-steel ange	• 7FSZ SPCVTU BOE TUJË EVF UP UIF TUFFM JOMBZ • $PSSPTJPO GSFF QMBTUJD ÍBOHF NBEF PG QPMZQSPQZMFOF 11 (' ÌCFS HMBTT SFJOGPSDFE XJUI TUFFM JOMBZ •)JHDIFNJSBTJTUBZEESPMZTJT SFTJTUBOU • .BYJNVN BNCJFOU UFNQFSBUVSF ‹$ • 67 TUBCJMJ[FE

Creating ange joints

8IFO FYFDVUJOH ÍBOHF KPJOUT UIF GPMMPXJOH QPJOUT TIPVME CF OPUFE

Orientation of bolts beyond the two main axes

- 'PS IPSJ[POUBM QJQJOHT TZTUFNT UIF PSJFOUBUJPO TIPXO PG UIF CPMUT CFZ TFF UIF GPMMPXJOH ÌHVSF JT QSFGFSSFE TJODF QPTTJCMF MFBLT BU UIF ÍBO DBVTF UIF NFEJVN UP SVO EJSFDUMZ POUP UIF CPMUT



Flange with main axes (cente red crosswise)

- 'MBOHF BEBQUPS WBMWF FOE PS ÌYFE ÍBOHF TFBM BOE MPPTF ÍBOHF NVTU CF on the pipe axis.
- #FGPSF UJHIUFOJOH UIF TDSFXT UIF TFBMJOH TVSGBDFT NVTU CF BMJHOFE QB BHBJOTU UIF TFBM 5JHIUFOJOH NJTBMJHOFE ÍBOHFT XJUI UIF SFTVMUJOH UFO avoided at all costs.

Selecting and handling bolts

- 5IF MFOHUI PG UIF CPMUT TIPVME CF JO TVDI B XBZ UIBU UIF CPMU UISFBE EPF UIBO UVSOT PG UIF UISFBE BU UIF OVU 8BTIFST NVTU CF VTFE BU UIF CPMU OVU *G UPP MPOH CPMUT BSF VTFE JUnT OPU QPTTJCMF UP NPVOU UIF JOTVMB BGUFSXBSET
- 5P FOTVSF UIBU UIF DPOOFDUJOH CPMUT DBO CF FBTJMZ UJHIUFOFE BOE SFNPV QFSJPE PG VTF UIF UISFBE TIPVME CF MVCSJDBUFE F H XJUI NPMZCEFOVN TV
- 5JHIUFOJOH UIF CPMUT CZ VTJOH B UPSRVF XSFODI
- 5IF CPMUT NVTU CF UJHIUFOFE EJBHPOBMMZ BOE FWFOMZ 'JSTU UJHIUFO UIF UIF HBTLFU JT FWFOMZ DPOUBDUJOH UIF KPJOUJOH GBDFT 5IFO UJHIUFO BMM PG UIF SFRVJSFE UPSRVF GPMMPXFE CZ PG UIF SFRVJSFE UPSRVF 5IF SF UJHIUFOJOH UPSRVFT BSF MJTUFE JO UIF GPMMPXJOH UBCMF)PXFWFS EFWJB QSBDUJDF F H UISPVHI UIF VTF PG TUJË CPMUT PS QJQF BYFT UIBU BSF OPU E IBSEOFTT PG UIF HBTLFU DBO BMTP JOÍVFODF UIF OFDFTTBSZ UJHIUFOJOH UPS
- 8F SFDPNNFOE DIFDLJOH UIF UJHIUFOJOH UPSRVFT IPVST BGUFS BTTFNCMZ B TQFDJÌFE WBMVFT BOE JG OFDFTTBSZ SFUJHIUFO UIFN "MXBZT UJHIUFO EJBH
- "GUFS UIF QSFTTVSF UFTU UIF UJHIUFOJOH UPSRVFT NVTU CF DIFDLFE JO BOZ OFDFTTBSZ UJHIUFOFE

For more information on anges, see DVS 2210-1 supplement 3.

In the area of exible sections and expansion loops, no bolt connections or ange connections should be used since the bending stress may cause leaks.

Bolt tightening torque guidelines for metric (ISO) ange connections with PP-V, PP- steel and PVC anges

5IF JOEJDBUFE UPSRVFT BSF SFDPNNFOEFE CZ (' 1JQJOH TZTUFNT 5IFTF UPSRVF B TVÎDJFOU UJHIUOFTT PG UIF ÍBOHF DPOOFDUJPO 5IFZ EFWJBUF GSPN UIF EBUB 4VQQMFNFOU XIJDI BSF UP CF VOEFSTUPPE BT VQQFS MJNJUT 5IF JOEJWJEVBM ÍBOHF DPOOFDUJPO WBMWF FOET ÍBOHF BEBQUFST ÍBOHFT CZ (' 1JQJOH TZTU dimensioned for these upper limits.

Pipe outside diameter d (mm)	Nominal Diameter DN (mm)	Tightening torque MD (Nm)		
		Flat ring maximum pressure 10 bar / 40 ° C	Pro le seal maximum pressure 16 bar	O-ring maximum pressure 16 bar
E	% /	15	10	10
d40	% /		15	15
d50	% /		15	15
E	% /			
E	% /	50		
d90	% /		15	15
E	% /			
d140	% /	45		

[1] Maximum operating QSFTTVSF CBS #PMU UJHIUFOJOH UPSRV MJOFT GPS *40 ÍBOHF DP

Length of bolts

*O QSBDUJDF JU JT PGUFO EJÎDVMU UP EFUFSNJOF UIF DPSSFDU CPMU MFOHUI C EFSJWFE GSPN UIF GPMMPXJOH QBSBNFUFST

- 5IJDLOFTT PG UIF XBTIFS Y
- 5IJDLOFTT PG UIF OVU Y
- 5IJDLOFTT PG UIF HBTLFU Y
- 'MBOHF UIJDLOFTT Y
- 5IJDLOFTT PG ÍBOHF DPMMBS WBMWF FOE PS ÍBOHF BEBQUPS Y
- 7BMWF JOTUBMMBUJPO MFOHUI JG BQQMJDBCMF Y

O PSEFS UP FOTVSF UIF ÌUUJOH PG UIF JOTVMBUJPO IBMG TIFMMT PG UIF $00- ' UIF VTFE CPMUT NVTU OPU CF UPP MPOH

5IF GPMMPXJOH UBCMF JT VTFGVM JO EFUFSNJOJOH UIF OFDFTTBSZ CPMU MFOHU

i Under DVS 2210-1, the screw length should be such that it extends 2 to 3 threads beyond the nut.

Online "screw lengths and tightening torques" tool on www.gfps.com/tools

'PS B $00- '*5 'MBOHF BEBQUPST VTFE UPHFUIFS XJUI 11 4UFFM CBDLJOH ÍBOH GPMMPXJOH CPMU MFOHUIT DBO CF VTFE

Dimension	E	d40	d50	E	E	d90	d110	d140
Screws	. Y	. Y	. Y	. Y or . Y	. Y	. Y	. Y	. Y

Installation ttings (for sensors)

5SBOTJUJPOT BOE UISFBEFE QMBTUJD ÌUUJOHT TIPVME ÌSTU CF TDSFXFE ÌOHFS U
UIFO TDSFXFE JO VTJOH BO BQQSPQSJBUF UPPM VOUJM PS UISFBET SFNBJO W

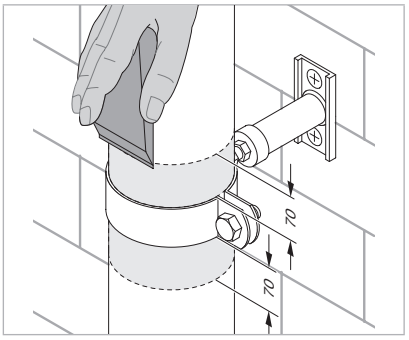
(' 1JQJOH 4ZTUFNT SFDPNNFOET VTJOH 15'& UBQF UP TFBM USBOTJUJPOT BOE UI
ÌUUJOHT "MUFSOBUJWFMZ)FOLFM 5BOHJU 6OJ -PDL PS -PDUJUF UISFBE TFBM
TFBMBOU HFM DBO CF VTFE 'PMMPX UIF NBOVGBDUVSFSnT JOTUSVDUJPOT 8IFO
ZPV NVTU DIFDL DPNQBUJCJMJUZ XJUI UIF QMBTUJD VTFE

0O JOTUBMMJOH *OTUBMMBUJPO ÌUUJOHT JO IPSJ[POUBM QJQJOH TZTUFNT UIF T
or
r DMPDL QPTJUJPO

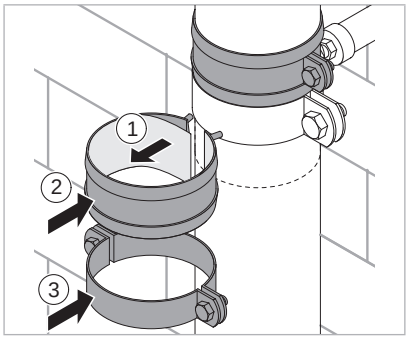
⚠ Do not use hemp! It may swell up, putting force on the plastic ttings and damaging plastic threads. Hemp is also not resistant to chemicals used in some media.

2.5.2 Installation of xed points

5IF $00- '*5 QJQF TIBMM CF JOTUBMMFE XJUI B TUBOEBSE ÌY QPJOU BT TIPXO C

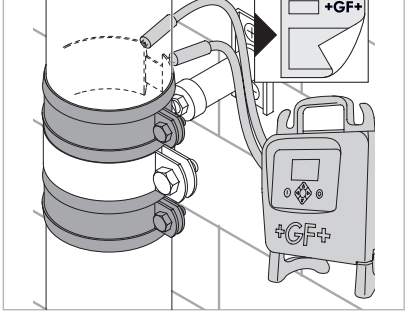


Step 1
3FNPWF UIF PVUFS MBZFS PG UIF
KBDLFU XJUI B QJQF TDS

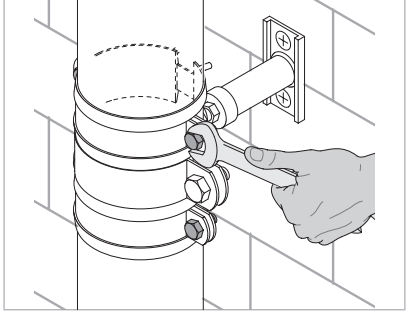


Step 2
3PUBUF UIF ZFMMPX QSPUFDUJWF
UIF XFMEJOH CBOET
UIFN PO UIF $00- '*5 QJQF
XFMEJOH CBOET XJUI UIF
provided.

Note: 5IF PGDFTTBSZ XFMEJOH
pressure on the clean and dry
$00- '*5 QJQF JT BDIJFWFE
UIF QJQF DMJQT
ÌYFE QPJOU D
XFME CBOE UIFSF BSF OP W



Step 3
#POE UIF XFMEJOH CBOE
$00- '*5 QJQF JO BDDPSEBODF
the operating instructions of the
FMFDUSPGVTJPO NBDIJOF 6TF XFMEJOH
BEBQUPST PG UIF Z DBCMF XJUI
JOUFHSBUFE XFMEJOH BEBQUPST GPS UIF
CPOEJOH



Step 4
XFJHI UIF QJQF DMJQT BGUFS

2.5.3 Pressure test

Internal pressure test

'PS JOUFSOBM QSFTTVSF UFTUJOH BOE DPNNJTTJPOJOH UIF TBNF DPOEJUJPOT B
BT GPS UIF OPO JOTVMBUFE FDP'*5 TZTUFN 1&

2.5.4 Internal pressure and leak testing

Introduction to the pressure test

Overview of the various test methods

Leakage test	Inner Pressure test			Leakage test
Medium	Water	Gas[1]	$PNQSFTTJCMF HBT	
5ZQF	*OEPNQSFTTJCMF MJRVJE	*OEPNQSFTTJCMF HBT	*OEPNQSFTTJCMF	
5FTU QSFTTVSF (overpressure)	$p_{(perm)}$ or $xP_{p\,(perm)}$	0QFSBUJOH QSFTTVSF	0QFSBUJOH QSFTTVSF	CBS
Potential risk during the pressure test	-PX	)JHI	)JHI	-PX
4JHOJÌDBOD	)JHI Proof of pressure resistance incl. JNQFSNFBCJMJUZ to test medium	)JHI Proof of pressure resistance incl. JNQFSNFBCJMJUZ to test medium	)JHI Proof of pressure resistance incl. JNQFSNFBCJMJUZ to test medium	Gering JNQFSNFBCJMJUZ

[1] 0CTFSWF UIF BQQMJDB safety precautions. More JOGPSNBUJPO JT BWBJ %74 BEEFOEVN

" OVNCFS PG JOUFSOBUJPOBM BOE OBUJPOBM TUBOEBSET BOE HVJEFMJOFT BSF QSFTTVSF UFTUT 5IFSFGPSF JU JT PGUFO OPU FBTZ UP ÌOE UIF BQQMJDBCMF U example the test pressure.

5IF QVSQPTF PG B QSFTTVSF UFTU JT

- &OTVSF UIF SFTJTUBODF UP QSFTTVSF PG UIF QJQJOH TZTUFN BOE
- 4IPX UIF MFBL UJHIUOFTT BHBJOTU UIF UFTU NFEJVN

6TVBMMZ UIF JOUFSOBM QSFTTVSF UFTU JT EPOF BT B XBUFS QSFTTVSF UFTU BC DBTFT VOEFS DPOTJEFSBUJPO PG TQFDJBM TBGFUZ QSFDBVUJPOT BT B HBT QS nitrogen.

8BUFS JT BO JODPNQSFTTJCMF NFEJVN *O DBTF PG B MFBLBHF EVSJOH UIF QSFT FOFSHZ JT TFU GSFF 5IFSFGPSF UIF IB[BSE QPUFOUJBM JT TJHOJÌDBOUMZ MPXF XJUI B DPNQSFTTJCMF NFEJVN MJLF F H DPNQSFTTFE BJS

Internal pressure test with water or similar incompressible test medium

5IF JOUFSOBM QSFTTVSF UFTU JT EPOF XIFO JOTUBMMBUJPO XPSL IBT CFFO DPN QSFTVQQPTFT BO PQFSBUJPOBM QJQJOH TZTUFN PS PQFSBUJPOBM UFTU TFDUJP MPBE JT JOUFOEFE UP GVSOJTI FYQFSJNFOUBM QSPPG PG PQFSBUJPOBM TBGFUZ CBTFE PO UIF PQFSBUJPOBM QSFTTVSF CVU SBUIFS PO UIF JOUFSOBM QSFTTVSF M UIF QJQF XBMM UIJDLOFTT

"EEFOEVN PG %74 GPSNT UIF CBTJT GPS UIF GPMMPXJOH JOGPSNBUJPO 5I EBUB JO %74 FOUJSFMZ 5IF NPEJÌDBUJPOT CFDBNF OFDFTTBSZ CFDBVTF UI WBMVF OPNJOBM QSFTTVSF 1/ JT CFJOH VTFE MFTT BOE MFTT UP EFUFSNJOF Y 1/ PS Y 1/ BOE JT CFJOH SFQMBDFE CZ 4%3 *O BEEJUJPO B TIPSU UFSN P SFEVDUJPO JO UIF TFSWJDF MJGF DBO PDDVS JG UIF QJQF XBMM UFNQFSBUVSF 5 NPSF UIBO ‹$ JO UIF DPVSTF PG UIF JOUFSOBM QSFTTVSF UFTU CBTFE PO UIF O

5FTU QSFTTVSFT BSF UIFSFGPSF EFUFSNJOFE JO SFMBUJPO UP 4%3 BOE UIF QJ 5IF I WBMVF GSPN UIF MPOH UFSN CFIBWJPS EJBHSBN JT VTFE GPS UIF UFTU

Test parameters

5IF GPMMPXJOH UBCMF QSPWJEFT SFDPNNFOEBUJPOT PO UIF QFSGPSNBODF PG U
test

Purpose	Preliminary Review	Main examination
5FTU QSFTTVSF (depends on the QJQF XBMM UFNQFSBUVSF BOE UIF permitted test pressure of the JOTUBMMFE DPNQPOFOUT TFF EFUFSNJOBUJPO PG UIF UFTU QSFTTVSF	Ç Q 1 [VM	Ç Q 1 [VM
5FTU EVSBUJPO EFQFOEÇT PONUIFIMFOHUÇI N IST of the pipe sections)	N - Ç N	IST N - Ç N IST
$IFDLT EVSJOH UIF UFTU MFBLUJHIU QSFTTVSF BOE UFNQFSBUVSF DVSWF recorded)	UFTU QFSJPE XJUIPVU pressure restored	UFTU QFSJPE XJUIPVU restoring the test pressure

Preliminary test

Pre-test

5IF QSF UFTU TFSWFT UP QSFQBSF UIF QJQJOH TZTUFN GPS UIF BDUVBM UFTU N
PG QSF UFTUJOH B UFOTJPO FYQBOTJPO FRVJMJCSJVN JO SFMBUJPO UP BO JOD
EFWFMPQ JO UIF QJQJOH TZTUFN " NBUFSJBM SFMBUFE ESPQ JO QSFTTVSF XJMM
SFQFBUFE QVNQJOH UP SFTUPSF UIF UFTU QSFTTVSF BOE BMTP GSFRVFOUMZ B S
ÍBOHF DPOOFDUJPO CPMUT

5IF HVJEFMJOFT GPS BO FYQBOTJPO SFMBUFE QSFTTVSF EFDSFBTF JO QJQF BSF

Material	Pressure drop (bar/h)
$00- '*5	

Main test

*O UIF DPOUFYU PG UIF NBJO UFTU B NVDI TNBMMFS ESPQ JO QSFTTVSF DBO CF
QJQF XBMM UFNQFSBUVSFT TP UIBU JU JT OPU OFDFTTBSZ UP QVNQ BHBJO 5IF D
QSJNBSJMZ PO MFBL EFUFDUJPO BU UIF ÍBOHF KPJOUT BOE BOZ QPTJUJPO DIBOH

Observe if using compensators

*G UIF QJQJOH TZTUFN UP CF UFTUFE DPOUBJOT DPNQFOTBUPST JU IBT BO JOÍV
BYJBM GPSDFT PO UIF ÌYFE QPJOUT PG UIF QJQQJOH TZTUFN #FDBVTF UIF UFTU
UIBO UIF PQFSBUJOH QSFTTVSF UIF BYJBM GPSDFT PO UIF ÌYFE QPJOUT JODSFB
IBT UP CF UBLFO JOUP BDDPVOU XIFO EFTJHOJOH UIF ÌYFE QPJOUT

Observe if using valves

8IFO VTJOH B WBMWF BU UIF FOE PG B QJQJOH TZTUFN FOE PS ÌOBM WBMWF UI
FOE TIPVME CF DMPTFE CZ B EVNNZ ÍBOHF PS DBQ 5IJT QSFWFOUT BO JOBEWFSU
valve and release of the medium.

Filling the pipe

#FGPSF TUBSUJOH UIF QSFTTVSF UFTU UIF GPMMPXJOH QPJOUT TIPVME CF DIFD
5IF JOTUBMMBUJPO IBT CFFO DBSSJFE PVU JO BDDPSEBODF XJUI JUT QMBOT
"MM QSFTTVSF SFMJFG BOE DIFDL WBMWFT BSF ÌUUFE JO UIF EJSFDUJPO PG Í
"MM FOE WBMWFT IBWF CFFO DMPTFE
"MM WBMWFT GPS EFWJDFT IBWF CFFO DMPTFE UP TFDVSF BHBJOTU QSFTTVS
" WJTVBM JOTQFDUJPO IBT CFFO NBEF PG BMM DPOOFDUJPOT QVNQT NFBTV
tanks.
5IF XBJUJOH UJNF BGUFS UIF MBTU XFME PS CPOE IBT CFFO PCTFSWFE

/PX UIF QJQJOH TZTUFN DBO CF ÌMMFE GSPN UIF HFPEFUJD MPXFTU QPJOU 4QFD
CF HJWFO UP UIF BJS WFOU *G QPTTJCMF WFOUT TIPVME CF QSPWJEFE BU BMM
QJQJOH TZTUFN BOE UIFTF TIPVME CF PQFO XIFO ÌMMJOH UIF TZTUFN 'MVTIJOH
at least 1 m/s.

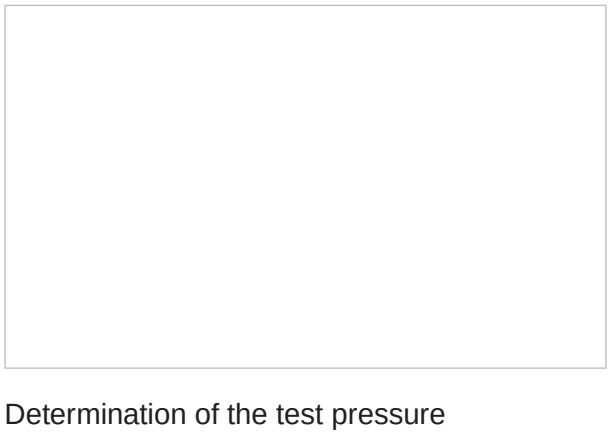
3FGFSFODF WBMVFT GPS UIF ÌMMJOH WPMVNF BSF HJWFO JO UIF UBCMF CFMPX

d (mm)	V (l/s)
Ç	0.15
110	

"MMPX TVÎDJFOU UJNF UP QBTT CFUXFFO ÌMMJOH BOE UFTUJOH UIF QJQF GPS UIF
TZTUFN UP FTDBQF UISPVHI UIF WFOUT BCPVU UP IPVST EFQFOEJOH PO OPN

Applying the test pressure

5IF UFTU QSFTTVSF JT BQQMJFE JO BDDPSEBODF XJUI UIJT EJBHSBN *U JT JNQP
SBUF PG QSFTTVSF JODSFBTF EPFT OPU DBVTF BOZ XBUFS IBNNFST



: 5FTU QSFTTVSF
9 5JNF PG UFTU QSFTTV
increase (min)
3BUF PG QSFTTVSF JO
VQ UP %/ NN
3BOHF PG QSFTTVSF
SBUFT CFUXFFO %/ E
%/ NN
(VJEFMJOF SBUF PG C
JODSFBTF GPS %/ BC
IJHIFS %/ CBS N

Determination of the test pressure

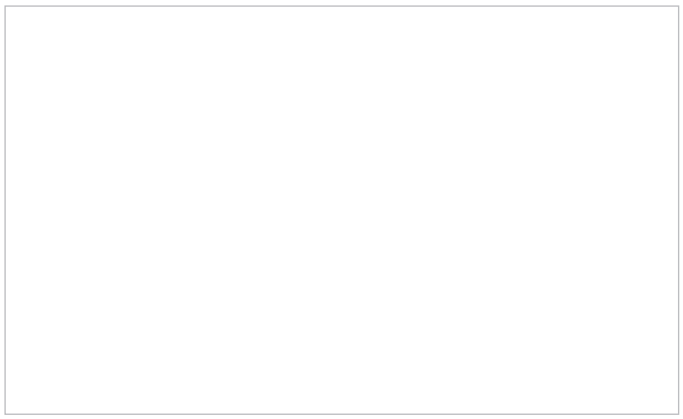
5IF QFSNJTTJCMF UFTU QSFTTVSF JT DBMDVMBUFE VTJOH UIF GPMMPXJOH GPSNV

$$P_{p(zul)} = \frac{1}{SDR} \frac{20}{S_p} \frac{v(T, 100\ h)}{A_G}$$

$V_{W\ 5}$ I $SFFQ TUSFOHUI GPS UIF QJQF XBMM UFNQFSBUVSF
S_p Minimum safety factor for creep strength
$"_G$ 1SPDFTTJOH NFUIPE PS HFPNFUSZ TQFDJÌD GBDUPS XIJDI SFEVDFT UIF QFS
test pressure
5_8 1JQF NFUBM UFNQFSBUVSF NFBO UFNQFSBUVSF PG UFTU NFEJVN BOE QJQ

Material	Sp minimum safety factor
1&	
17$ 6	

To make things easier, the permissible test pressures can be taken directly from the following diagrams.



P permitted test pressure
CBS
5 QJQF XBMM UFNQFSBU

Checks during testing

5IF GPMMPXJOH NFBTVSFNFOU WBMVFT NVTU CF SFDPSEFE DPOTJTUFOUMZ EVSJ
*OUFSOBM QSFTTVSF BU UIF BCTPMVUF MPXFTU QPJOU PG UIF QJQJOH TZTUF
.FEJVN BOE BNCJFOU UFNQFSBUVSF

10. Water volume input
11. Water volume output

1SFTTVSF ESPQ SBUFT

2.5.5 Start-up with secondary coolants

4FDPOEBSZ DPPMBOUT TVDI BT HMZDPM TPMVUJPOT NVTU POMZ JOUSPEVDFE JO
JOUP $00- '*5 QJQJOH TZTUFNT 'JMMJOH TIPVME CF QFSGPSNFE TMPXMZ GSP
UIF TZTUFN UP BMMPX UIF QJQJOH TZTUFN UP WFOU BU JUT IJHIFTU QPJOU

Filling and Venting

*U JT JNQPSUBOU UP WFOU BJS GSPN BMM QJQJOH TZTUFNT 5IJT JT QBSUJDVMB
TPMVUJPOT CFDBVTF PG UIFJS DPSSPTJWF QSPQFSUJFT 7FOUJOH QSPDFTT

- 5IF TZTUFN NVTU CF ÌMMFE TMPXMZ
- .BOVBM PS BVUPNBUJD WFOUJOH EFWJDFT NVTU CF ÌUUFE BU UIF IJHIFTU QPJO
- -POH IPSJ[POUBM MJOFT TIPVME CF JOTUBMMFE BU B TMJHIU HSBEJFOU
- 5IF QJQJOH MBZPVU TIPVME CF DIPTFO JO TVDI B XBZ BT UP QSFWFOU UIF GPS pockets.
- *OTUBMMBUJPO PG BO BJS WFOU XJUI B NFEJVN DPMVNO BT B SFTFSWF
- 'PMMPX UIF TQFDJÌD NBOVGBDUVSFS JOTUSVDUJPOT GPS UIF MJRVJET BT SFHB

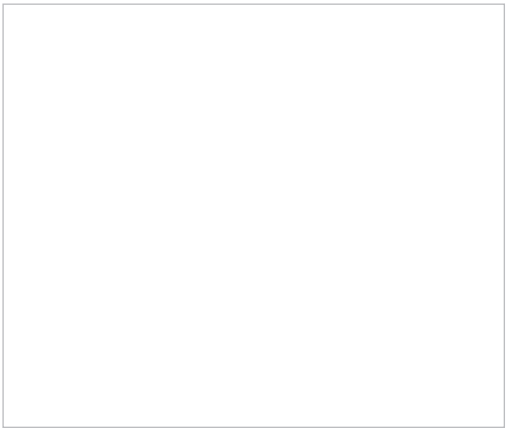
2.6 Transport and Stocking

2.6.1 Transport

0O USVDLT JO DSBUFT NBOVBM USBOTQPSU

2.6.2 Storage

"MM QMBTUJD QJQF JODMVEJOH QSF JOTVMBUFE QMBTUJD QJQF TVDI BT $00- '*5
B ÍBU TVSGBDF XJUI OP TIBSQ FEHFT %VSJOH IBOEMJOH DBSF NVTU CF UBLFO U
UIF FYUFSOBM TVSGBDF PG UIF QJQF J F CZ ESBHHJOH BMPOH UIF HSPVOE 1J
FBDI PUIFS JO TUPSBHF BT UIJT JT MJLFMZ UP DBVTF CFOEJOH



2.7 Environment

5IF NBUFSJBMT VTFE GPS $00- '*5 BSF TVJUBCMF GPS SFDZDMJOH (' 1JQJOH 4
TBUJTGZ JUT DVTUPNFSnT XJTIFT DPODFSOJOH FOWJSPONFOUBM BTQFDUT 5&8*
BOE UFTU SFQPSUT BSF BWBJMBCMF GPS $00- '*5 . QJQF

i For more information at www.cool t.georg scher.com

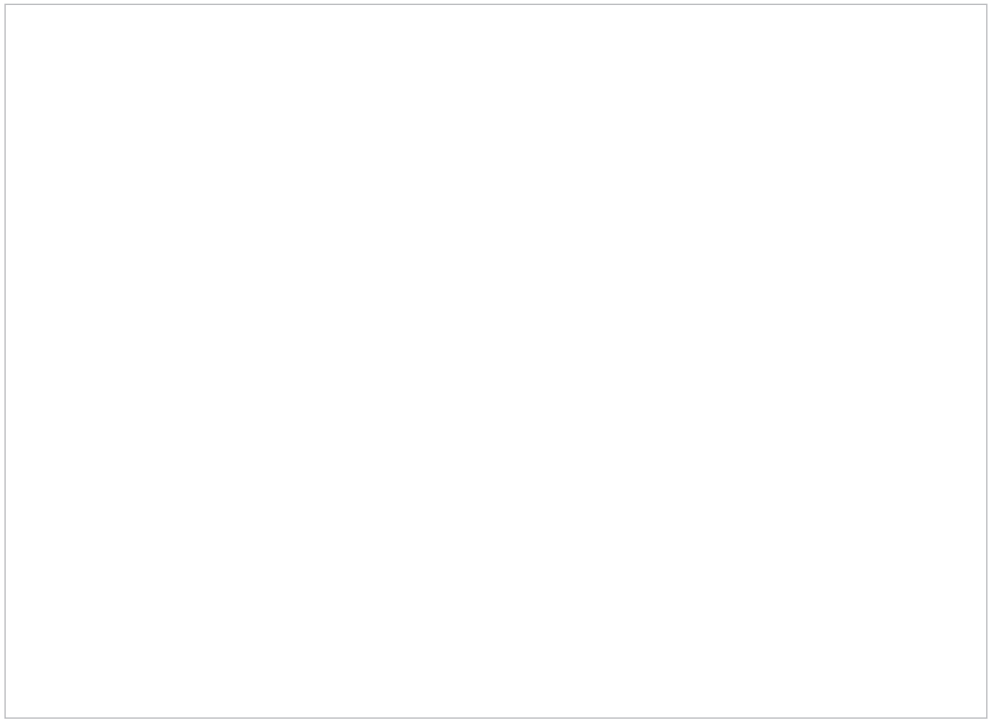
3 COOL-FIT 4.0

3.1 General Information

$00- '*5 JT B QSF JOTVMBUFE QJQJOH TZTUFN GPS UIF EFMJWFSZ PG TFDPOEB
$00- '*5 TZTUFN JT B DPNQMFUFMZ QSF JOTVMBUFE QMBTUJD QJQJOH TZTUFN
SFGSJHFSBOU DJSDVJUT UIBU SVO XJUI XBUFS CSJOF PS (MZDPM CBTFE TPMVU
JOTVMBUJPO UIJDLOFTT PG NN UZQJDBM BSFBT PG BQQMJDBUJPO BSF JOEVTU
TZTUFNT XJUI NFEJVN UFNQFSBUVSFT CFMPX ‹$ BOE DIJMMFE XBUFS TZTUFNT G
{‹$

$00- '*5 JT CBTFE PO FTUBCMJTIFE JNQBDU SFTJTUBOU BOE DPSSPTJPO GSFF
ÌUUJOHT 5IF TNPPUI JOOFS TVSGBDF PG UIF ÍVJE QJQF QSPWJEFT NJOJNBM MPT
MPX UIFSNBM DPOEVDUJWJUZ BOE IJHI RVBMJUZ JOTVMBUJPO HVBSBOUFF MPX P
FOUJSF MJGFTQBO PG UIF TZTUFN 5IBOLT UP UIF JO EFTJHO r 'MVJE QJQF *
3PCVTU{KBDLFU r JOTUBMMBUJPO UJNF JT LFQU WFSZ TIPSU

"MM DPNQPOFOUT BSF QSF JOTVMBUFE PS TVQQMJFE XJUI NPVOUBCMF JOTVMBUJ
5IF$00- '*5{ UPPMT BMMPX GPS GBTU BOE TBGF JOTUBMMBUJPO PG UIF TZTUFN

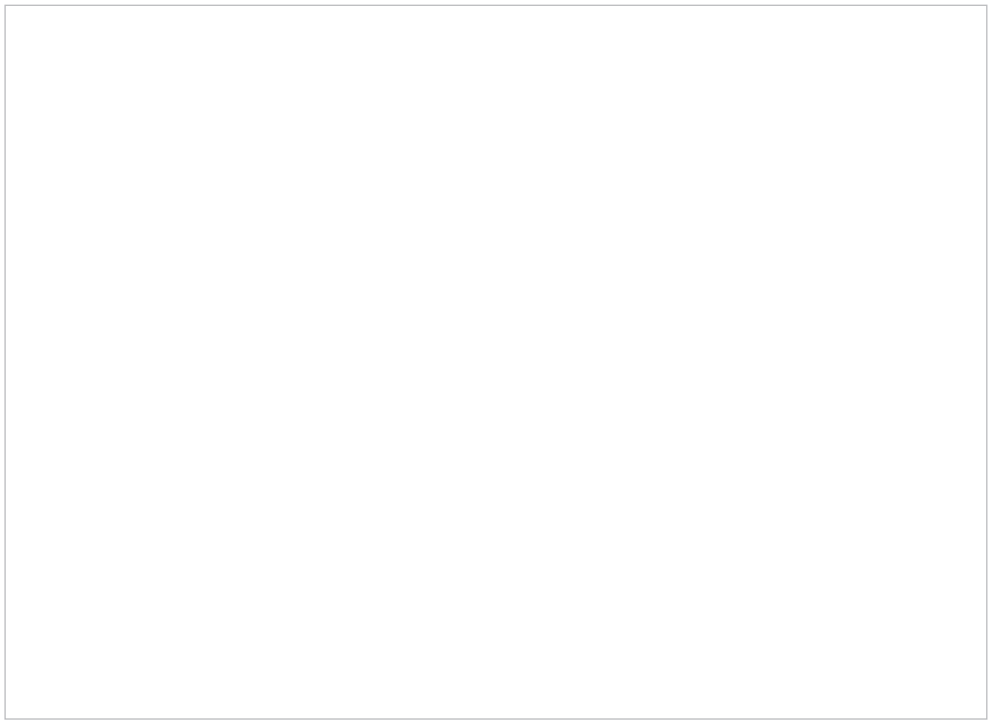


5IF $00- '*5 TZTUFN JT B DPNQMFUFMZ QSF JOTVMBUFE QMBTUJD QJQJOH TZTU
SFGSJHFSBOU DJSDVJUT UIBU SVO XJUI XBUFS CSJOF PS (MZDPM CBTFE TPMVU

5IF $00- '*5 TZTUFN JT TVJUBCMF GPS VTF JO BQQMJDBUJPOT MJLF

- 'SVJU BOE WFHFUBCMF QSPDFTTJOH
- #BLFSJFT
- Fish and meat processing
- $PME TUPSFT
- #SFXFSJFT BOE XJOFSJFT
- "JSPOEJUJPOJOH
- "JSQPSUT
- "QBSUNFOUT
- *OEVTUSJBM CVJMEJOHT
- %BUB DFOUFST
-)PUFMT
- Shopping centers
- Sports centre / leisure centre
- 6OJWFSTJUJFT
- #BOL QVCMJD JOTUJUVUJPOT

3.2 System Speci cation



Speci cation		COOL-FIT 4.0
Materials[1)]	Pipe	1&
	Insulation	(')& GPBN IBMPHFO GSFF DMPTFE QPSPVT
	0VUFS KBDLFU	Pipe)%1&
		Fitting (')&
4J[F		E %/ E %/
+PJOUFOHOPMPHZ		&MFDUSPGVTJPO
/PNJOBM QSFTTVSF	Medium	E %/ r E %/
	CBS 4%3	E %/ r E %/
5FNQFSBUVSF	Medium	‹$ UP ‹$
	&OWJSPONFOU	‹$ UP ‹$
Insulation	5IFSNBM DPOEVDUJWJUZ	E 8 N,
	)& 'PBN	E E
	1& KBDLFU JOOFS SPJNQF	
	%FOTJUZ	È LH N
	'PBN DFMM TJ[F	max. Ø 0.5 mm
	/PNJOBM UIJDLOFTT	40 mm (')&
Mechanical strength (from insulation)	"YJBM TIFBS TUSFOHUI	È N/I NN
	$PNQSFTTJWF TUSFOHUI	/ NN
$PNPVS	0VUFS KBDLFU	#MBDL
Weight	1JQF E	1.41 kg/m
XJUIPVU XBUFS	Pipe d110	LH N
	1JQF E	LH N
0YZHFO EJËVTJPO BU{ { ‹ $		Ç NHd) N
'JSF DMBTTJÌDBUJPO		/PSNBMNCVTUJCJMJUZ
&OWJSPONFOUBM	UBCJMJUZ	.PJTUVSF BOE WBQPS UJHIU
	3FTJTUBODF	Weather resistant 67 SFTJTUBOU
	(MPCBM XBSNJOH QPUFOUJBM GWP	
	0[POF %FQMFUJPO 0%1	PP UFOUJBM

[1)] "MM UISFF NBUFSJBMT ÌSNMZ CPOEFE UPHFUI BU ‹$ .FEJB 8BUFS

Speci cation		COOL-FIT 4.0
Standards and Guidelines	&/ *40	Plastic piping systems for industrial BQQMJDBUJPOT r QPMZCVUFOF 1# QPMZFUIZ MFOF 1& BOE QPMZQSPQZMFOF 11 r TQFDJ ÌDBUJPOT GPS DPNQPOFOUT BOE UIF QJQJOH system – metric series
	*40	5ISFBEFE +PJOUT
	&/ *40	*OEVTUSJBM WBMWFT r #BMM WBMWFT NBEF PG thermoplastics
	&/ *40	*OEVTUSJBM WBMWFT r #VUUFSÍZ WBMWFT NBEF of thermoplastics
	&/ *40	*OEVTUSJBM WBMWFT r #BDLÍPX QSPUFDUJPO made of thermoplastics
	&/ *40	Plastic piping and ducting systems – 1MBTUJD QJQF BOE ÌUUJOHT r .FUIPE GPS FYQPTVSF UP EJSFDU OBUVSBM XFBUIFSJOH
	&/ *40	'JSF DMBTTJÌDBUJPO PG DPOTUSVDUJPO QSPEVDUT BOE CVJMEJOH FMFNFOUT
Product declarations	(SFFOCVJMEJOHT TDDPSEJOH UP % (/# % (/# #3&&". -&&% -&&% W	

3.3 Technical Details

3.3.1 COOL-FIT 4.0 Pipe and Fittings

COOL-FIT 4.0 Pipe

$00- '*5 QJQF BSF NBEF GSPN 1& 5IF IJHI FÎDJFODZ (')& IBSE GPBN JOTVMBUJPO FYIJCJUT DPBGUIFSNBM, DPOEVDUJWJUZ SFTQFDUJWFMZ 8N, E E 5IF QJQF BSF QSPUFDUFE CZ BO JNQBDU BOE XFBUIFS SFTJTUBOU 1& KBDLFU

"MM UISFF NBUFSJBMT BSF ÌSNMZ CPOEFE JO PSEFS UP FOTVSF HPPE JOTVMBUJP QSPQFSUJFT BOE MPX UIFSNBM FYQBOTJPO PS DPOUSBDUJPO GPS UIF TZTUFN

5IF QJQF BSF BWBJMBCMF JO N MFOHUIT 5IF QJQF IBWF GSFF VOJOTVMBUFE F QSFQBSFE BMSFBEZ GPS UIF KPJOUJOH XJUI UIF $00- '*5 ÌUUJOHT

Pipe	Pipe	Outer jacket	Free pipe ends	Weight		Volume	Insulation thickness	Heat transfer coe cient (U)
				empty	with Water			
d x e (mm)	d_i (mm)	D x e1 (mm)	(mm)	(kg/m)	(kg/m)	(l/m)	(mm)	(W/m K)
Y		Y		1.41	1.95	0.54		
Y		Y	40					0.14
Y		Y	44					
Y	51.4	Y						
Y		140 x 4.0	55					
Y		Y						
110 x 10	90	Y						
Y	141.0	Y	90	9.95			40	
Y		Y	110					0.50
Y		Y					5.9	0.49
Y		Y					5.9	
Y		Y					5.9	
Y		Y	145				5.9	0.49
Y		Y					5.9	0.50

E /PNJOBM PVUFS EJ PG UIF 1& QJQF

d_i /PNJOBM JOTJEF diameter of the pipe

% /PNJOBM PVUFS PG UIF PVUFS 1 KBDLFU

F F /PNJOBM XBMM UI

Pipe	Pipe	Outer jacket	Free pipe ends	Weight		Volume	Insulation thickness	Heat transfer coe cient (U)
				empty	with Water			
d x e (mm)	d_i (mm)	D x e1 (mm)	(mm)	(kg/m)	(kg/m)	(l/m)	(mm)	(W/m K)
Y		Y		55.50			5.9	0.50

COOL-FIT 4.0 Fittings

General

5IF NFEJB ÌUUJOH BOE JOTVMBUJPO VTFE GPS $00- '*5 ÌUUJOHT GVMÌMM UIF T
BT UIF $00- '*5 QJQF 5IF $00- '*5 ÌUUJOHT BSF CBTFE PO &-(&' FMFDUSPGV
XIJDI IBWF CFFO JO VTF TVDDFTTGVMMZ GPS ZFBST 5IFZ QSPWJEF BO FBTZ BOE

5IF QSF JOTVMBUFE $00- '*5 ÌUUJOHT BSF BWBJMBCMF JO UXP UZQFT

Type A

‹ FMCPX BOE SFEVDFS I

example

&MFDUSPGVTJPO ÌUUJOH XJUI JOUF T GPS EJSFDU
FMFDUSPGVTJPO ÌUUJOHT

Type B

4QJHPU ÌUUJOH XJUI GSFF FOET GP XJUI
$00- '*5{ FMFDUSPGVTJPO ÌUUJOH

Usefull functions

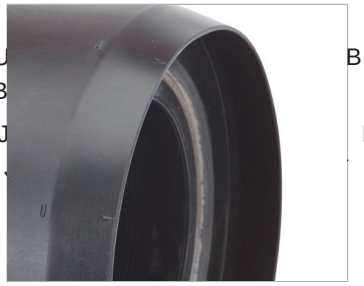
Fusion indicators

"GUFS UIF XFMEJOH QSPDFTT UIF XT UIBU
FOFSHZ IBT CFFO BQQMJFE UP UIF

Sealing lip at ttings Type A d32-d225

5IF TFBMJOH MJQ FOTVSFT B NPJTU BQPVS UJHIU
TFBMJOH PG UIF JOTVMBUJPO UPXB

0O KPJOJOH UIF ÌUUJOHT UP UIF QJ NFDIBOJDBMMZ
%VF UP UIJT BO BEEJUJPOBM TFBM JT OPU OFDFT
sary.



Label

5IF ÌUUJOHT IBWF BCSBTJPO SFTJT

Trace code

3FMFWBOU QSPEVDU EBUB DBO CF USBDFE CBDL UP QSPEVDUJPO WJB U S B D F BDCPJEMFJTU Z

Angle marking

#Z NBSLJOH UIF FOET PG UIF ÌUUJO CFUXFFO QJQF BOE ÌUUJOHT DBO CF PQUJNB

Jointing

Pipe and Fitting

5ZQF " ÌUUJOHT IBWF JOUFHSBUFE SFTJTUBODF XJSFT XIJDI BSF QVU VOEFS FMF UIF XFMEJOH PQFSBUJPO UISPVHI XFMEJOH DPOUBDUT PO UIF ÌUUJOHT 5IJT IFBU ÌUUJOH BOE CPOET UIF NFMUJOH [POF XJUI UIF QJQF

5ZQF # ÌUUJOHT GFBUVSF OPO JOTVMBUFE TQJHPU FOET 5IFZ BSF DPOOFDUFE X ÌUUJOHT UZQF " UP B QJQF

Fitting-to- tting

5XP $00- '*5 ÌUUJOHT BSF VTVBMMZ DPOOFDUFE CZ VTJOH B QJFDF PG $00- '*5 GSFF FOET 'PS DPNQBDU KPJOUT UIF TQFDJBM $00- '*5 CBSSFM OJQQMF XJU used.

5XP $00- '*5 5ZQF # ÌUUJOHT DBO CF KPJOFE VTJOH BO FMFDUSPGVTJPO ÌUUJC

5IF EJSFDU DPOOFDUJPO PG B $00- '*5 ÌUUJOH 5ZQF " BOE 5ZQF # JT BMTP QP

Components

COOL-FIT 4.0 Electrofusion coupler

$00- '*5 FMFDUSPGVTJPO DPVQMF DPOOFDU QJQF BOE DPNQPOFOUT XJUI GSFF F # ÌUUJOHT WBMWFT BOE USBOTJUJPO ÌUUJOHT

COOL-FIT 4.0 Elbows 45° and 90°

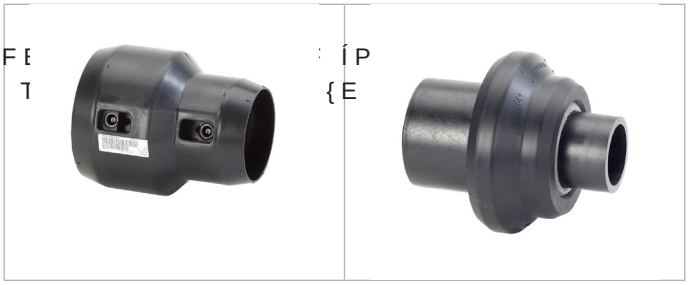
3FGFS UP c(FOFSBM *OGPSNBUJPOo

COOL-FIT 4.0 T90° equal and COOL-FIT T90° reduced

5IF FRVBM BOE SFEVDFE UZQF " ‹ U UI
DPVQMFS SFTJTUBODF XJSFT GPS FI 5II
CSBODIFT DBO CF DPOOFDUFE UP UII T
DPNCJOBUJPOT BSF QPTTJCMF

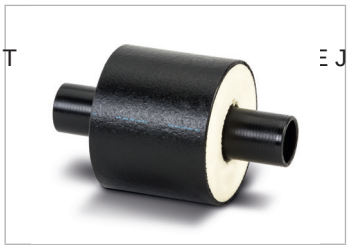
COOL-FIT 4.0 reducer

5IF $00- '*5 SFEVDFS DBO CF VTFE ÍP
UIF TUBSUJOH TJ[F CZ VQ UP UP T {E
E



COOL-FIT 4.0 barrel nipple (with insulation)

$00- '*5 CBSSFM OJQQMF TFSWFT EJSFDU
DPOOFDUPS GPS UZQF " ÌUUJOHT



Combination of T90° and Reducer

*G B SFEVDFS JO B TZTUFN JT ÌUUFE CFIJOE B UFF FJUIFS B $00- '*5 5 ‹ SFE
$00- '*5 5 ‹ SFEVDFE FRVBM DPOOFDUFE UP B SFEVDFS TIPVME CF VTFE

Branch \ Run	40	50	63	75	90	110	160	225
	X	X	X	0	0	0	0	0
40		X	X	0	0	0	0	0
50			X	0	0	0	0	0
				—	—	—	—	—
					—	—	†	†
90						—	—	—
110							—	—

— 5 ‹ SFEVDFE
9 5 ‹ FRVBM SFEVDFS
0 5 ‹ SFEVDFE UP E
SFEVDFS UZQF "
† 5 ‹ SFEVDFE UP E
DPVQMFS E SFEVDF
UZQF{#

Accessories for dimensions d32 - d225

Insulation for fusion contacts

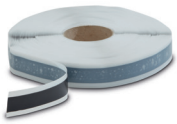
4VQQMJFE XJUI FBDI ÌUUJOH 1SFWFO PG B DPME
CSJEHF BU UIF GVTJPO DPOUBDUT *C SUT DBO BMTP
TFSWF BT BO JOEJDBUPS UIBU B DPO FFO XFMEFE
*OTUBMM JOTVMBUJPO BGUFS XFMEJC U UIF XFMEJOH IBT
CFFO DPNQMFUFE

Sealing clamps

'PS WFSUJDBM JOTUBMMBUJPOT PV DMBNQT NPVOUFE
BU UIF UPQ MJQ PG UIF ÌUUJOH BSF

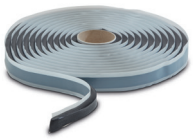
Sealing tape

"T BO BMUFSOBUJWF UP UIF TFBMJO FBMJOH UBQF
XJUI XJEUI NN JT JOUFOEFE UP CF IDBM
JOTUBMMBUJPOT PVUEPPST UP TFB G UIF ÌUUJOH



Transition of insulation

5IF 5SBOTJUJPO PG JOTVMBUJPO JT V JTUVSF QSPPG
BOE WBQPVS UJHIU TFBMJOH PG UIF J $00- '*5
'JUUJOH UP $00- '*5 QJQF



Cement

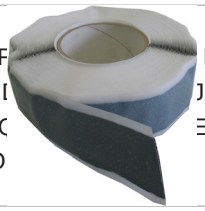
'PS GSPOUBM CPOEJOH PG UIF JOTVMBUJ USBOTJUJPO ÌUUJOHT
BOE ÍFYJCMF IPTFT

Adhesive tape

0QUJPOBM GPS DPWFSJOH IBOE DVU GBDFT BT XFMM BT GPS CPOEJOH
PG UIF JOTVMBUJPOT PG USBOTJUJPO ÌUUJOHT UP UIF JOTVMBUJPO PG
ÍFYJCMF IPTFT

Accessories for dimensions d250 - d450

Sealing tape



" SPMM PG NN XJEF CVUZMFOF SVCCF FBMJOH UBQF 'PS B XBUFS BOE WBQPS UJHIU DPOOFI JOTQFDUJPO HBQT XJUI TISJOL TPDLFUT 5IF TFBMJOH UBC Ξ UP UIF DJSDVNGFSFODF PG UIF QJQF PS ÌUUJO

Shrink socket

5IF TISJOL TPDLFU JT VTFE UP XBUFS BOE WBQPS TFBM UIF JOTQFDUJPO HBQ PO UIF PVUFS KBDLFU BOE DBO TFBM POMZ DPNQPOFOUT XJUI UIF TBNF PVUTJEF EJBNFUFS 'VODUJPOBMJUZ JT FOTVSFE POMZ JO DPNCJOBUJPO XJUI UIF CVUZMFOF SVCCFS TFBMJOH UBQF 5IJT WFSTJPO QSPWJEFT BEEJUJPOBM NFDIBOJDBM TUSFOHUI XJUI SFHBSE UP CFOEJOH GPSDFT 5IF TPDLFU TISJOLT VOJGPSNMZ SFTVMUJOH JO B HPPE WJTVBM BQQFBSBODF *U DBO CF TISVOL XJUI BO PQFO TPGU ÍBNF

End cap

&OE DBQT BSF VTFE UP DBQ UIF QSF JOTVMBUFE TZTUFN 5IFZ TFBM UIF 163 JOTVMBUJPO BOE QSFWFOU NPJTUVSF GSPN FOUFSJOH 4FBMJOH 163 JT BDIJFWFE CZ VTJOH B TVJUBCMF sealant.

Sealant

5IF TJMJDPOF GSFF TFBMBOU JT VTFE BU UIF FOE PG UIF QSF JOTVMBUFE TZTUFN UP TFBM UIF 163 JOTVMBUJPO *U JT VTFE UP cement the end caps.

COOL-FIT 4.0 Valves

5IF QMBTUJD WBMWFT EFTJHOFE GP /WFT BSF CBTFE PO (FPSH 'JTDIFS 1JQJOH 4Z QMBTUJD WBMWFT 5IF WBMWFT BSF TVQQMJ (')& JOTVMBUJPO TIFMMT XJUI B QSPUF 5IF TFBMJOH GBDFT CFUXFFO UIF TIFMMT BSF WI JS EFTJHO /P additional tape or sealant is required.

3FMFBTBCMF QMBTUJD CBOET GPS TJ[FT E %/ r E %/ BOE NFUBM TUSBQT XJU GPS TJ[FT E %/ r E %/ QFSNJU UIF QSF JOTVMBUFE TIFMMT UP CF ÌUUFE UP GSPN UIF WBMWFT FBTJMZ BMMPXJOH FBTZ NBJOUFOBODF

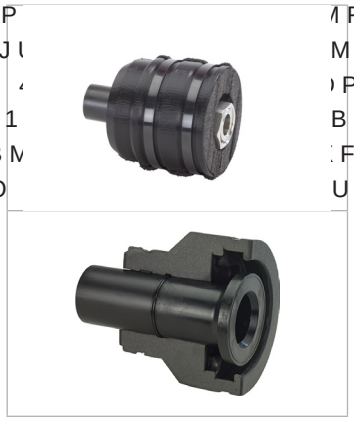
5IF JOTVMBUFE CBMM WBMWF JO "#4 JT BWBJMBCMF JO TJ[FT E %/ r E %/ 'PS E %/ r E %/ CVUUFSÍZ WBMWFT LJUT BSF BWBJMBCMF UIBU DPOTJTU PG CV ÍBOHF BEBQUPS CBDLJOH ÍBOHF 11 4U TDSFX LJUT BOE JOTVMBUJPO IBMG TIFM #PUI WBMWF UZQFT BSF BWBJMBCM SMMZ PQFSBUFE or electric actuated version.

5IF FMFDUSJD BDUVBUPST VTFE GFBUVSF GPMMPXJOH CFOFÌUT

- 1PTJUJPO GFFECBDL WJB SFMBJT PQFO DMPTF NJEEMF
-)FBUJOH FMFNFOU UP QSFWFOU DPOEFOTBUJPO
- 0QUJDBM QPTJUJPO JOEJDBUPS XJUI -&% TUBUVT NPOJUPSJOH
- 5IJSE QPTJUJPO CFUXFFO oPQFOp BOE oDMPTFEp PQUJPOBM
- 3FMBZ PVUQVU GPS oSFBEZ UP PQFSBUFp BOE TFHNFOU FSSPS EJTQMBZ
- *OUFHSBUFE NBOVBM PWFSSJEF XJUI NBHOFUJD MPDL
- -POH TFSWJDF MJGF EVF UP SPCVTU EFTJHO BOE TVQFSJPS FMFDUSPOJDT
- 'MFYJCMF DPOÌHVSBUJPO UIBOLT UP NPEVMBS DPODFQU
- /VNFSPVT NPOJUPSJOH BOE DPOUSPM PQUJPOT
- Simple handling

COOL-FIT 4.0 transition ttings, ange joints

5SBOTJUJPO ÌUUJOHT BOE ÍBOHF DP MF DPOOFD
UJPOT UP EJËFSFOU TZTUFNT JO FJU MBTUJD TVDI BT
UIF (FPSH 'JTDIFS TZTUFNT J'*5 PS PNQP
OFOUT BSF TVQQMJFE JODMVEJOH 1 BMG TIFMMT XJUI
B QSPUFDUJWF 1& KBDLFU 5IF TFBM FFO UIF TIFMMT
BSF WBQPS UJHIU CZ UIFJS EFTJHO UBQF PS TFBMBOU
is required.



	Size	Material	Thread type/ connector/bolt circle
"EBQUPS ÌUUJOH UE P NF UEBM 1& r TUBJOMFT TB MT FU FI SFBE 3 /15 ~o r o			GFNBMF UISFBE 3Q /15 loose nut (G)
"EBQUPS 'JUUJOH UE P J'*5 4BOJQFY{.5		Stainless steel / #SBTT	J'*5 4BOJQFY .5
6OJPOT	E r E E r E	1& r 1& 1& r "#4	Welding spigots cementing sockets
'MBOHF "EBQUPS ÍE BO HE E KP 1& OUT			4VJUBCMF GPS #PMU DJSDMF 1/

COOL-FIT 4.0 ex hoses

5IF ÍFYJCMF IPTFT JO &1%. QFSNJU P EFWJDFT
TVDI BT DIJMMFST BOE GBO DPJMT IJT UIF ÍFY
IPTF BSF DPNQFOTBUJOH FYQBOTJP O XJUIJO UIF
TZTUFN 5IF UFBS SFTJTUBOU QSPU DE /#3
insulation (O‹${Ç{ {8 N, FOTVSF UIF U
UIE PPMNJFOHJVSN NBJVOTIFSBDUPJOF
WJUZ PQUJPOT NFBO UIBU TZTUFN TVSFE
({UISFBE NBMF UISFBE MPPTF OVU JODMVEJOH HBTLFU

COOL-FIT 4.0 Installation ttings type 313

*OTUBMMBUJPO ÌUUJOHT BSF VTFE PVT UZQFT PG
sensors to the system. Pressure or temperature sensors
DBO CF DPOOFDUFE VTJOH UIF ~ P BMF
thread.

5IF JOTVMBUJPO JT DPNQSJTFE PG)& GPBN
XJUI FYDFMMFOU JOTVMBUJOH DBQ

3.3.2 COOL-FIT Tools

Electrofusion Machines

&MFDUSPGVTJPO NBDIJOFT BSF SFRVJSFE UP KPJO $00- '*5 DPNQPOFOUT 5IF SBOHF JODMVEFT EFEJDBUFE BOE NVMUJQVS QPTF FMFDUSPGVTJPO NBDIJOFT XIJDI BSF SFMJBCMF BOE FBTZ UP use.

(FPSH 'JTDIFS 1JQJOH 4ZTUFNT SFDPNNFOET .4" 4FSJFT electrofusion machines.

Long Fusion adaptors

-POH 'VTJPO BEBQUPST TFSWF BT B UIF GVTJPO QMVHT PG FMFDUSPGVTJPO NBDIJO TUBOEBSE BEBQUPST UIF MPOHFS BEBQUPS M F JOTVMBUJPO PG UIF $00- '*5 FMFDUSPGVTJPO OH GVTJPO BEBQUFST BSF OFFEFE GPS FMFDUS OHT E È E %

Y-cable kit for COOL-FIT xed point

4BWFT IBMG PG UIF OPSNBM XFMEJ 0- '*5 ÌYFE points.

Assembly aids

5IF $00- '*5 BTTFNCMZ BJET BSF NPVOUJOH PG $00- '*5 'JUUJOH P 5IF BTTFNCMZ BJE TQMBZT UIF QSF TU JQT PG UIF ÌUUJOHT FOBCMJOH UIF FBTZ JOTFS '*5 QJQF

Foam removal tool and peeling tool – manually operated

5IF GPBN SFNPWBM UPPM JT VTFE U FOFE $00- '*5 QJQF GPS FMFDUSPGVTJ PWFT UIF GPBN BOE DVUT PVUFS KBDLFU BO TVSGBDF PG UIF JOOFS QJQF "OZ PYJEF MBZFS VFE XIFO UIF XFMEJOH [POF JT USFBUFE 5IF UPP O UXP WFSTJPOT

- GPS TJ[FT E r E
- GPS TJ[FT E r E
- GPS TJ[FT E r E

Powered foam removal and peeling tool

5IF QPXFSFE GPBN SFNPWBM UPPM QSFQBSF TIPSUFOFE $00- '*5 QJQF GPS FM F UP UIF DPNQBUJCJMJUZ UP DPNNPOMZ VTF JU TFSWFT B DPNGPSUBCMF BOE QPXFSTBWJOH F NBOVBMMZ operated tool.

5IF UPPM JT BWBJMBCMF BT B LJU

Clamping tool

5IF GVTJPO QSPDFTT HJWFT SJTF UP GPSDFT UIBU DBO QVMM UIF QJQF PVU PG UIF DPVQMFS 5IFSFGPSF JU JT SFDPNNFOEFE UIBU UIF BTTFNCMZ TIPVME CF ÌUUFE XJUI $00- '*5 JOTUBMMBUJPO DMBNQT 5IJT QSFWFOUT NPWFNFOU EVSJOH UIF XFMEJOH BOE DPPM EPXO QSPDFTT
5IF DFOUSBM IJOHF BMMPXT UIF VTF PG UIF DMBNQT PO FMCPXT BOE SFEVDFST %FQFOEJOH PO UIF MFOHUI PG UIF QJQF {PS{ {PG UIF HMBTT SFJOGPSDFE QMBTUJD IPMEFST DBO CF VTFE 5IF MJOLBHF JT NBEF PG HBMWBOJ[FE TUFFM 5FOTJPO CBOET BSF JODMVEFE BOE B 5 BEBQUFS JT PQUJPOBM BWBJMBCMF

3.4 Dimensioning and Design

3.4.1 General information about the dimensioning and installation of plastic piping

1MBTUJDT IBWF EJËFSFOU QIZTJDBM DIBSBDUFSJTUJDT UP NFUBMT 8IFO EFTJHO UIFSNPQMBTUJD QJQJOH TZTUFNT UIJT OFFET UP CF UBLFO JOUP BDDPVOU "MU $00- '*5{ BSF WFSZ SPCVTU TZTUFNT DBSF TIPVME CF UBLFO UP BWPJE EBNBH and transportation.

'PS PWFS ZFBST (FPSH 'JTDIFS 1JQJOH 4ZTUFNT IBT EFWFMPQFE BOE TPME B QJQJOH TZTUFNT XIJDI BSF TVCKFDUFE UP WFSZ SJHPSPVT EFNBOET TVDI BT PQ QSPQFSUJFT JO DPPMJOH BQQMJDBUJPOT &YQFSJFODF IBT TIPXO UIBU QMBTUJD BOE SFMJBCMF BMUFSOBUJWF UP NFUBM XIFO EFTJHOFST BOE JOTUBMMFST UBLF mendations in the technical documentation. In the professional production of plastic piping TZTUFNT GPS FYBNQMF QJQJOH TZTUFNT NVTU CF BCMF UP NPWF UP BDDPNNPE MFOHUI DBVTFE CZ UFNQFSBUVSF BOE QSFTTVSF DIBOHFT 5P BMMPX GPS UIFTF the use of pipe holders that permit this movement is vital.

5IF GPMMPXJOH UFDIOJDBM JOGPSNBUJPO DPOUBJOT UIF CBTJD JOGPSNBUJPO O FDPOPNJDBM BOE USPVCMF GSFF JOTUBMMBUJPO)PXFWFS UIJT DIBQUFS EPFT EFUBJMT 'PS NPSF JOGPSNBUJPO PS JG ZPV IBWF TQFDJÌD RVFTUJPOT QMFBTF (FPSH{'JTDIFS 1JQJOH 4ZTUFNT SFQSFTFOUBUJWF "EEJUJPOBM JOGPSNBUJPO JT PÎDJBM (FPSH 'JTDIFS 1JQJOH 4ZTUFNT XFCTJUF

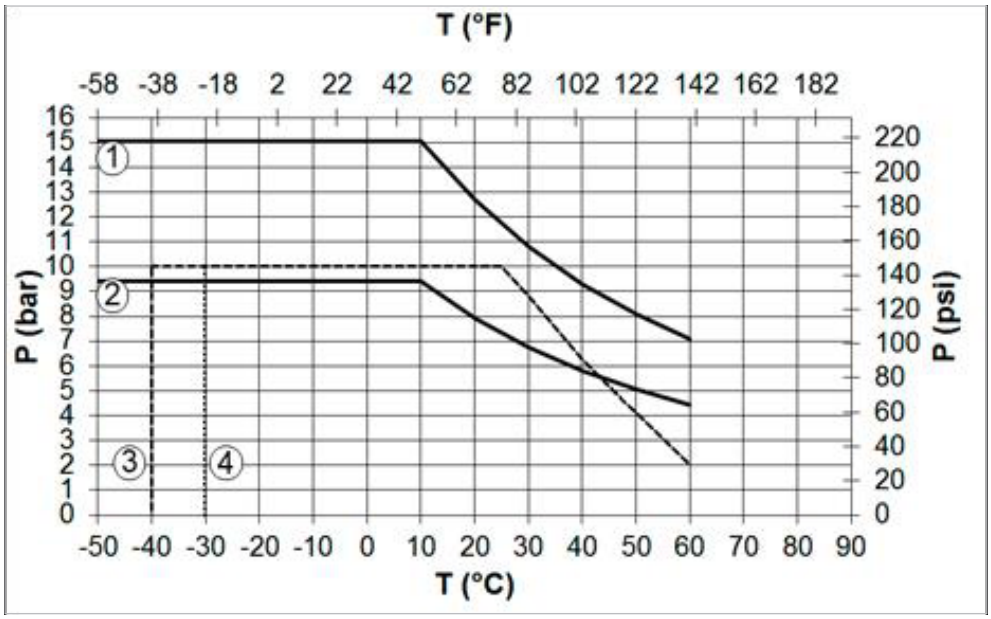
3.4.2 COOL-FIT 4.0 pressure-temperature diagram

5IF QSFTTVSF SFTJTUBODF GPS UIFSNPQMBTUJD QJQF GPS XBUFS JT BMXBZT TQF
IJHIFS UFNQFSBUVSFT BMMPXBODF NVTU CF NBEF GPS B MPXFS NBYJNVN PQFSBU

5IF HSBQI TIPXT UIF NBYJNVN QFSNJTTJCMF QSFTTVSF GPS $00- '*5 QJQF BOE
WBSJPVT UFNQFSBUVSFT VQ UP UIF NBYJNVN QFSNJTTJCMF NFEJB UFNQFSBUVSF
HSBQI JT CBTFE PO BO BNCJFOU UFNQFSBUVSF PG ‹$ " TBGFUZ GBDUPS PG
MJGFTQBO PG ZFBST IBWF CFFO BMMPXFE GPS JO BMM DBMDVMBUJPOT

Pressure/temperature limits for COOL-FIT 4.0 pipe, ttings, valves –
water as secondary refrigerant

-JNJUT GPS $00- '*5 ZFBS WBMVFT BMMPXJOH GPS UIF TBGFUZ GBDUPS
secondary refrigerant).



1 "MMPXBCMF QSFTTVSF
CBS {QTJ
5 5FNQFSBUVSF ‹$ ‹'
$ 4BGFUZ GBDUPS

$00- '*5 1JQF BOE
ÌUUJOH E $ E
4%3
$00- '*5 1JQF BOE
ÌUUJOH E $ E
4%3
$00- '*5 #BMM WBMWF
1/
$00- '*5 #VUUFSÍZ WB
1/

In uence of secondary refrigerants with antifreeze additives

"U NFEJB UFNQFSBUVSFT CFMPX ‹$ BOUJGSFF[F NVTU CF VTFE JO UIF XBUFS UI
GSFF[JOH EVSJOH B QMBOU TIVU EPXO

$00- '*5 JT HFOFSBMMZ SFTJTUBOU UP TFDPOEBSZ SFGSJHFSBOUT TVDI BT HM
tions. For some refrigerants a reduction factor is necessary depending on the type and
NJYJOH SBUJP 5IF QFSNJTTJCMF PQFSBUJOH QSFTTVSF JT DPSSFDUFE EPXOXBS
SF UFNQFSBUVSF DVSWF GPS XBUFS

Reduction factors	COOL-FIT 4.0 Pipe and Fitting	COOL-FIT 4.0 Valves
*OPSHBOJD TBMU TPMVUJPOT	F = 1	F = 1
0SHBOJD TBMU TPMVUJPOT	F = 1.2	'
(MZDPM TPMVUJPOT	F = 1.1	'

'PS UIF DBMDVMBUJPO UIF GPMMPXJOH GPSNVMB JT VTFE

$$P_{AF} = \frac{P_w}{AF}$$

P_{AF} 1FSNJTTJCMF QSFTTVSF XJUI SFEVDUJPO GBDUPS
P_W 1FSNJTTJCMF QSFTTVSF GPS XBUFS
"' 3FEVDUJPO GBDUPS

Glycol solutions

$00- '*5 DBO CF VTFE XJUI HMZDPM TPMVUJPOT XJUI DPODFOUSBUJPOT VQ UP
SFTJTUBODF PG $00- '*5 TZTUFNT JT TVJUBCMF GPS UIF GPMMPXJOH BOUJGSF

Brand name	Manufacturer	Type
"OUJGSPHFO /	$MBSJBOU	&UIZMFOFHMZDPM
"OUJGSPHFO -	$MBSJBOU	Propylene glycol
4IPXCSJOF #MVF 44IPXBSJOF TUBOEBSE &$ CSJOF		&UIZMFOFHMZDPM
5ZGPDPS -	5ZGP	Propylene glycol
5ZGPDPS	5ZGP	&UIZMFOFHMZDPM
%08'3045	%08	Propylene glycol
;ZUSFD '$	Frigol	Propylene glycol
;ZUSFD -$	Frigol	Propylene glycol
;ZUSFD .$	Frigol	&UIZMFOFHMZDPM
/FVUSPHFM	$MJNBMJGF %FIPO	&UIZMFOFHMZDPM
'SJPHFM /FP	$MJNBMJGF %FIPO	Propylene glycol
%085)&3. 43	%08	&UIZMFOFHMZDPM

When using other secondary
SFGSJFHFSBOUT DPNQBU
$00- '*5 TIPVME CF DM
XJUI (FPSH 'JTDIFS 1JQJ
Systems.

Example – glycol dissolved in water

'PS XBUFS HMZDPM NJYUVSF Ç UIF SFEVDUJPO GBDUPS GPS UIF QSFTTVSF
EJBHSBN JT GPS $00- '*5 WBMWFT 5IVT BU ‹$ XJUI B NJOJNVN MJG
{ZFBST UIF NBYJNVN BMMPXBCMF XPSLJOH QSFTTVSF JT SFEVDFE BT GPMMF

$$P_{AF} = \frac{10\ \text{bar}}{1.7} = 5.88\ \text{bar}$$

Organic salt solutions

5IFTF NFEJB BSF VTVBMMZ QPUBTTJVN GPSNBUFT PS QPUBTTJVN BDFUBUFT BRV
MPX WJTDPTJUZ BU MPX UFNQFSBUVSFT $00- '*5 DBO CF VTFE XJUI UIF NFEJB
NBOVGBDUVSFS T JOTUSVDUJPOT NVTU CF GPMMPXFE

Brand name	Manufacturer	Type
"OUJGSPHFO ,'	$MBSJBOU	#SJOF
;ZUSFD 4	Frigol	#SJOF
5FNQFS	5FNQFS	#SJOF
)ZDPPM	"EEDPO	#SJOF

[1] Please contact
(FPSH{'JTDIFS 1JQJOH
Systems

For detailed information on resistance and reduction factors, see Planning Fundamentals "Material selection – Chemical resistance".

3.4.3 Polyethylene (PE)

5IF EPNJOBOU NBUFSJBM GPS UIF $00- '*5 TZTUFN JT QPMZFUIZMFOF 1& "T U
XIJDI DPNFT JOUP DPOUBDU XJUI UIF NFEJB JT NBEF PG 1& JUT QSPQFSUJFT
high relevance.

Properties of PE (approximate)

Property	PE 100-value[1]	Unit	Testing standard
%FOTJUZ	0.95	g/cm	&/ *40
:JFME TUSFTT BU ‹ $		/ NN	&/ *40
5FOTJMF NPEVMVT BU ‹ 9$00		/ NN	&/ *40
$IBSQZ OPUDIFE JNQBDU TUSFOHUI LB+UN		‹&$	*40 F"
$IBSQZ OPUDIFE JNQBDU TUSFOHUI LB+UN		&/$	*40 F"
$SZTUBMMJOF NPEVMVT		‹ $	%*/
5IFSNBM DPOEVDUJWJUZ BU ‹ $	8 N ,		&/
8BUFS BCTPSQUJPO BU	0.01 $ to 0.04		&/ *40
$PMPS			3"-
0YZHFO *OEFY -0*			

[1] 5ZQJDBM NFBTVSFE P
NBUFSJBM DIBSBDUFSJ
TIPVME OPU CF VTFE G
calculations.

General information

"MM QPMZNFST NBEF GSPN IZESPDBSCPOT PG UIF GPSNVMB $O) O BSF DPOTUSVD
CPOE FUIZMFOF QSPQZMFOF CVUFOF JTPCVUFOF BSF SFGFSSFE UP DPMMFD
"NPOH UIFN JT QPMZFUIZMFOF 1& *U JT B TFNJ DSZTUBMMJOF UIFSNPQMBTUJD
QSPCBCMZ UIF CFTU LOPXO QMBTUJD 5IF DIFNJDBM GPSNVMB JT $) $) O 1PM
FOWJSPONFOUBMMZ GSJFOEMZ IZESPDBSCPO QSPEVDU 1& MJLF 11 JT B OPO QI
JU JT JOTPMVCMF BOE TDBSDFMZ TXFMMBCMF JO DPOWFOUJPOBM TPMWFOUT 1&
BEIFTJWFMZ CPOEFE UP ÌUUJOHT 8FMEJOH JT UIF BQQSPQSJBUF DPOOFDUJPO N

5IF NPTU XJEFTQSFBE JO QJQJOH TZTUFN DPOTUSVDUJPO JT 1& GPS VTF JO VOE
XBUFS QJQF *O UIJT BSFB QPMZFUIZMFOF IBT CFDPNF UIF EPNJOBOU NBUFSJBM
)PXFWFS UIF BEWBOUBHFT PG UIJT NBUFSJBM NFBO UIBU JU JT BMTP VTFE JO EF
and industrial piping.

Advantages of PE

- -JHIUXFJHIU
- &YDFMMFOUXFMEJOHBCJMJUZ
- (PPEXFBUIFSSFTJTUBODFBOEXFBUIFSTUBCJMJUZ
- $PSSPTJPOSFTJTUBODF
- %VDUJMF GSBDUVSF QSPQFSUJFT
-)JHI JNQBDU TUSFOHUI FWFO BU WFSZ MPX UFNQFSBUVSFT
- 7FSZ HPPE DIFNJDBM SFTJTUBODF
- 8FMEBCMF

Mechanical properties, chemicals, weathering and abrasion resistance

UV and weather resistance

#FDBVTF PG UIF CMBDL QJHNFOUT VTFE QPMZFUIZMFOF VFSZ XFBUIFS SFTJT
FYQPTVSF UP EJSFDU TVOMJHIU XJOE BOE SBJO UIF NBJOJBM DBO CF VTFE XJU

Chemical resistance

1PMZFUIZMFOF FYIJCJUT HPPE SFTJTUBODF UP B XJEF SBOHF PG NFEJB 'PS EFU
QMFBTF TFF UIF EFUBJMFE DIFNJDBM SFTJTUBODF MJTU GSPN (FPSH 'JTDIFS 1JQ
DPOUBDU UIF QFSTPO SFTQPOTJCMF BU (FPSH 'JTDIFS 1JQJOH 4ZTUFNT EJSFDUM

Abrasion resistance

1& IBT FYDFMMFOU SFTJTUBODF UP BCSBTJWF XFBS :PV DBO UIFSFGPSF ÌOE 1& C
in numerous applications for transporting solids and media containing solids. For many
BQQMJDBUJPOT 1& IBT QSPWFO FTQFDJBMMZ BEWBOUBHFPVT XJUI NFUBMT

Thermal and electrical properties

Operating limits

5IF BQQMJDBUJPO MJNJUT PG UIF NBUFSJBM EFQFOE PO CPUI FNCSJUUMFNFOU B
SFT BOE PO UIF NBOOFS BOE NFUIPE PG BQQMJDBUJPO %FUBJMT BSF QSPWJEFE
QSFTTVSF UFNQFSBUVSF

Electrical properties

1PMZFUIZMFOF MJLF NPTU UIFSNPQMBTUJDT JT OPO DPOEVDUJWF 5IJT NFBOT
OPU TVËFS GSPN FMFDUSPMZUJD DPSSPTJPO)PXFWFS UIF OPO DPOEVDUJWF QS
JOUP DPOTJEFSBUJPO BT FMFDUSPTUBUJD DIBSHFT DBO CVJME VQ JO UIF QJQF
FMFDUSJDBM JOTVMBUJPO QSPQFSUJFT˜DNIFUWPMTVSGBDFJTUBODF JT Y
resistance 10 ˜ 5IJT NVTU CF UBLFO JOUP BDDPVOU JO BQQMJDBUJPOT XIFSF UIFSF J
or explosion.

3.4.4 Fire behavior and re prevention measures

1PMZFUIZMFOF JT B ÍBNNBCMF QMBTUJD 5IF PYZHFO JOEFY JT 1& ESJQT BOE XJUIPVU TPPU BGUFS UIF ÍBNF JT SFNPWFE 8IFO 1& CVSOT DBSCPO EJPYJEF DI BOE XBUFS BSF QSJNBSJMZ GPSNFE

(')& GPBN GPBN XJMM CVSO JG FYQPTFE UP ÍBNFT 5IF DPNCVTUJCJMJUZ DIBSBD JUT DIFNJDBM DPNQPTJUJPO 6OMJLF FYQBOEFE QPMZTUZSFOF FQT (')& EPFT CFUXFFO ‹$ BOE ‹$ BOE DIBST 5IF DIBSSJOH NBZ IFMQ QSPUFDU BEKBDFOU

Fire load

d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
Fire load $00- '*5 Pipe (kWh/m)	15.1							110.4	

d/D (mm)	250/355	280/400	315/450	355/500	400/560	450/360
Fire load $00- '*5 Pipe (kWh/m)						

Fire prevention classes EN13501-1 and British building codes

	COOL-FIT 4.0	COOL-FIT 4.0/mineral wool[2]
&/	&	" -
7,'	3' DS	3'
#4 [1]	/BUJPOBM $MBTT	/BUJPOBM $MBTT

[1] 5FTU NFUIPE BDDPSEJ #4 BOE #4 5ZQF 3PDLXPPM 3' GPS E E NN

Fire collars

*O PSEFS UP DBSSZ ÍBNNBCMF QJQF UISPVHI ÌSF QSPUFDUJPO CVMLIFBET XJUIPVU DPNQSPNJTJOH JUT TBGFUZ GVODUJPO ÌSF QSPUFDUJPO TMFFWFT NVTU CF VTFE JO BDDPSEBODF XJUI MPDBM requirements and legislation.

'PMMPXJOH 'JSF DPMMBS TPMVUJPOT IBWF BO BQQSPWBM BDDPSEJOH UP UIF &VSPQFBO UFDIOJDBM "QQSPWBM &5" GPS $00- '*5

Fire collar	Manufacturer	Approval	Dimensions
30,6 ‰ "8. **[3]	3PMG ,VIO (&6)	E	E
#*4 1BDJGZSVE [4]	Walraven	&5"	E	E
"8. **			
$1	)JMUJ	&5"	XJM MMPX

System description

5IF BCPWF MJTUFE DPMMBST DPOTJTU PG B NFUBM FODMPTVSF MJOFE XJUI NVMU JOUVNFTDFOU NBUFSJBM *O UIF FWFOU PG ÌSF UIF NBUFSJBM FYQBOET XJUI IJH UIF PQFOJOH IFSNFUJDBMMZ BHBJOTU ÍBNFT BOE TNPLF 'PS XBMM JOTUBMMBUJP FBDI TJEF PG UIF XBMM GPS DFJMJOH JOTUBMMBUJPOT POF DPMMBS BU UIF VOE provided.

Applications

- Sealing of plastic pipe up to max. 400 mm outside
  EJBNFUFS JO TPMJE XBMMT ESZXBMM QBSUJUJPOT BOE TPMJE ceilings
- 4VTUBJOBCMF QSPUFDUJPO JO DBTF PG GJSF JO HJQTVN QMBTUFSCPBSE plastic multilayer pipe
- 4VJUBCMF GPS JOTVMBUFE BOE VOJOTVMBUFE QMBTUJD QJQF BOE TPVOE JTPMBUFE XBTUFXBUFS QJQF

Minimal distances

Opening size	20 x 20 cm	40 x 40 cm	> 40 x 40 cm
against other pipe penetration systems	10 cm	10 cm	D N
against other openings	10 cm	D N	D N

Solutions for emergency corridors

8JUIJO FNFSHFODZ DPSSJEPST UIF DPNCVT UJCMF NBUFSJBMT JT BMMPXFE 5IF PPM PËFST XJUI 3PDLXPPM B QSPUFDUJPO T JOFSBM XPPM XIJDI BMMPXT UIF VTF PG OP MF QJQF XJUIJO FNFSHFODZ BSFBT 5IJT TPM FE PO QJQF PVUFS EJBNFUFST PG VQ UP NN

'PS EFUBJMFE JOGPSNBUJPO BCPVU XXX SPDLXPPM EF

3.4.5 Hydraulic design

Determination of pipe diameter based on ow rate

"T B ÌSTU BQQSPYJNBUJPO UIF SFRVJSFE QJQF DSPTT TFDUJPO GPS B DFSUBJO DBMDVMBUFE VTJOH UIF GPMMPXJOH GPSNVMB

$d_i = 18.8 \sqrt{\frac{Q_1}{v}}$ oder $d_i = 35.7 \sqrt{\frac{Q_2}{v}}$

W ÍPX WFMMPDJUZ N T
d_i Pipe internal diameter (mm)
Q_1 'MPX SBUF N
2 'MPX SBUF M T
Q_2 $POWFSTJPO GBDUPS GPS VOJUT 2
v $POWFSTJPO GBDUPS GPS VOJUT 2

Example calculation of an internal diameter d_i

$00- '*5 QJQF 4%3
'MPX SBUF 2 55 l/s
6TVBM ÍPX WFMMPDJUZ W 1.5 m/s

$d_i = 35.7 \sqrt{\frac{55}{1.5}} = 216.2$ mm

" QJQF XJUI E % JT VTFE "GUFS UIF JOUFSOBM EJBNFUFS IBT CFFO EFUFS XBZ UIF BDUVBM ÍPX SBUF JT EFUFSNJOFE XJUI UIF GPMMPXJOH GPSNVMB

$v = 354 \frac{Q_1}{d_i^2} = 1.8 \frac{m}{s}$ oder $v = 1275 \frac{Q_2}{d_i^2} = 1.8 \frac{m}{s}$

W 'MPX WFMMPDJUZ W N T
d_i Pipe internal diameter (mm)
Q_1 'MPX SBUF N
2 'MPX SBUF M T
Q_2 $POWFSTJPO GBDUPS GPS VOJUT 2
v $POWFSTJPO GBDUPS GPS VOJUT 2

Determination of pipe diameter based on cooling power

"T B ÌSTU BQQSPYJNBUJPO UIF SFRVJSFE QJQF DSPTT TFDUJPO GPS B DFSUBJO DBMDVMBUFE VTJOH UIF GPMMPXJOH GPSNVMB

$$di = 18.8 \sqrt{\frac{\left(\frac{Q \cdot 3600}{T \cdot c}\right)}{v}}$$

di Pipe inner diameter (mm)
2. $PPMJOH DBQBDJUZ JO L8
—5 5FNQFSBUVSF EJËFSFODF TVQQMZ SFUVSO ,
D 4QFDJÌD IFBU DBQBDJUZ L8 T LH ,
U %FOTJUZ PG UIF)NFEJVN LH N
W 'MPX WFMPDJUZ N T

Example for calculating the inner diameter d_i based on cooling capacity with water medium water

$PPMJOH D.BQBDJUZ 2 L8
4QFDJÌD IFBU DBQBDJUZ ‹$ D+ LH ,
8BUFS EFOTJUUZ ‹$ LH N
5FNQFSBUVSF EJËFSFODF —5 ,
'MPX WFMPDJUZ W 1.5 m/s

$$di = 18.8 \sqrt{\frac{\left(\frac{2000 \cdot 3600}{10 \cdot 4.187 \cdot 998.2}\right)}{1.5}} = 18.8 \sqrt{\frac{172.3}{1.5}} = 201.5 \text{ mm}$$

5IF ÍPX SBUF TIPVME CF FTUJNBUFE PO UIF CBTJT PG UIF JOUFOEFE QVSQPTF PG GPS UIF ÍPX SBUF UIF GPMMPXJOH TQFDJÌDBUJPOT BQQMZ

Liquids

v = 0.5 – 1.0 m/s for the suction side

W r N T GPS UIF QSFTTVSF TJEF

5IJT NFUIPE PG DBMDVMBUJPO PG QJQF EJBNFUFS EPFT OPU BMMPX GPS IZESBVM DBMDVMBUFE TFQBSBUFMZ 5IF GPMMPXJOH TFDUJPOT TFSWF UIBU QVSQPTF

(m³/h)	(l/min)	(l/s)	(m³/s)
1.0			Y
	1.0		Y
		1.0	1.00 x 10
		1000	1.0

$POWFSTJPO UBCMF XJUI ÍPX SBUF

Correlation of outer diameter - inner diameter

5P EFUFSNJOF UIF PVUFS EJBNFUFS CBTFE PO UIF JOUFSOBM EJBNFUFS BOE 4%3 GPSNVMB DBO CF VTFE

$$d = d_i \frac{SDR}{SDR - 2}$$

Correlation between pipe external and internal diameter

di (mm)			51.4		90	141.0	
d (mm)	40	50		90	110		

3.4.6 Nomogram for easy calculation of diameter and pressure loss

5IF OPNPHSBN CFMPX DBO CF VTFE UP TJNQMJGZ UIF EFUFSNJOBUJPO PG UIF EJ
QSFTTVSF MPTT JO UIF QJQF DBO CF SFBE PË QFS NFUFS PG UIF QJQF MFOHUI

⚠ The pressure loss calculated using the nomogram only applies to ows of substances with density 1000 kg/m³, i.e. water. Further pressure losses from ttings, valves, etc. also need to be considered using the instructions that follow.

Using the nomogram

#BTFE PO B ÍPX WFMPDJUZ PG N T B MJOF JT ESBXO UISPVHI UIF EFTJSFE ÍPX
UP UIF BYJT XIJDI TIPXT BO JOUFSOBM EJBNFUFS EJ Å NN)FSF B DMPTFMZ N
NN GPS 4%3 BOE B TFDPOE MJOF JT ESBXO CBDL UISPVHI UIF EFTJSFE ÍPX S
QSFTTVSF ESPQ BYJT —Q NCBS QFS NFUFS PG QJQF

Nomogram for COOL-FIT 4.0 pipe (PE, SDR11) using the metric system

For detailed information on the determination of diameter and pressure loss, see Planning Fundamentals "Hydraulic calculation and pressure losses of metric industrial piping systems".

3.4.7 Pressure loss

Pressure loss in straight pipe

*O EFUFSNJOJOH QSFTTVSF MPTTFT JO TUSBJHIU QJQF TFDUJPOT B EJTUJODUJP MBNJOBS BOE UVSCVMFOU ÍPXT 5IF 3FZOPMET OVNCFS 3F EFUFSNJOFT UIJT 5I MBNJOBS UP UVSCVMFOU PDDVST BU UIF DSJUJDBM 3FZOPMET OVNCFS 3F

*O QSBDUJDF MBNJOBS ÍPXT PDDVS QBSUJDVMBSMZ GPS UIF NPWFNFOU PG WJTD MVCSJDBUJOH PJMT *O NPTU BQQMJDBUJPOT UIVT JODMVEJOH ÍPXT PG BRVFPV UVSCVMFOU ÍPX XJUI B TVCTUBOUJBMMZ NPSF VOJGPSN WFMPDJUZ EJTUSJCVUJP TFDUJPO UIBO JO MBNJOBS ÍPX

5IF QSFTTVSF MPTT JO B TUSBJHIU QJQF TFDUJPO JT JOWFSTFMZ QSPQPSUJPOBM JT DBMDVMBUFE BT GPMMPXT

$$p_R = \frac{L}{d_i} \cdot \frac{}{2 \cdot 10^2} \cdot v^2$$

—3Q 1SFTTVSF MPTT JO UIF TUSBJHIU QJQF SVO CBS
O Pipe friction factor
- -FOHUI PG UIF TUSBJHIU QJQF TFDUJPO N
d_i Inner diameter of the pipe (mm)
U %FOTJUZ PG UIF ÍPX (1 kg/m³ = 0.06 lb/ft³)
GPS XBUFS ‹$ LH N
W 'MPX WFMPDJUZ W N T

In practice, when making a rough calculation (i. e. smooth plastic pipe and turbulent ow) it is enough to use the value O= 0.02 to represent the hydraulic pressure loss.

Pressure losses in ttings

Coe cient of resistance

5IF QSFTTVSF MPTTFT EFQFOE VQPO UIF UZQF PG ÌUUJOH BT XFMM BT PO UIF ÍPX TP DBMMFE DPFÎDJFOU (value) is used for calculation.

Fitting type	Coe cient of resistance]
&MCPX ‹	
&MCPX ‹	
5 [1]	
3FEVDFS	0.5
3FEVDFS	1.0
$PVQMFS 'MBOHF KPJOU	5SBOTJUJPO E
Fittings	E E
	E E E

[1] 'PS B NPSF EFUBJMFE EJËFSFOUJBUF CFUXFF coalescence and separation values for] up to a NBYJNVN PG DBO CF found in the respective MJUFSBUVSF 6TVBMMZ PG B 5 JO UIF PWFSBM QSFTTVSF MPTT JT WF therefore in most cases]{ { DBO CF VTFE

Calculation of the pressure loss

5P DBMDVMBUF UIF UPUBM QSFTTVSF MPTT JO BMM ÌUUJOHT JO B QJQJOH TZTUFN JOEJWJEVBM MPTTFT JT WFBMVF TVN PG QSFTTVSF MPTT DBO UIFO CF DBMDVMBUFE BDDPSEJOH UP UIF GPMMPXJOH GPSNVMB

$$p_{Fi} = \frac{v^2}{2 \cdot 10^5}$$

—Fi Q 1SFTTVSF MPTT PG BMM ÌUUJOHT CBS
6] Sum of all individual losses
W 'MPX WFMPDJUZ W N T
U %FOTJUZ PG UIF NFEJVN (1 kg/dm³ = 1000 kg/m³) N

Pressure losses in valves

5IFv{LGBDUPS JT B DPOWFOJFOU NFBOT PG DBMDVMBUJOH UIF IZESBVMJD ÍPX SBU
GPS BMM JOUFSOBM SFTJTUBODFT BOE GPS QSBDUJDBM QVSQPTFT JT SFHBSEFE
UIF ÍPX SBUF PG XBUFS JO MJUFST QFS NJOVUF XJUI B QSFTTVSF ESPQ PG CBS
technical data of the Georg Fischer Piping Systems valves contains the kW BMVFT BT XFMM BT
QSFTTVSF MPTT DIBSUT 5IF MBUUFS NBLF JU QPTTJCMF UP SFBE PË UIF QSFTTV
QSFTTVSF MPTT DBO BMTP

$$p_{Ar} = \left(\frac{Q}{k_v}\right)^2 \cdot \frac{\rho}{1000}$$

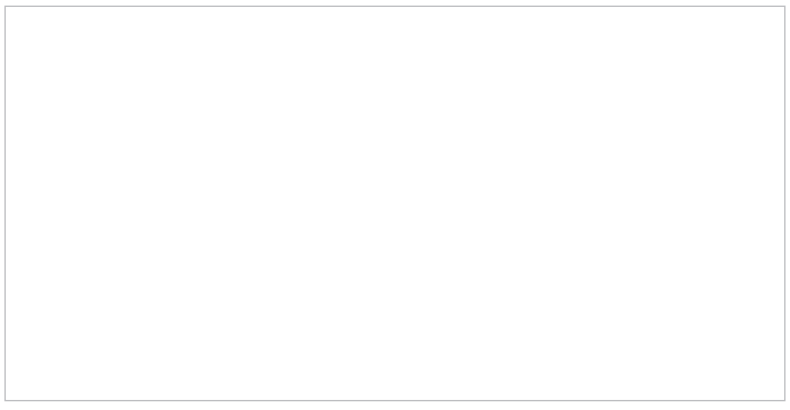
—"Q 1SFTTVSF MPTT GPS UIF WBMWF CBS
2 'MPX SBUF N
U %FOTJUZ PG UIF EPXOTUSFBN (1 kg/dm³ = 1000 kg/m³) LH N
kv 7BMWF DIBSBDUFSJTUJD WBMVF N

kv 100-Werte

DN (mm)	Zoll (inch)	d (mm)	kv 100 (l/min)	Cv 100 (gal/min)	kv 100 (m³/h)
1	1			49.0	
1	1 ¼	40	1000		
40[1]	~	50			
50[1]					
1	~		5000		
1		90		490.0	
100	4	110		455	
150					1000

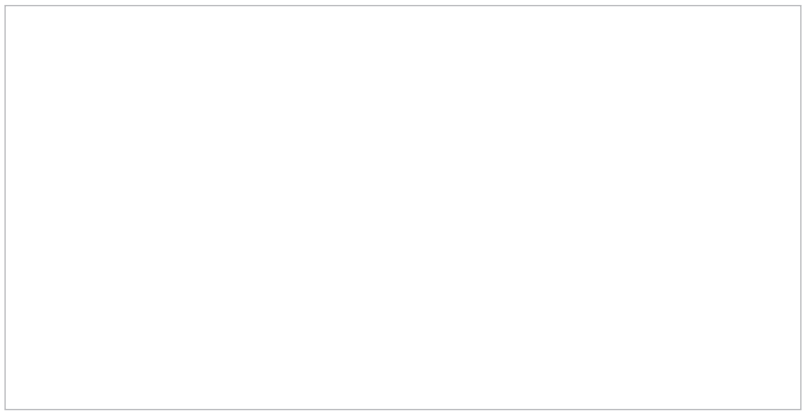
[1] $00- '*5 #BMM WBMW
$00- '*5 #VUUFSÍZ
valve

Flow characteristic Ball valve



9 0QFOJOH BOHMF
: L $W WBMVF

Flow characteristic butter y valve



9 0QFOJOH BOHMF
: ⊥ $W WBMVF

Pressure di erence between the static pressure

*G UIF QJQJOH TZTUFN JT JOTUBMMFE WFSUJDBMMZ UIFO B HFPEFUJD QSFTTVSF DBMDVMBUFE GPS JU 5IJT QSFTTVSF EJËFSFODF JT DBMDVMBUFE BT GPMMPXT

$$p_{geod} = H_{geod} \cdot 10^{-4}$$

—geod (FPEFUJD QSFTTVSF EJËFSFODF CBS
—) %JËFSFODF JO FMFWBUJPO PG UIF QJQJOH TZTUFN N
U %FOTJUZ PG UIF)(1 g/cm³ = 1000 kg/m³)

⚠ At closed systems, the geodetic pressure di erence does not need to be considered

Sum of pressure losses

5IF TVN PG BMM QSFTTVSF ESPQT GPS B QJQJOH TZTUFN JT DBMDVMBUFE BT GPM

$$p = p_R + p_{Fi} + p_{Ar} + p_{geo}$$

√ Example for pressure drop calculations

5IF GPMMPXJOH FYBNQMF JMMVTUSBUFT UIF DBMDVMBUJPO QSPDFTT GPS EFU loss of a piping system.

		Number of Fittings
$00- '*5 QJQF	d40 mm	Y ‹ BOHMF
4%3 ÍPX SBUF	1.5 l/s	Y ‹ BOHMF
Medium	Water	Y 5 QJFDF
%FOTJUZ PG UIF NFEJVHNDNŽ		Y TDSFXT
-FOHUI TUSBJHIU QJQF	15 m	Y ÍBOHF DPOOFDUJPOT
)FJHIU EJËFSFODF	N	Y CBMM WBMWF
		opened

5IF XBMM UIJDLOFTT PG UIF QJQJOH TZTUFN DBO CF DBMDVMBUFE BT GPMMPX

$$e = \frac{d}{SDR} = \frac{40\ mm}{11} = 3.6\ mm$$

5IF JOOFS EJBNFUFS PG UIF QJQJOH TZTUFN JT BT GPMMPXT

$$d_i = d - 2\ e = d - \frac{2\ d}{SDR} = 32.8\ mm$$

8JUI UIF EFTJSFE ÍPX SBUF PG M T UIF ÍPX WFMPDJUZ JT BT GPMMPXT

$$v = 1275\ \frac{Q_2}{d_i^2} = 1275\ \frac{1.5}{32.8^2}\ \frac{m}{sec} = 1.78\ \frac{m}{sec}$$

Pressure loss	Formula
Pressure loss for straight pipe sections	$p_R = 0.02 \frac{15}{32.8} \frac{1000}{2 \ 10^2} 1.78^2 = 0.14$ bar
1SFTTVSF MPTT GPS ÌUUJOH connections	(12 1.2) + (4 0.3) + (3 1.3) + (5 0.7) =
	$p_{Fi} = 23 \frac{1.78^2}{2 \ 10^5} 1000 = 0.36$ bar
1SFTTVSF MPTT GPS UIF WBMWF PQFOFE 8JUI UIF ÍPX SBUF TUJDT EJBHSBN GPS CBMM WBMWFT UZQF{ GSPN BO { PQFOJOH angle a percentile kv WBMVF PG { DBO CF SFBE PVU UIBU NFBOT { of the kv{ WBMVF {)({ {N ÍPX SBUF {M/h)T{ { {N	$p_A = \left(\frac{5.4}{0.5 \ 60}\right)^2 \frac{1000}{1000} = 0.03$ bar
1SFTTVSF MPTT PG IFJHIU EJËFSFODF	$p_{geod} = 2.0 \ 1000 \ 10^{-4} = 0.2$ bar
Whole pressure loss of the piping	p = 0.14 bar + 0.36 bar + 0.03 bar + 0.2 bar = 0.73 ba

3.4.8 Dimension comparison COOL-FIT 4.0 metal

COOL-FIT 4.0			Stainless steel	
d (mm)	d_i (mm)	DN	inches	da (mm)
			1	
40			1 ¼	
50		40	~	
	51.4	50		
			~	
90				
110	90	90	4	
	141.0	150		
			10	
			10	
			14	
400		400		
450		450		

E /PNJOBM FYUFSOBM E
PG 1& QJQF
d_i /PNJOBM JOUFSOBM E
of pipe

3.4.9 Z-dimension method

Overview

5IF QSFTTVSF PG DPNQFUJUJPO BOE IJHI XBHFT NBLFT JU FTTFOUJBM UP JOTUBM
FÎDJFOUMZ 5IF (FPSH 'JTDIFS 1JQJOH 4ZTUFNT NFUIPE PG BTTFNCMZ JT IJHIMZ T
*U SFQMBDFT UIF UFEJPVT BOE UJNF DPOTVNJOH DVUUJOH UP TJ[F PG POF QJQF
QSFDJTF XBZ PG QSFQBSJOH XIPMF HSPVQT PG QJQF BDDPSEJOH UP QMBOT PS K

5IF SFTQFDUJWF QJQF HSPVQ XJUI UIF DPSSFTQPOEJOH EFTJHO EJNFOTJPOT BOE
FOUFSFE JO UIF JTPNFUSJD QBQFS PG (FPSH 'JTDIFS 1JQJOH 4ZTUFNT TFF .FBTV
.

1MFBTF BEIFSF UP UIF GPMMPXJOH HVJEFMJOFT GPS ESBXJOH

Pipe running perpendicular to one another	Pipe running diagonally

)PSJ[POUBMMZ
left and right

7FSUJDBM

)PSJ[POUBMMZ
front and rear

5IF [EJNFOTJPOT PG UIF ÌUUJOHT BSF OFFEFE GPS EFUFSNJOJOH UIF BDUVBM DV
QJQF 5IF UBCMFT JO PVS QSPEVDU SBOHFT BOE JO UIF POMJOF DBUBMPHVFT DP
EBUB GPS UIF ÌUUJOHT 5IF MFOHUI PG QJQF UP CF DVU JT HJWFO BT JO UIF GPM
EJTUBODF CFUXFFO UIF DFOUFS PG BEKPJOJOH ÌUUJOHT MFTT UIF TVN PG UIF [E
ÌUUJOHT

Procedure

Electrofusion

Formula for determining the required pipe length

$L_0 = M – Z_{F1} – Z_{F2}$

-0 1JQF MFOHUI UP CF DVU
. $FOUFS UP DFOUFS EJTUBODF CFUXFFO ÌUUJOHT
[F1 [NFBTVSFNFOU GPS ÌUUJOH
[' [NFBTVSFNFOU GPS ÌUUJOH

Example

%JNFOTJPO E %
$FOUFS UP DFOUFS EJTU 1000 mm .
[NFBTVSFNFOU GPS ‹ FMCNPNX [
[NFBTVSFNFOU GPS ‹ FMCNPNX [
. NN0 -

L_0 = 1000 mm – 20 mm – 20 mm = 960 mm

Measuring Sheet

3.4.10 Length changes and exible sections

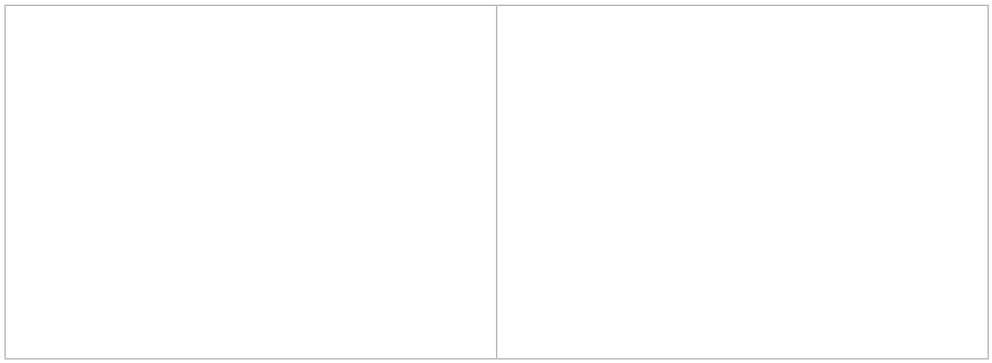
Overview

Length changes L and expansion bend L_B – General

5IFSNPQMBTUJDT BSF TVCKFDU UP HSFBUFS UIFSNBM FYQBOTJPO BOE DPOUSBDU
NBUFSJBMT 1JQF JOTUBMMFE BCPWF HSPVOE BHBJOTU XBMMT PS JO EVDUT SF
CF UBLFO VQ JO PSEFS UP QSFWFOU BOZ TVQFSJNQPTFE FYUSB TUSBJO PO UIF Q
especially to pipe exposed to operating temperature variations.

5P BDDPNNPEBUF B DIBOHF JO MFOHUI UIF GPMMPXJOH PQUJPOT DBO CF DPOTJE
" 'MFYJCMF TFDUJPOT
'MFYJCMF IPTFT
$ $PNQFOTBUPST

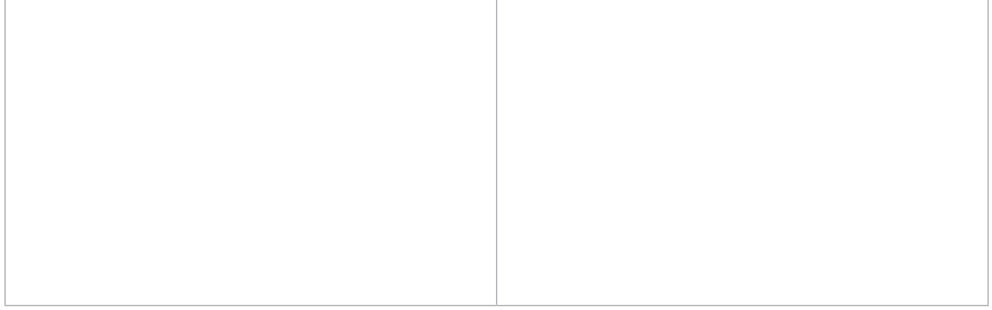
'MFYJCMF TFDUJPOT BSF UIF NPTU DPNNPO UIF TJNQMFTU BOE UIF NPTU FDPOPN
DBMDVMBUJPOT GPS BOE UIF QPTJUJPOJOH PG ÍFYJCMF TFDUJPOT BSF UIFSFGPS



—- $IBOHF JO MFOHUI
-# 'MFYJCMF TFDUJPO

Fundamentals

5IF MPX FMBTUJDJUZ PG UIFSNPQMBTUJDT BMMPXT DIBOHFT JO MFOHUI UP CF UB
TFDUJPOT XIFSF QJQF TVQQPSUT BSF QPTJUJPOFE TP UIBU UIFZ DBO UBLF BEWE
ÍFYJCJMJUZ PG UIF NBUFSJBM 5IF MFOHUI PG TVDI TFDUJPOT JT EFUFSNJOFE CZ
QJQJOH TZTUFN BOE UIF FYUFOU PG UIF UIFSNBM FYQBOTJPO UP CF DPNQFOTBUI



'MFYJCMF TFDUJPOT BSJTF OBUVSBMMZ BU BOZ CSBODIJOH PS DIBOHF JO EJSFDU
5IF NPWFNFOU PG UIF ÍFYJCMF TFDUJPO BT B SFTVMU PG B DIBOHF —- JO UIF MFOHUI
SFTUSBJOFE CZ ÌYFE QJQF CSBDLFUT XBMM QSPUSVTJPOT HJSEFST PS UIF MJLF

Calculation of length changes

5P EFUFSNJOF change in length due to temperature —- NN PG $00- '*5 QJQF UIF GPMMPXJOH UFNQFSBUVSFT NVTU CF LOPXO

Installation temperature

- .JOJNVN ÍPX UFNQFSBUVSF
- .BYJNVN ÍPX UFNQFSBUVSF
- .JOJNVN BNCJFOU UFNQFSBUVSF
- .BYJNVN BNCJFOU UFNQFSBUVSF

F Fixpoint

-- FOHUI PG QJQF TFDU

The following tables show changes in length at di erent media temperatures for certain conditions. To determine the change in length for other conditions, the COOLING Tool-Box can be used. Contact your local Georg Fischer Piping Systems representative or visit www.gfps.com

Example of use:

*OTUBMMBUJPO UFNQFSBUVSF $

.JO BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU

.BY BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU

.JO ÍPX UFNQFSBUVSF 4FF UBCMF

.BY ÍPX UFNQFSBUVSF ‹$

-- BJE QJQF MFOHUI

Length change L (mm) at 20° C ow temperature					Length change L (mm) at 15° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E NN					E NN				
d40 mm					d40 mm				
d50 mm					d50 mm				
E NN					E NN				
E NN					E NN				
d90 mm					d90 mm				
d110 mm					d110 mm				
E NN					E NN				
E NN					E NN				

-- BJE QJQF MFOHUI

Length change L (mm) at 10° C ow temperature					Length change L (mm) at 5° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E NN					E NN				
d40 mm					d40 mm				
d50 mm					d50 mm				
E NN					E NN				
E NN					E NN	40			
d90 mm					d90 mm	44			
d110 mm					d110 mm	49			
E NN					E NN				
E NN					E NN				

Length change L (mm) at 0° C ow temperature					Length change L (mm) at -5° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E N N					E N N				
d40 mm					d40 mm				
d50 mm					d50 mm				
E N N					E N N				
E N N					E N N				
d90 mm					d90 mm				
d110 mm					d110 mm				
E N N					E N N				
E N N					E N N				

- -BJE QJQF MFOHUI

Length change L (mm) at -10° C ow temperature					Length change L (mm) at -15° C ow temperature				
L (m)	25	50	100	150	L (m)	25	50	100	150
E N N					E N N				
d40 mm					d40 mm				
d50 mm					d50 mm				
E N N					E N N				
E N N					E N N				
d90 mm					d90 mm				
d110 mm					d110 mm				
E N N					E N N				
E N N					E N N				

- -BJE QJQF MFOHUI

COOL-FIT 4.0 Flexible sections for COOL-FIT 4.0

Flexible Section L_B

5IF WBMV F TDNPSSPN UIJT UBCMF DBO CF VTFE GPS B HJWFO — - NN BOE UIF SFM TJ[F

Flexible section L_B (cm)													
L (mm)	10	20	30	40	50	60	70	80	90	100	150	200	300
E N N		110				191							
d40 mm			149										
d50 mm			149										
E N N			159									411	
E N N				195									
d90 mm	104												
d110 mm	110		191										
E N N										411			
E N N													

3.4.11 Installation

Recommendations for installation

-FOHUI DIBOHFT JO QJQF TFDUJPOT TIPVME BMXBZT CF BDDPNNPEBUFE UISPVHI U
PG ÌYFE CSBDLFUT 5IF GPMMPXJOH FYBNQMFT TIPX IPX UIF DIBOHFT DBO CF EJT
TFDUJPOT CZ TVJUBCMF QPTJUJPOJOH PG ÌYFE CSBDLFUT

3FDPNNFOEFE JOTUBMMBUJPO	/PU SFDPNNFOEFE JOTUBMMBUJPO

&YQBOTJPO MPPQT DBO CF JOTUBMMFE UP UBLF VQ DIBOHFT JO MFOHUI XIFO ÍFYJCMF TFDUJPOT DBOOPU CF JODMVEFE BU B DIBOHF JO EJSFDUJPO PS CSBODI JO UIF QJQJOH TZTUFN PS JG TVCTUBOUJBM changes in the length of a straight section OFFE UP CF UBLFO VQ *O TVDI B DBTF UIF compensation for changes in length is EJTUSJCVUFE PWFS UXP ÍFYJCMF TFDUJPOT

⚠ Bending stress can lead to leaks in mechanical joints.
Do not use any unions or anged connections close to expansion bends and loops.

Pre-tensioning

*O QBSUJDVMBSMZ EJÎDVMU TJUVBUJPOT XJUI MBSHF DIBOHFT JO POF EJSFDUJPO
QSF UFOTJPOJOH UIF ÍFYJCMF TFDUJPO EVSJOH JOTUBMMBUJPO BOE UIFSFCZ TIF
JMMVTUSBUFE JO UIF OFYU FYBNQMF

Example

1JQF MFOHUI - N
%JBNFUFS E % NN
*OTUBMMBUJPO UFNQFSBUVSF ‹$
.JO BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU
.BY BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU
.JO ÍPX UFNQFSBUVSF ‹$
.BY ÍPX UFNQFSBUVSF ‹$

$IBOHF JO MFOHUI GSPN UIF UBCMF PS $00-*/(5PPM #PY
—- NN

" ÍFYJCMF TFDUJPO UP UBLF VQ B DIBOHF JO MFOHUI PG {—-{ { {NN OFFET U
-#{ NN { { {NN MPOH BDDPSEJOH UP UIF UBCMF

*G UIF ÍFYJCMF TFDUJPO JT QSF UFOTJPOFE UP —- UIF ÍFYJCMF TFDUJPO SFRV
UP{_ NN 5IF DIBOHF JO MFOHUI TUBSUJOH GSPN UIF QPTJUJPO JT UIFO
{—- { { { { {NN

#Z QSF UFOTJPOJOH UIF ÍFYJCMF TFDUJPO NBLFT JU QPTTJCMF UP SFEVDF JUT S
JOTUBMMBUJPOT XIFSF TQBDF JT SFTUSJDUFE 1SF TUSFTTJOH BMTP SFEVDFT UI
TFDUJPO JO TFSWJDF JNQSPWJOH UIF BQQFBSBODF PG UIF QJQJOH TZTUFN

3.4.12 Pipe bracket spacing and support of piping systems

Overview

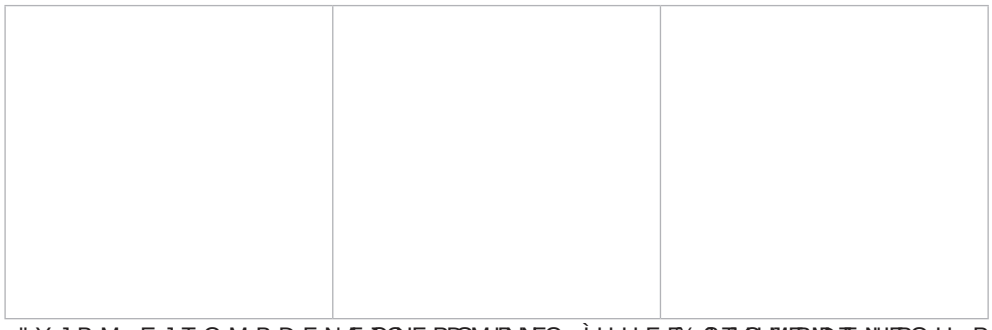
Installation of plastic pipe

$00- '*5 QJQF TIPVME CF JOTUBMMFE VTJOH TVQQPSUT EFTJHOFE GPS VTF XJU
TIPVME UIFO CF JOTUBMMFE UBLJOH DBSF OPU UP EBNBHF PS PWFSTUSFTT UIF Q
$00- '*5 NVTU CF JOTUBMMFE JO PSEFS UP BMMPX TUSFTT GSFF PQFSBUJPO
5IBOLS UP UIF FYDFMMFOU JOTVMBUJOH QSPQFSUJFT PG UIF
$00- '*5 QJQF BOE JUT IBSE JNQBDU SFTJTUBOU PVUFS
KBDLFU TUBOEBSE QJQF DMBNQT XJUI IBSE QMBTUJD JOMBZ NBZ CF
used. Special insulation pipe clamps or cold clamps are not necessary.

Arranging loose brackets

What is a loose bracket?

" MPPTF CSBDLFU JT B QJQF CSBDLFU XIJDI BMMPXT BYJBM NPWFNFOU PG UIF QJ
TUSFTT GSFF DPNQFOTBUJPO PG UFNQFSBUVSF DIBOHFT BOE DPNQFOTBUJPO PG
condition changes.



"YJBM EJTQMBDFNFOU PG UIF QJQF JO UIF QJQF BYJBM EJTQMBDFNFOU PG UIF QJQF JO
pipe in the clamp. in the suspension of the pipe clamp.

5IF JOOFS EJBNFUFS PG UIF CSBDLFU NVTU CF MBSHFS UIBO UIF PVUFS EJBNFUF
GSFF NPWFNFOU PG UIF QJQF 5IF JOOFS FEHFT PG UIF CSBDLFUT TIPVME CF GS
contours to avoid damaging the pipe surface.

"OPUIFS NFUIPE JT UP VTF CSBDLFUT XJUI TQBDFST JO Spacers prevent pinching the
XIJDI BMTP BWPJET DMBNQJOH UIF CSBDLFU PO UIF QJQF pipe

5IF BYJBM NPWFNFOU PG UIF QJQJOH NBZ OPU CF IJOEFSFE CZ
ÌUUJOHS BSSBOHFE OFYU UP UIF QJQF CSBDLFU PS PUIFS EJBNFUFS
changes.

4MJEJOH CSBDLFUT BOE IBOHJOH CSBDLFUT QFSNJU UIF QJQF UP
NPWF JO EJËFSFOU EJSFDUJPOT "UUBDIJOH B TMJEJOH CMPDL UP UIF
CBTF PG UIF QJQF CSBDLFU QFSNJUT GSFF NPWFNFOU PG UIF QJQF
BMPOH B ÍBU TVQQPSUJOH TVSGBDF 4MJEJOH BOE IBOHJOH
CSBDLFUT BSF OFFEFE JO TJUVBUJPOT XIFSF UIF QJQJOH TZTUFN
DIBOHFT EJSFDUJPO BOE GSFF NPWFNFOU PG UIF QJQF NVTU CF
BMMPXFE

Pipe bracket spacing

5IF QJQF CSBDLFU TQBDJOH IBWF CFFO EFUFSNJOFE - 1JQF CSBDLFU TQBDJ
GPS DPOWFZJOH XBUFS PO UIF CBTJT PG B TQFDJÌD
EFÍFDUJPO PG UIF QJQF CFUXFFO UXP DMBNQT
DPOTJEBRDSDFFEQ UBCMF

5IF QJQF CSBDLFU TQBDJOH GPS $00- '*5 QJQF
JT BMXBZT DPOTJTUFOU JOEFQFOEFOU PG QSFTTVSF
and temperature.

Pipe bracket intervals L for COOL-FIT 4.0

d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
- N N		1950	1950						

d/D (mm)	250/355	280/400	315/450	355/500	400/560	450/630
- N N					4100	

5IF QJQF DMBNQ JOUFSWBMT GSPN UIF UBCMF DBO CF JODSFBTFE CZ GPS WFS
WBMVFT HJWFO CZ JO UIJT DBTF

KLIP-IT pipe brackets

5IFTF SPCVTU QMBTUJD QJQF CSBDLFUT DBO CF VTFE OPU POMZ VOEFS SJHPSPV
CVU BMTP XIFSF UIF QJQFXPSL JT TVCKFDU UP BHHSFTTJWF NFEJB PS BUNPTQIFS
CSBDLFUT BOE QJQF DMBNQT GSPN (FPSH 'JTDIFS 1JQJOH 4ZTUFNT BSF TVJUBCM
materials used.

%P OPU VTF ,-*1 *5 QJQF CSBDLFUT BT ÌYFE QPJOUT

⚠ From d90 upwards KLIP-IT pipe clamps must be mounted upright, as in the installation examples below.

Arranging xed points

" ÌYFE QPJOU JT B CSBDLFU XIJDI QSFWFOUT UIF QJQF GSPN NPWJOH JO BOZ EJS
PG B ÌYFE QPJOU JT UP DPOUSPM UFOTJPO DBVTFE CZ UFNQFSBUVSF DIBOHFT BC
certain direction.

⚠ Fixpoint design

5IF QJQF NVTU OPU CF ÌYFE CZ DMBNQJOH JU JO UIF QJQF CSBDLFU 5IJT DBO
UJPO BOE QIZTJDBM EBNBHF UP UIF QJQF EBNBHF UIBU TPNFUJNFT EPFT OPU
very much later.

⚠ Pipe brackets must be robust and mounted rmly to be able to take up the forces arising from changes in length in the piping system. Hanging brackets or KLIP-IT pipe brackets are unsuitable for use as xed points.

COOL-FIT 4.0 Fixpoint

'JYFE QPJOUT GPS $00- '*5 BSF FTUBCMJTIFE XJUI UIF TQFDJBM
$00- '*5 ÌYFE QPJOUT 5IF QSPEVDU DPOTJTUT PG GVTJPO UBQFT
BOE QJQF CSBDLFUT &MFDUSPGVTJPO CBOET BT QFSNBOFOU KPJOUT
USBOTNJU UIF GPSDFT UIBU PDDVS JO UIF QJQF UP UIF ÌYFE QPJOU
5IF TVQQMJFE QJQF CSBDLFUT TFSWF UP CVJME VQ UIF GVTJPO
QSFTTVSF EVSJOH JOTUBMMBUJPO PG UIF GVTJPO CBOET BOE QSPWJEF
TUBCJMJUZ EVSJOH PQFSBUJPO 'PS GVTJPO VTF BO .4" Y
.4"{ Y .4" PS DPNNFSDJBMMZ BWBJMBCMF
7 FMFDUSPGVTJPO VOJU *G ZPV VTF BO .4" FMFDUSPGVTJPO
VOJU CZ (FPSH 'JTDIFS 1JQJOH 4ZTUFNT VTF UIF Z DBCMF LJU
XJUI DPEF{

1MFBTF UBLF OPUF PG UIF NBYJNVN BMMPXFE GPSDFT JO UIF UBCMF CFMPX

Diameter (mm)	90	40/ 110	50/ 110	140	90/	110/	E %	E %	E %
Maximum force F (kN)			5.0	10	10	10	10.0	10.0	10.0

⚠ COOL-FIT 4.0 xed points must be calculated on the basis of the application. Fixed point brackets and cross braces are not included.

Scope of delivery

$MBNQT UP NBJOUBJO
pressure
&MFDUSPGVTJPO CBOE

Y-cable kit for COOL-FIT xed points

5IF $00- '*5 : DBCMFT DBO CF VTFE GPS B GBTUFS JOTUBMMBUJPO PG $00- '*5 ÌY
FMFDUSPGVTJPO UBQFT BMXBZT DPNF JO QBJST : DBCMFT BMMPX GPS B TJNVMU
cutting fusion time in half.

Rigidly xed installations

⚠ Pipe which are axially clamped and rigidly xed must be tested for their resistance to kinking. In most cases, this test results in a reduction of the maximum internal pressure and more tightly spaced supports. The forces acting on the xed points should be considered.

$00- '*5 QJQF BOE ÌUUJOHT BSF TVJUBCMF GPS B SJHJEMZ ÌYFE JOTUBMMBUJP
7BMVGHSPSBEUUPÒMFQJHUXBMUIFTVQQMJJCDLBDLSMJTUFE
JO GPMMPXJOH UBCMFT
Example of use:

*OTUBMMBUJPO UFNQFSBUVSF
.JO BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU
.BY BNCJFOU UFNQFSBUVSF ‹$ DPOTUBOU
.JO ÍPX UFNQFSBUVSF 4FF UBCMF
.BY ÍPX UFNQFSBUVSF ‹$

Fixpoint forces F and maximal pipe bracket spacing L at 15 °C ow temperature									
d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
' L /							4.5		
- N N		1950	1900						
Fixpoint forces F and maximal pipe bracket spacing L at 5 °C ow temperature									
d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
' L /							10.49*		
- N N		1950	1900						
Fixpoint forces F and maximal pipe bracket spacing L at -5 °C ow temperature									
d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
' L /									
- N N		1950	1900						
Fixoint forces F and maximal pipe bracket spacing L at -15 °C ow temperature									
d/D (mm)	32/90	40/110	50/110	63/125	75/140	90/160	110/180	160/250	225/315
' L /									
- N N		1950	1900						

NBY BMMPXFE GPSDF
$00- '*5 ÌYFE QPJOU
exceeded

⚠ Please contact Georg Fischer Piping Systems for rigidly xed installations that contain ball valves and mechanical joints as well as if the max. allowed forced on the xed points are exceeded

3.4.13 Hoses

Installation of elastomer hoses

5P FOTVSF UIF VTBCJMJUZ PG IPTF MJOFT BOE UP BWPJE TIPSUFOJOH UIFJS TFSV
BEEJUJPOBM TUSFTTFT QMFBTF OPUF UIF GPMMPXJOH

-)PTF MJOFT NVTU CF JOTUBMMFE TP UIBU UIFJS OBUVSBM QPTJUJPO BOE NPWF
- %VSJOH PQFSBUJPO IPTF MPJOFT NVTU JO QSJODJQMF OPU CF TVCKFDUFE UP UFOTJPO UPSTJPO BOE DPNQSFTTJPO VOMFTT UIFZ IBWF CFFO TQFDJBMMZ NB
- 5IF NJOJNVN SBEJVT PG DVSWBUVSF TQFDJÌFE CZ UIF NBOVGBDUVSFS NVTU CF
- #VDLMJOH JT UP CF BWPJEFE QBSUJDVMBSMZ CZ UIF KPJOU
- #FGPSF QVUUJOH UIF TZTUFN JOUP PQFSBUJPO DIFDL UIBU UIF NFDIBOJDBM DI properly tightened.
- *G UIFSF JT WJTJCMF FYUFSOBM EBNBHF UIF IPTF MJOF NVTU OPU CF QVU JOU
- 5IF DPOOFDUJPO ÌUUJOHT TIPVME CF ÌSNMZ TDSFXFE UPHFUIFS

Proper use of the hose line

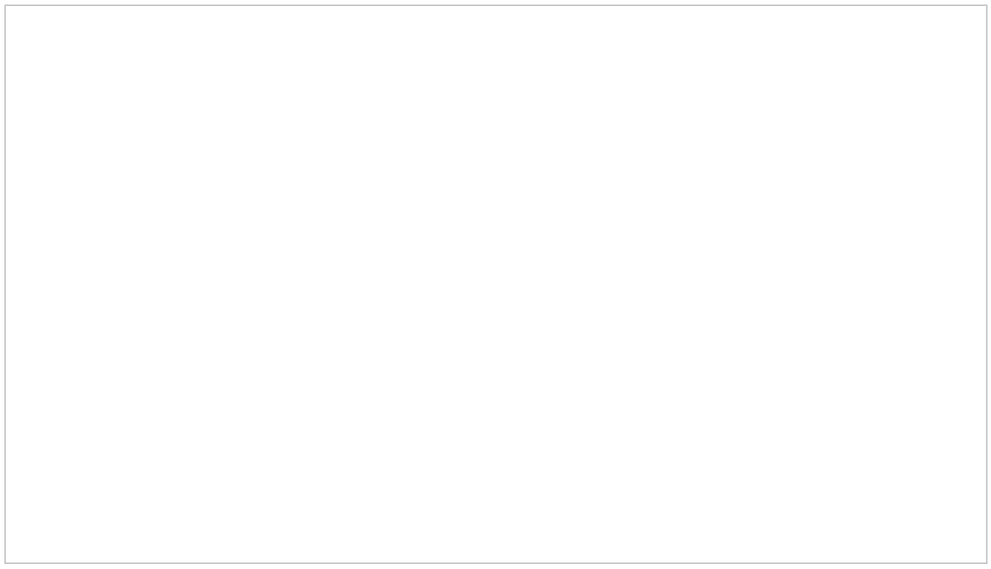
- 1SFTTVSF EP OPU FYDFFE NBYJNVN QFSNJUUFE XPSLJOH QSFTTVSF BOE PQFSE
- 5FNQFSBUVSF EP OPU FYDFFE NBYJNVN QFSNJUUFE UFNQFSBUVSF GPS UIF NFE

Storage

- 4UPSF JO B DPPM ESZ BOE EVTU GSFF BSFB BWPJE EJSFDU TVOMJHIU PS VMU QSPUFDU GSPN OFBSCZ IFBU TPVSDFT 1JQJOH NVTU OPU DPNF JOUP DPOUBDU can cause damage.
-)PTFT BOE IPTF BTTFNCMJFT NVTU CF TUPSFE IPSJ[POUBMMZ GSFF PG UFOTJPO

3.4.14 Underground installation

$00- '*5 DBO CF VTFE VOEFSHSPVOE 5IF DPSSFTQPOEJOH OBUJPOBM JOTUBMM
BQQMZ UP CVJMEJOH UIF QJQF USFODIFT BOE JOTUBMMJOH UIF QJQF *O HFOFSB
MFTT UIBO NFUFS EFFQ EFFQFS JG UIFSF JT B SJTL PG GSPTU 5IF TBOE CFE N
XBZ UIBU UIF QJQF JT FWFOMZ TVQQPSUFE 5IF QJQF NVTU CF MBJE JO B TBOE C
BHBJOTU TIBSQ TUPOFT BOE EFCSJT 5IF TBOE NVTU CF XFMM DPNQBDUFE



5IF QJQF [POF IBT UP CF EFTJHOFE BDDPSEJOH UP QMBOOJOH SFRVJSFNFOUT BO
5IF BSFB CFUXFFO USFODI TPMF BOE TJEF ÌMM JT SFGFSSFE UP BT CFEEJOH " M
NVTU CF DSFBUFE CZ VTJOH TPJM SFQMBDFNFOU 'PS SFHVMBS TPJM DPOEJUJPO
NJOJNVN UIJDLOFTT PG B NN GPS UIF MPXFS CFEEJOH *O BEEJUJPO UP UIF
OFTT DPSSFTQPOEJOH SFRVJSFNFOUT BSF BMTP JNQPTFE PO UIF CVJMEJOH NBU
VTFE GPS UIF CFEEJOH

/P CVJMEJOH NBUFSJBMT XJUI DPNQPOFOUT FYDFFEJOH UIF GPMMPXJOH SBOHFT

- NN GPS %/ Ç

5IF VQQFS CFEEJOH MBZFS C JT EFSJWFE GSPN TUBUJD DBMDVMBUJPOT *U JT B
UIBU OP DBWJUJFT BSF DSFBUFE CFMPX UIF QJQF 5IF CFEEJOH EJTTJQBUFT BMM
TFDVSFMZ BOE FWFOMZ JOUP UIF HSPVOE 'PS UIJT SFBTPO UIF $00- '*5 QJQF
PO UIF CFEEJOH BDSPTT JUT FOUJSF MFOHUI 5IF VQQFS FOE PG UIF QJQF [POF J
&/ BT NN BCPWF UIF QJQF BQFY PS NN BCPWF UIF QJQF DPOOFDUJPO &
UIF QJQF JT OPU EBNBHFE XIFO UIF DPWFS BOE NBJO CBDLÌMM BSF ÌMMFE BOE D

$00- '*5 QJQF IBWF B IJHIFS EFHSFF PG TUJËOFTT BOE B IJHIFS XFJHIU UIBO C
QJQF 'PS UIJT SFBTPO UIF QJQF TIPVME BMXBZT CF DPOOFDUFE JO UIF USFODI
PO UIF $00- '*5 KPJOUJOH FMFNFOUT JT UIVT BWPJEFE 6OEFS OPSNBM DJSDV
necessary to install expansion loops in the system.

⚠ A movement of the pipe before lling the pipe trench should be avoided. Please contact Georg Fischer Piping Systems concerning recommendations for underground installa tions.