Generel introduction 1.1.2 - 1/2

Logstor has manufactured pre-insulated pipe systems since 1992. They all adjust the demands on the industrial market. Our primary markets for the pipe systems are provision industry, chemical industry, wood industry, cold stores and marine.

With a wide product range and flexibility the pre-insulated pipe systems are adaptable to even very specific demands.

The pre-insulated pipe systems are characterized as follows:

- Pre-insulated systems with PUR- insulation have a very high insulation capacity.
- Pipe supports are to be fitted outside jacket to avoid thermal bridges
- Insulation and the jacket material have a high mechanical strength, which make the pre-insulated pipe systems resistant to physical effects, for instance when they are used as footbridge.
- The jacket joints are 100 % sealed, so that the pipes are cleanable, and result in low maintenance costs.

The pipes are all dimensionally stable, sturdy and high-insulated. The installation is simple and quick. This means, lower total costs, higher security and longer validity.

For the marine market Logstor has developed an insulation system, which is called LT pipe system, for the low temperature area, which has the above-mentioned advantages contrast with the traditional insulated pipe systems. The properties of the insulation system are higher, the installation is quick and simple, and the system is maintenance-free after installation. If you wish to save time and costs, the pre-insulated pipes are available on the spot, for instance at a shipyard.

Logstor and its customers

Over 40 years experience with the development and sale of complete pre-insulated pipe systems, known with a worldwide reputation. A well developed network of distributors and subsidiaries has resulted in thousands of kilometres of the characteristic Logstor pipes being laid all over the world. Our distributors and subsidiaries represent us in over 30 countries around the world.

We regularly attend international exhibitions manned by personnel from Logstor and local distributors.

Extensive service

Logstor's engineers and technicians provide an extensive service for any given project – right from initial planning to commission, engineering and follow-up servicing and training of fitters.

Years of experience of the installation of joints and devising customized solutions have given us the expertise to carry out installation work and supervision within our market areas.

Production locations

Logstor was founded in the early 60s, in Løgstør, Northern Jutland, in Denmark, which is still the site of most of our production today. Over the years, the factory has expanded to cover 50,000 m2 on a site of 420,000 m2. To cope with rising demand in Eastern Europe, a new factory was opened in Zabrze, Poland. This new facility combines the latest technology and well-proven Logstor traditions.

Large orders for remote areas are generally produced using our mobile production units, in particular offshore pipe systems – one of Logstor's specialities.

Version/07.2005.DK

Generel introduction 1.1.2 - 2/2

Quality assurance

Logstor has been DS/ISO 9001 certified by Lloyd's since 1992 for product development and manufacturing, plus project management, which has entailed introduction of the strictest requirements for quality assurance in the whole company. Quality control is also the customer's guarantee that all Logstor products and services fulfil our industry's strictest standards.

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

LOGSTOR
Logstor Rør A/S
Logstør
Denmark

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001:2000

The Quality Management System is applicable to:

Development and manufacture of isothermal transport systems for liquids and gas, including production on location and installation of joints on site.

This certificate is valid only in association with the certificate schedule bearing the same number on which the locations applicable to this approval are listed.

Approval Certificate No: 930476

Original Approval: 2nd July 1992
Current Certificate: 18th December 2003
Certificate Expiry: 30th June 2006

Magnus Fiberg
on behalf of LRQA Denmark

This document is subject to the provision on the reverse.

LLOYD'S REGISTER QUALITY ASSURANCE

Løgstør Rør A/S · Danmarksvej 11 · DK-9670 Løgstør · Tel. +45 99 66 10 00 · Fax +45 99 66 11 80 · lrinfo@logstor.com

Generelintroduction 1.1.4 - 2/3

Carrierpipes

Logstor's industrial products are manufactured and supplied in different pipe systems including carrier pipes of different types.

The choice of the carrier pipe depends on the transported medium. The carrier pipe is available in steel, stainless steel, copper or in plastic. The pipe can be supplied with tracer pipes.

Insulation

The type of insulation depends on the medium temperature.

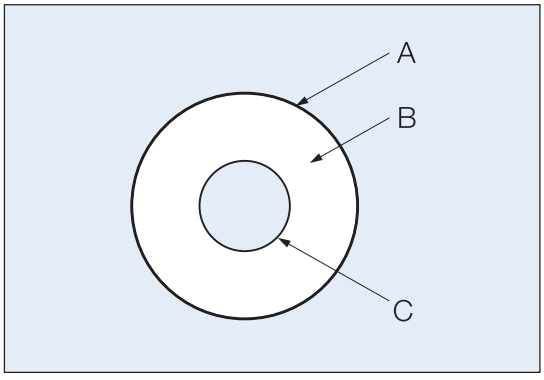
Logstor cooling pipes are insulated with a special HCFC/CFC free PUR- foam, which is applicable in the temperature area -200° C - +120° C.

Furthermore, flexible foam pipe systems are available within temperature variations from -200° C - +120° C.

During temperatures between 140° C and 315° C, the insulation is composed of mineral wool and PUR foam according to the present temperature.

Jacketpipes

The industrial pipes are available with black or white HPDE jackets (polyethylene), as standard. The jacket is UV resistant.



A: Jacket pipe

B: Insulation

C: Carrier pipe

Warningwires

The steel- and copper programme is available with integrated warning wires for registration of moisture in the insulation, which is caused by damages on the jacket or carrier pipe. In this way, moisture damages can be discovered in time and be repaired, before corrosive damages on the carrier pipe arise. See the Logstor district heating catalogue.

Certificates

Logstor offers you complete traceability if we are informed by placing of the order.

Joints

The Logstor industrial programme is primarily based on straight pipes and joints. We offer you a range of joints, which fit applications for pipes and components.

Logstor supplies two different joint solutions:

- Joints for foaming on site.
- Joints consisting of pre-manufactured PUR half shells.

All joints are produced of shrinkable PE plastic materials.

Straight pipes and sleeves up to and including ø315 are used for freely suspended pipe systems. The product programme includes bend joints, straight joints, T- joints, reduction and repair joints plus end caps.

Logstor district heating joints are used for directly buried pipe systems.

Fittings

Logstor offers you a complete fitting programme of joint solutions in St.35.8,St. 37.0 BW, AISI 304 L and AISI 316 L, which complements our joint solutions. The programme includes:

- Elbows
- T-joints
- Reductions
- Anchors

Thus, the customer has all the requisite components at disposal.

Version/07.2005.DK

Generelintroduction 1.1.4 - 3/3

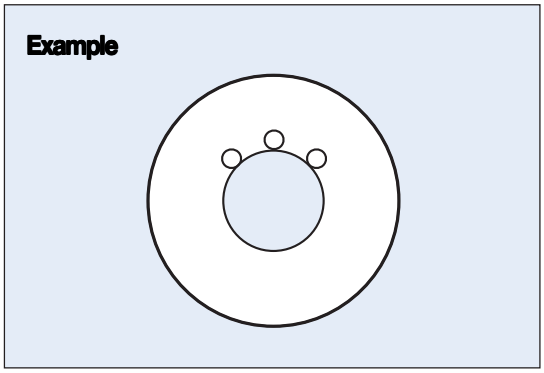
Centring

The insulation centring of carrier pipes is performed using centring spacers. The spacers are made of heat resistant materials with low thermal conductivity.

Tracerpipes

All pipe types can be supplied with an empty pipe laid directly into the insulation, within which self-regulating heat cables can be laid, or a fluid heat medium can be passed through.

Example



Thermallife

A correct installation of the complete pipe system secures a thermal life of more than 10 years, depending on operational conditions.

Version/07.2005.DK

Carrier pipes

Steel pipe systems

Material specifications 1.2.1 - 1/5

St. 37.0 BW

High- frequency welded St. 37.0 BW to P235 GH according to EN 10217-2 or EN10217-5 equivalent to St. 37.0 BW according to the previous DIN 1626.

Technical conditions of supply to DIN 1626 (October 1984).

Measurements and weights to DIN 2458.

Wall thicknesses from 21.3 up to 33.7 mm are applicable to DIN 2440, thus, thread tapping is possible .

Bevelled ends to DIN 1626/4.10.5.

Testing pressure min. 50 bar or eddy-current tested.

Welding zone 100% NDT- tested to SEP 1917.

Mill certificate to EN 10204/3.1 B.

Supplied in lengths of 6, 12 and 16 m.

Application

Heat and steam (T≤ 210°C)

Mechanical properties of St. 37.0 BW:		
Density	7850	kg/m^3
Tensile strength	> 360	N/mm^2
Yield stress	> 235	N/mm^2
Young's modulus	$2.1 \cdot 10^5$	N/mm^2
Thermal properties:		
Coefficient of expansion	$1.2 \cdot 10^{-5}$	$°C^{-1}$
Specific heat	0.48	kJ/kg°C
Thermal conductivity	76	W/m°C

St. 35.8 I

Seamless steel pipes St. 35.8 I to P235 GH TC1 according to EN 10216 equivalent to St. 35.8 I according to the previous DIN 17175 (05.79). Measures and weight according to DIN 2448.

Mill certificate to EN 10204/3.1 B.

Ends, in dimensions from 3.2 mm wall thickness, are bevelled according to DIN 2559/2.2 or 2.1. Ends < 3.2 mm wall thickness are bevelled according to DIN 2559/1.

Supplied in lengths of 6 and 12 m.

Application

Heat, steam and condensate.

Mechanical properties of St. 35.8 I:		
Density	7850	kg/m^3
Tensile strength	> 360	N/mm^2
Yield stress	> 235	N/mm^2
Young's modulus	$2,1 \cdot 10^5$	N/mm^2
Thermal properties:		
Coefficient of expansion	$1.2 \cdot 10^{-5}$	$°C^{-1}$
Specific heat	0.43	kJ/kg°C
Thermal conductivity	76	W/m°C

Version/07.2005.DK

Insulation

Material specifications 1.2.2 - 1/1

The pre-insulated straight pipes and components for bonded systems are supplied with a hard polyurethane foam insulation. Pre- insulated pipes in coils are supplied with semi-flexible foam.

PUR insulation

Hard polyurethane foam (PUR) which fulfils the functional requirements of EN 253:

Material: Polyurethane foam made from polyol and isocyanate. The foam is homogeneous with an average cell size of max. 0.5 mm.

Density	≥	60 kg/m^3
Closed cells	>	88%
Water absorption if boiled	≤	10% (Vol)
Compressive strength 10% deformation	≥	0.3 N/mm^2
Axial shear strength	≥	0.12 N/mm^2
Tangential shear strength	≥	0.20 N/mm^2
Thermal conductivity at 50° C	<	0.03 W/m° C
Max. operating temperature		140° C

The technical requirements are tested according to the EN 253 standard, which is valid for district heating pipes.

The material parameters are subject to revision due to technical developments.

NT and LT insulation

Logstor pipe systems are insulated with PUR foam, which ensures high insulation properties.

The PUR foam must not be subject to temperatures exceeding 140° C, by continuous operation.

HT2 insulation

This system is applied at temperatures above 140° C.

The pipe is designed as a two-part insulation, of which the inner part consists of a half shell of mineral wool and the outer part of a PUR foam layer.

The system operates as a bonded system, and is used as a freely suspended system at max. temperatures of 210° C or 315° C.

HT3 insulation

Two-part insulation is used in directly buried systems where temperatures exceed 140° C. The pipe is designed as a two-part insulation, of which the inner part consists of a half shell of mineral wool and the outer part of a PUR foam layer.

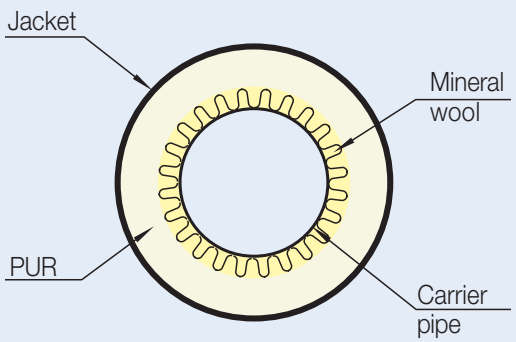
HT3 operates as a sliding system and is applied at max. temperatures of 210° C or 315° C.

Mineral wool

Hard mineral wool.

Density:	Ø < 323 mm	75 kg/m^3
	Ø < 323 mm	40 kg/m^3
Water absorption		< 1% (vol)
Tensile strength		0.01 N/mm^2
Thermal conductivity at 50° C		0.04 W/m° C
Max. operating temperature		315° C

Insulation PUR- mineral wool (HT2/HT3)



Version/07.2005.DK

Jacketpipes

Materialspecifications 1.2.3 - 1/1

Logstor products with steel carrier pipes complying with EN 253 are supplied with PEH jackets, or with extruded jackets, which fulfill the technical requirements, stated in EN 253.

HDPEjackets

High-density polyethylene.

Mechanical properties of HDPE:		
Density	> 940	kg/m^3
Yield stress	> 19	N/mm^2
Max. load		
(during transport)	3	N/mm
(continually)	0.5	N/mm^2
Thermal properties:		
Coefficient of expansion	$2 \cdot 10^{-4}$	$°C^{-1}$
Thermal conductivity	0.43	W/m° C

Melt flow rate 0.3-0.8 g/10 min.

Material parameters are subject to revision due to technical developments.

Pre-insulated straight pipes are supplied with black as well as white HDPE jackets. Pipes in coils are supplied with black LDPE jackets (low-density polyethylene).

Black HDPE jacket pipes are UV- resistant as a result of addition of UV- impeded additives. Black jacket pipes are therefore suitable outdoor as well as indoor.

White jacket pipes are moderate UV- resistant and are only suitable for indoor insulation.

Version/07.2005.DK

Material specifications 1.2.4 - 1/1

Properties

Shrink sleeves are made of elastic, shrinkable modified PE plastic material.

Black shrink sleeves are UV- stabilized.

White shrink sleeves are not UV-stabilized and is only for indoor installation.

Packing

Black sleeves: White bag, white tape

White sleeves: White bag, yellow tape with black writing.

Do not remove packing before installation. It is recommended to leave the protective bag on the pipe until the installation has been completed.

Cleaning

High pressure cleaning:
Max. pressure 160 bar
Max. water temperature 60° C

Cleaning distance between nozzle and product surface: Min. 30 cm.

Cleaning materials: Topax 18 (with chlorine) or Topax 66(without chlorine) or similar.
Cellosolve (for removal of grease)

Chemicals

The product is resistant to the following chemicals: Lye, petrol, turpentine, petroleum products, salt, sodium sulphate, chlorine etc.

The product has a short-term resistance to the following chemicals: Acetone, cellulose, hydrochloric acid (0.1 M), acetic acid (0.1 M), sulphuric acid (0.1 M).

Test

The values of the joints observe the following:

ASTM E96 permeability test < 0.8 g per joint per day at 38° C and 90% relative air humidity.

ISO 3127 drop test (- 20° C, 0 faults in 100 drops)

Version/07.2005.DK

Fittings

Material specifications 1.2.5 - 1/1

The specification for carrier pipes, insulation and jackets apply to all pre-insulated components. The Logstor components comply with the technical requirements of EN 448.

Components with steel carrier pipes are supplied with bevelled ends according to DIN 1626/4.10.5.

Elbows

The angle of deflection is defined as the deviation from a straight pipe.

The bending radius, R, depends on the pipe dimension, as follows:

St. 37.0 BW

d ≤ 508.0 mm bended R = 2.5

St. 35.8 I

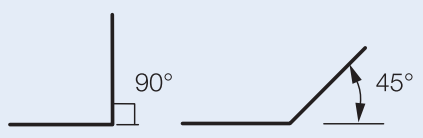
d ≤ 323 weld elbow: DIN 2605 Bauart 3

Stainless ISO dimension

Weld elbows R-1651/ABE-211

Stainless metric dimension

Weld elbows R-1651/ABE-111

Standard elbows 

Other angels are delivered on order.

T-fittings

The main pipe is supplied with a branch connection stub which is flared into the main pipe, so that the wall thickness of the branch connection is not reduced. Branch pipes are welded with a regular circumferential seam, which ensures ideal stress distribution.

Movable T-fittings only permit expansion in direction of the main pipe. The branch pipe has to be ensured with an anchoring pipe or an expansion element.

Anchoring pipes

The anchor plate consists of a circular flange fully welded to the carrier pipe.

The circular flange has been proportioned to transmit the stresses that arise in connection with axial tension in the carrier pipe of 150 N/mm^2.

Other components

Compensators, valves and other components integrated in the Logstor standard systems are provided by recognised suppliers. The pipe ends on the pre-insulated components have the same dimension as the pipes with which they are to be joined.

The assembly length depends on the component.

Compensators are supplied fully expanded and ready for use. If the compensator is to be integrated in an operational hot system, it is possible to change the presetting.

Compensators and valves have been designed to resist the tensile and compressive stresses that may appear in the pipe system.

Version/07.2005.DK

Calculation of heat loss

Dimensioning 1.3.1 - 1/2

Underground systems

Heat loss ϕ [W/m] for a pair of underground pipes is calculated:

$$\phi = U (T_F + T_R - 2 \cdot T_E)$$

Where: U [W/mK] : Heat transmission coefficient in a pipe
T_F [°C] : Supply temperature
T_R [°C] : Return temperature
T_E [°C] : Soil temperature

Heat transmission coefficient U [Wm · K] defined as:

$$U = 1 / (R_{PUR} + R_R + R_M + R_J + R_H)$$

Where: R_{PUR} [m · K/W] Thermal resistance, PUR
R_R [m · K/W] Thermal resistance, pipe
R_M [m · K/W] Thermal resistance, jacket
R_J [m · K/W] Thermal resistance, soil
R_H [m · K/W] Thermal resistance, media

Thermal resistance values calculated by:

$$R_{PUR} = \ln[Di / d] / [2 \pi \lambda_{PUR}]$$

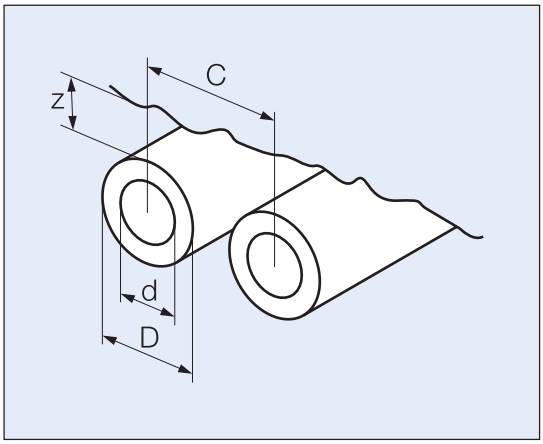
$$R_R = \ln[d / d_i] / [2 \pi \lambda_R]$$

$$R_M = \ln[D / D_i] / [2 \pi \lambda_{PE}]$$

$$R_J = \ln[4(z + 0{,}0685 \lambda_E) / D] / [2 \pi \lambda_E]$$

$$R_H = \ln[1 + (2(z + 0{,}0685 \lambda_E))^2 / C^2] / [2 \pi \lambda_{PUR}]$$

Where: D_i [m] : Int. dia. Jacket
D [m] : Ext. dia. Jacket
d_i [m] : Int. dia. carrier pipe
d [m] : Ext. dia. carrier pipe
λ_{PUR} [W/m · K]: Thermal conductivity, PUR
λ_R [W/m · K]: Thermal conductivity, carrier pipe
λ_{PE} [W/m · K]: Thermal conductivity, jacket
λ_J [W/m · K]: Thermal conductivity, soil
z [m] : Laying depth
C [m] : Distance between axes



Freely suspended pipes

Heat loss for an above-ground pipe is different compared to that of an underground pipe. This can be calculated as follows:

$$\phi = U (t_M - t_L)$$

Where: U [W/mK] : Heat transmission coefficient in a pipe
t_M [°C] : Media temperature
t_L [°C] : Air temperature

The heat transmission coefficient can be defined as:

$$U = 1 / (R_{PUR} + R_R + R_M + R_A)$$

Where: R_A [m · K/W]: Transmission resistance, air

Transmission resistance R_A [mK/W] can be calculated by:

$$R_A = 1 / \pi h D$$

Where: h [W/m² · K] : Thermal conductivity, air

The thermal conductivity of air has two components, convection and radiation:

$$h = h_c + h_R$$

Where: h_c [W/m²K] : Convection coeff.
h_R [W/m²K : Radiation coeff.

Version/07.2005.DK

Calculation of heat loss

Dimensioning 1.3.1 - 2/2

Convection component:

$$h_c = 0{,}023\ [\ V^{0,8} \cdot k^{0,8} \cdot (\rho \cdot c_p)^{0,4}] / [D^{0,2} \cdot n^{0,4}]$$

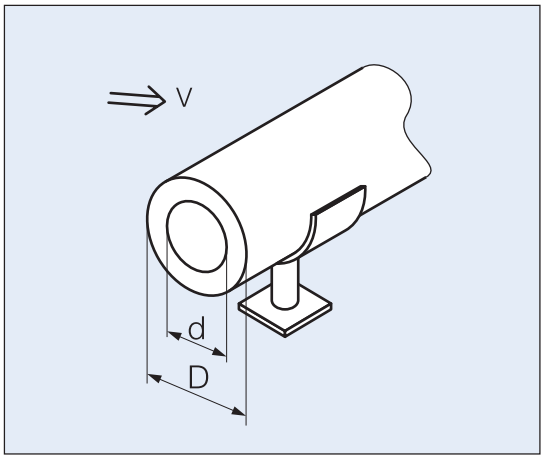
Where:
- v [m/s] : Air velocity
- k [W/mK] : Thermal conductivity, air
- ρ [kg/m³] : Density, air
- c_p [J/kgK] : Heat content, air
- D [m] : Diameter jacket
- n [m²/s] : Kinematic visc. Air

The calculations above can also be used to calculate other media than air if the values exist.

Radiation transmission coefficient h_R [W/m²·K] :

$$h_R = 4 \cdot \varepsilon \cdot \sigma \cdot T^3$$

Where:
- ε [-] : Emmissivity
- σ [W/m²K⁴]: Stefan-Bolzmann constant
- T [°K] : Air temperature, Kelvin



Calculation program

These and many other calculations can easily be performed using the calculation program **StaTech**. The programme is available at Logstor.

Version/07.2005.DK

Pipe dimensioning

LOGSTOR Industry

LG Scale Solar

Dimensioning 1.3.2 - 1/1

This chapter describes the method used to calculate pressure loss.

You can choose either to optimise the pipe, or calculate the capacity of a given pipe.

Optimisation calculation

Pipe dimensioning is calculated using the medium volume and a criterion, either the pressure gradient or the flow.

The total volume to be conveyed in a pipe is:

$$\mathbf{Q = \rho \cdot V}$$

Where: Q [kg/s] : Water flow
ρ [kg/m³] : Density
V [m³/s] : Volume flow

Speed is:

$$\mathbf{v = 4 \cdot Q / \rho \cdot \pi \cdot d_i^2}$$

Where: v [m/sec.] : Velocity
d_i [m] : Int. dia. carrier pipe

Giving:

$$\mathbf{d_{i\,MIN} = (4 \cdot Q / \rho \cdot \pi \cdot v)^{0,5}}$$

Pressure loss Δp (Pa) is calculated as follows:

$$\mathbf{\Delta p = 0,5 \cdot \rho \cdot v^2 \cdot f \cdot L / d_i}$$

Where: Δp [Pa] : Pressure loss
f [-] : Friction factor
L [m] : Pipe length

To calculate friction factor using Colebrook & White, interpolation has to be applied.

This is done using a start value to gradually reach a convergence level.

$$\mathbf{1 / f^{0,5} = 1,14 - 2 \cdot \log[k / d_i + 9,35/Re \cdot f^{0,5}]}$$

Where: k [mm] : Roughness factor
Re [-] : Reynold's formula (vR/n)
n [m²/s] : Kinematic viscosity

A direct calculation can also be made using the following formula:

$$\mathbf{f = 0,25 / [\log[K / 3,7 \cdot d_i + 5,74 / Re^{0,9}]]^2}$$

$$5000 \leq Re \leq 10^8$$

$$10^{-6} \leq k/d_i \leq 10^{-2}$$

Capacity calculation

The calculation above can also be used to calculate pressure loss and capacity of a given pipe.

Calculation program

These and many other calculations can easily be performed using the calculation programme **StaTech**. The programme is available at Logstor.

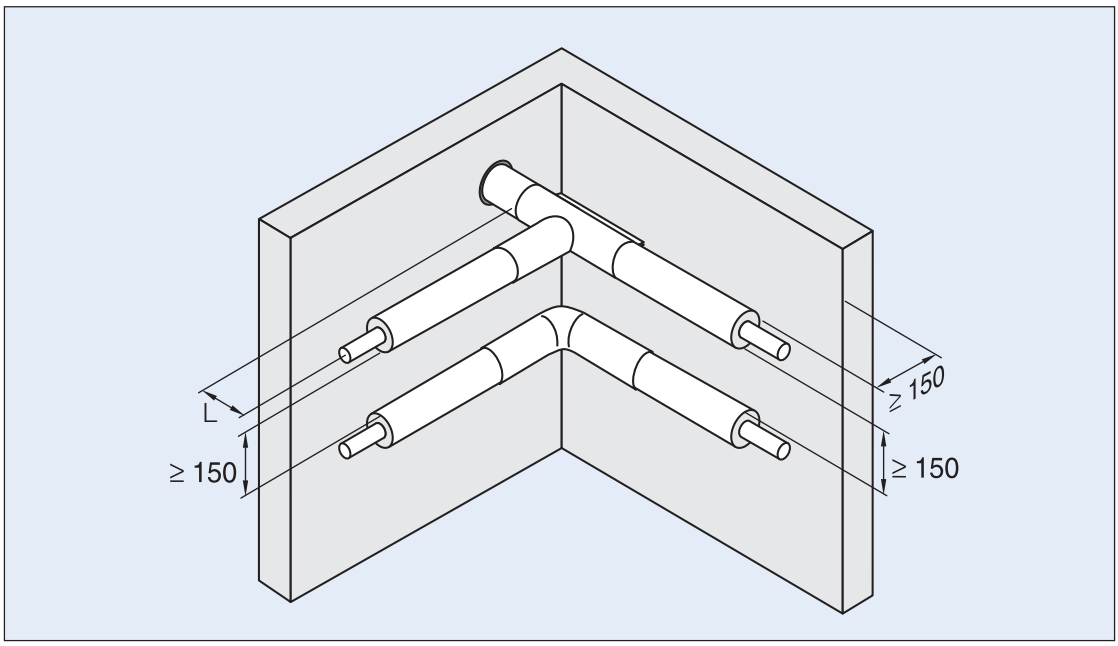
Version/07.2005.DK

Design rules

Freely suspended system

Dimensioning **1.3.3 - 1/2**

The following drawing indicates the mutual placing of pipes and distances to wall.



Minimal mounting distance between jacket/ jacket and jacket/wall:

L ≥ 320 at installation of the T-joint.

L ≥ 150 after installation of the pipe lengths.

Version/07.2005.DK

Design rules

Directly buried system

Dimensioning 1.3.3 - 2/2

Trenches for laying of Logstor pipes should be excavated in accordance with the instructions below.

The trench cross-section must be sufficiently large for a correct pipe and joint installation. The backfilling is to be compacted. Consider any cables and pipes and the need for trench drainage.

In areas with poor soil quality, it may be necessary to replace some of the soil to a substantial depth to avoid settlement.

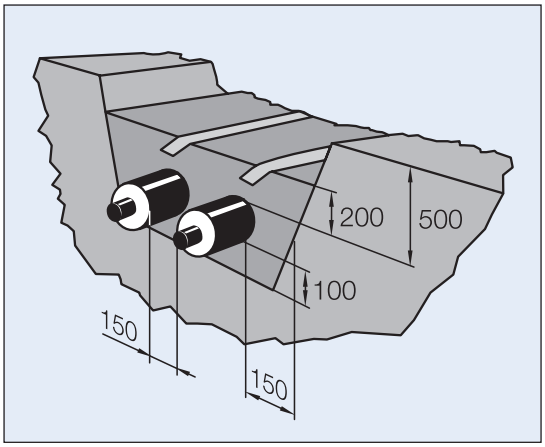
Back filling material

The following specification for the back filling material should be observed:

Maximum grain size	≤	32	mm
Maximum 10% weight	≤	0.075	mm
or 3% weight	≤	0.020	mm
Non- uniformity figure $\frac{d_{60}}{d_{10}}$	>	1.8	

The material is not to contain damaging organic material. Sharp-edged grains, which may damage pipe and joints, should be avoided.

Pipe trenches



Backfilling should be carried out with a shovel, and the material around the pipes should be compacted by hand.

As the backfilling progresses any supports under the pipes should be removed.

Warning tape is placed at least 200 mm above both pipes, and the trench is refilled, rather during recycling of the excavated material.

Compaction of the backfilling from 200-500 mm above the pipes can be carried out using a vibratory plate with a maximum surface pressure of 100 k Pa.

In areas with substantial traffic load, or where a soil cover of min. 500 mm cannot be observed, the pipes must be protected, e.g. by means of a steel plate.

Fitting

To avoid leaks and corrosion, all joints should be free of sand and impurities.

During the process the pipes are placed above or directly next to the deepening, to obtain an optimum joint and tightening test.

Version/07.2005.DK

Project preparation

Dimensioning 1.3.4 - 1/1

Any preparatory component count by Logstor shall not be binding and can only be used for advance planning on the customer's behalf for the ordering of materials. The customer shall generally provide a written order indicating the number of components and amounts. A corresponding order confirmation will subsequently be provided.

Pipe routing must be inspected prior to placing the order at which point the customer shall be responsible for defining the precise path of the pipe route and the space available. In the case of large multi-branched networks, Logstor personnel should be involved so that any static or system requirements can be taken into account from the beginning.

If Logstor is to calculate quantities and the basic layout from drawings and plans, the customer shall provide written confirmation of their accuracy and scope to Logstor. Installations in shafts and channels in particular will require an inspection of existing documentation on-site.

Written agreement must be reached as early as possible in the project of the extent to which Logstor is to provide consultation and calculations for the pipe system.

Pre-insulated industrial pipes from Logstor are always project-specific special products, and cannot be returned.

Pipe routing

The LT, NT and HT industrial pipe systems can be subject to significant expansion due to their operating temperatures. Expansion is absorbed using expansion components L-, Z-, or U bends or compensators precisely calculated in accordance with the pipe routing.

Installation may therefore **only** be carried out in accordance with the pipe route agreed with Logstor.

Any amendments must be agreed and approved by Logstor before installation, for the purpose of ensuring pipe stability.

Upon project completion, the "as-build" documentation shall be reviewed on-site and forwarded to Logstor.

If no agreement on pipe routing and installation facilities exists, or if installation has been performed in contradiction of the agreement, no claims for deficiencies will be entertained.

Please note that freely suspended and directly buried systems may only be used for the purpose for which they are designed, as per chapter 1.1.4.

Version/07.2005.DK

Transport and storage

LOGSTOR Industry

LG Scale Solar

Product handling 1.4.1 - 1/2

The present instructions are designed to describe vital aspects to take into account when handling and using Logstor products. In order to ensure that the product does not get damaged in transit and handling.

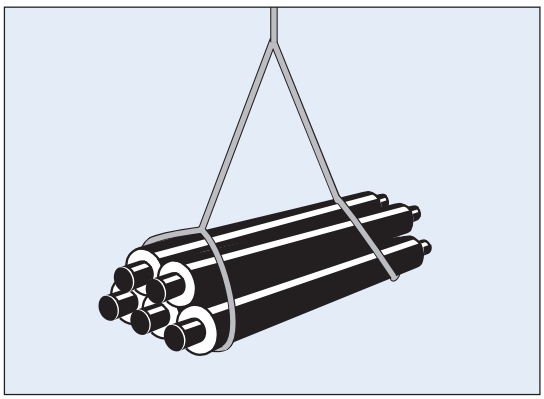
Logstor recommends these instructions are followed. Please note that the instructions are an integrated part of the supplementary technical terms for installation services.

Delivery

Delivery can only be made on firm road surfaces that can bear a truck with an on-board crane. Time of delivery in accordance with the order confirmation is when the goods leave the factory. Delivery on-site will be effected within three days of this time and will be advised. At the time of delivery, there must be sufficient personnel and gear available for unloading. The consignment must be checked for completeness and damage. Receipt of the goods must be signed for on the delivery note.

Logstor industrial pipes can be unloaded manually. If lifted mechanically, at least two woven straps must be used – or preferably a vacuum suction hoist. Distance between the two straps must be approx. ½ the pipe length. When unloading, pipes or fittings must not be tipped or dropped.

The pipes must be unloaded onto a level surface, so that the pipe has a substantial surface of support. To avoid damages of the jacket, the surface must not contain stones.



Transport

During transport of pipes and fittings, care must be taken that they do not come into contact with sharp edges or objects. Pipes must not overhang the end of a trailer or truck bed by more than 2 m. They must be placed flat or upon minimum 100 mm-wide wooden slats with no more than 2 m between them. For HT2 and HT3 pipe systems, the maximum distance must be 1 m.

Pipes and fittings must be transported in such a way that the ends of the jacket and carrier pipes do not suffer damage.

At very low temperatures below -10° C, jacket pipes contract which creates strong tension. At such temperatures, special care must be taken when transporting jacket pipes. Avoid sharp blows to the pipes.

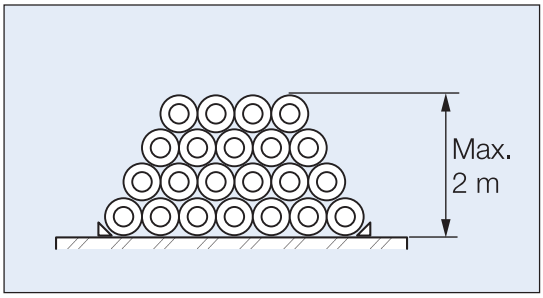
Storage

Pipes and fittings must not be stored in disorderly piles, as this may cause unintended punctual loads.

For temporary storage, pipes must be stacked on a flat surface or wooden slats either in the shape of a pyramid or straight-sided with slats between each layer. When using the pyramidal shape LT and NT pipe systems can be stacked at a maximum height of 2 m. HT2 and HT3 can only be stacked at a height of 1 m.

All systems may be stacked on slats up to a height of 1 m with a distance of 2 m between the slats.

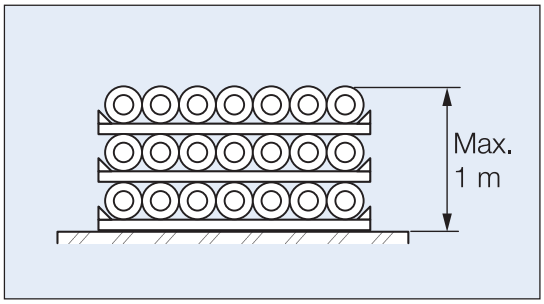
For the HT2 and HT3 systems, the maximum distance between the slats must be 1 m. The slats must be at least 100 mm wide.

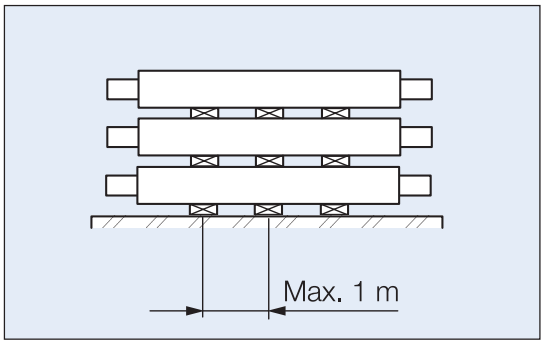


Version/07.2005.DK

Transport and storage

Product handling 1.4.1 - 2/2





Fittings must also be placed on a level surface. It is important to ensure that the free pipe ends point downwards to avoid rainwater collecting on them.

White pipes are to be stored on slats – preferably indoor.

Shrink sleeves, shrink materials and foam components must be stored dry and cool at temperatures of less than 50° C, to avoid a premature shrinking of the material. If components for polyurethane foam become frozen, they must be slowly thawed at a temperature of 35° C.

Rigid joints are to be stacked upright to avoid them becoming oval.

Coated pipes

Coated pipes must be treated with special care. The pipes must be placed on sand beds and be transported on a soft bedding layer.

Pipes with white HDPE - jackets

The white jacket pipes are supplied covered with a white or transparent polyethylene bag to protect the pipes against impurities, weather, scratches and discolorations.

Handling and storage of the white jacket must take place most carefully, as it is very sensitive to impurities.

If a dirty surface cannot be cleaned with water, use solvents for plastic.

It is recommended to leave the protective bag on the pipe until the installation has been completed. The protective bag is removed by cutting it open with a scissor along the pipe.

The polyethylene bag is to deposit with ordinary garbage, as burned polyethylene is recycled in nature.

Version/07.2005.DK

Installation

Product handling 1.4.2 - 1/7

It is crucial for the service life of the components that the joints between the two jacket pipes are – and remain watertight.

If installed correctly, the joint will be just as tight as the jacket pipes and have the same strength.

The pre-treatment of the plastic material is crucial to the effectiveness of the joint. It is of importance, that the materials used in the joint are completely clean and dry.

Any labels on the jacket pipe within the installation area must be removed.

Scratches must be scraped off. Large scratches must be filled with mastic.

When components designed to absorb expansion are installed, it has to be ensured that the necessary expansion is possible.

During joint installation the working premises must be protected against wind and weather.

The joint installation must not be carried out under circumstances, where the activation of the plastic surfaces cannot be maintained throughout the installation process or other circumstances, which might reduce the quality of the joint.

Leak and pressure test

The leak and pressure test must be carried out in accordance with accepted standards, and in all respects as described by the client.

There are five “golden rules” of how to install a Logstor HDPE- jacket pipe joint:

Preparation

All materials must be at hand when the installation work starts.

Cleaning

All surfaces must be cleaned.

Activation

All plastic surfaces must be activated by means of a gas flame to ensure that the plastic oxides are reduced. At the same time, the components are preheated.

Installation

All components of the joint must be installed in a single work routine without interruptions.

Inspection

Finally, the fitter ensures that the joint has been made correctly, and that the surface is even and smooth. Follow the fitting instruction of the joints thoroughly.

Course K3001

The purpose of the course is to communicate the required knowledge of the materials and their application to the assembly fitters, in order to enable them to carry out insulation of the carrier pipe joints in the Logstor pipe systems, and to store and support them. Furthermore, they get acquainted with the most important components of the product catalogue. Many customers require a valid certificate before start-up of the installation.

Qualifications of the participants

None, but it is advantageous to have a professional background from the plastic industry.

After completion

The participant will be qualified for:

- Installations of closed joints
- Installations of open T-joints
- Installations of joints for foaming

This part includes real practical installations which are time-consuming, but give the participant a fundamental experience of joint installations.

At the same time, the participants have become acquainted with components, which will enable them to choose the right spare parts at any given time.

Version/07.2005.DK

Product handling 1.4.2 - 2/7

Furthermore, the participant will have a knowledge of the following:

- Repair materials and auxiliaries
- Transport and handling
- Components of the pipe systems
- Installation of pipe supports
- Estimation of thermal expansion

The present instructions are meant as a help to the fitter, as they will enable him to estimate the circumstances of the installation BEFORE the beginning of the process, and to avoid delay caused by commonplace design errors.

Certificate

A written examination and an evaluation of a chosen assignment are to be carried out. Both are to be passed before a certificate can be issued.

Carrier pipe joints

The Logstor standard carrier pipe programme includes steel, stainless steel, cobber and plastic.

There are different methods to assemble these types of carrier pipes. The table below indicates typical assembling methods for the specific types of carrier pipes.

The diagram is intended as a guide. It is recommended, that the customer contacts Logstor for further information, in connection with special media and e.g. pressure and temperature conditions.

Pipe types	Assembling methods		
	Welding Soldering	Press coupling	Mechanical coupling
Steel pipes			
St. 37.0 BW	√		
St. 35.8 I	√		
Stainless steel pipes			
AISI 316 L	√		
Copper pipes			
Hard	√		
Soft	√	(√)	
Plastic pipes			
PEX		√	√

√ = Typical method.

(√) = Applicable.

Version/07.2005.DK

Installation

Jacket pipe joints

Terminology

Shrink sleeve:

Drifted polyolefin pipes shrink when heated.

Shrink wrap:

Open material shaped in the form of a pipe when installed. Mastic on the inside. Sealed with closure patch. Shrinks when heated.

Closure patch:

A patch with melting glue for fixation of longitudinal joints of wrap and cut shrink sleeve. To be heat-treated. Does not shrink.

End cap:

Drifted mastic polyolefin. Used as end cap. Shrinks when heated.

Shrink film:

Thin-walled wrap without closure patch. Cut in lengths suitable for the joint in question. Shrinks when heated.

Shrink collar:

Soft, short sleeve. Mastic on the inside. Shrinks when heated.

Hotmelt/combi-strips:

Glue activated when heated. Adheres to clean and dry surfaces. Mastic on the outside.

Mastic:

Sealing mastic: Activated when heated. Adheres to clean and dry surfaces.

Mastic tape/single strip:

Used for sealing in certain joints.

Adhesive tape:

Film with an adhesive agent. Adheres to clean, degreased surfaces.

Insulation shells:

Half shells used for traditional insulation of pipe joints.

Foaming:

Injection of a suitable volume of mixed polyol and isocyanate. These agents react and develop PUR –foam.

Activation (plastic):

A propane gas flame is used to pre-heat the surface. By this process, the pure basic material stands out and the surface gets dry and temperate. The plastic surfaces of the joint always have to be activated.

Version/07.2005.DK

Installation

Jacket pipe joints

Activation

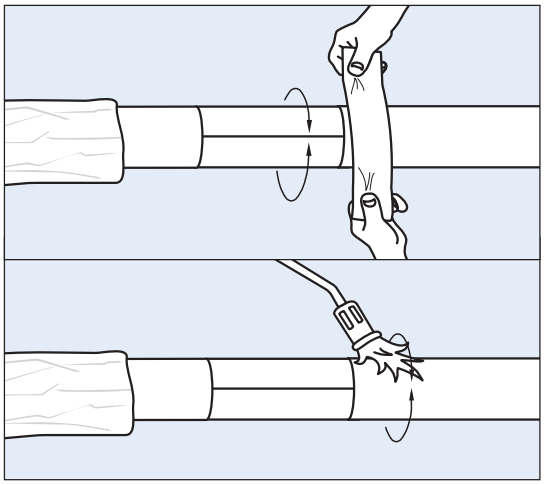
Activation of the surface is intended to remove the plastic oxides (soapy surface coat – “plastic rust”) which cover any plastic surface. Activation ensures that the sealing and adhesion materials adhere directly to the clean plastic surface.

Activation can be made mechanically (grinding), electrically (spark-treatment) or thermally (flame).

Activation of Logstor joints is normally carried out mechanically and thermally.

Thermal activation also ensures that all moisture is removed and that no dew is formed during shrinking.

Activation is carried out by grinding the surface with emery paper, and afterwards slowly heating the surfaces using a soft gas flame (with yellow ends). The flame must “lick” the plastic surfaces.



After a thoroughly activation of the plastic, the surface temperature must be at least 60° C.

Once the right temperature has been reached, i.e. when the plastic oxides have been reduced, the surface of the plastic becomes silk-matt. The plastic material must not look shiny or burned.

The joint must be installed immediately after activation, since plastic oxides reform quickly.

The heat used when activating the surface is also used in the following installation, thereby ensuring a close connection between the surfaces and correct adhesion.

Version/07.2005.DK

Installation

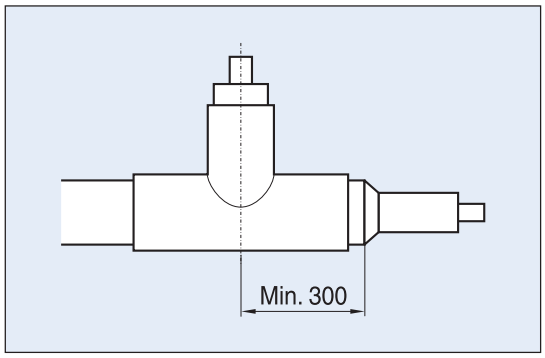
Branch pipe

Reduction

Reductions are not to be placed on the main pipe of the T-joint. Reductions near the T-joint must be completed before the installation of the T-joint.

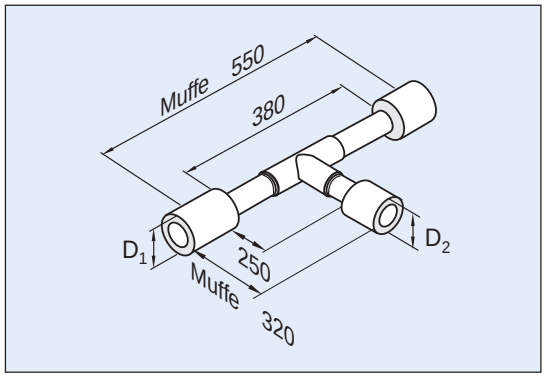
Reductions on branch pipes must be carried through a tee-fitting reduction, not welded directly onto the tee-fitting.

All free pipe ends = 150 mm.



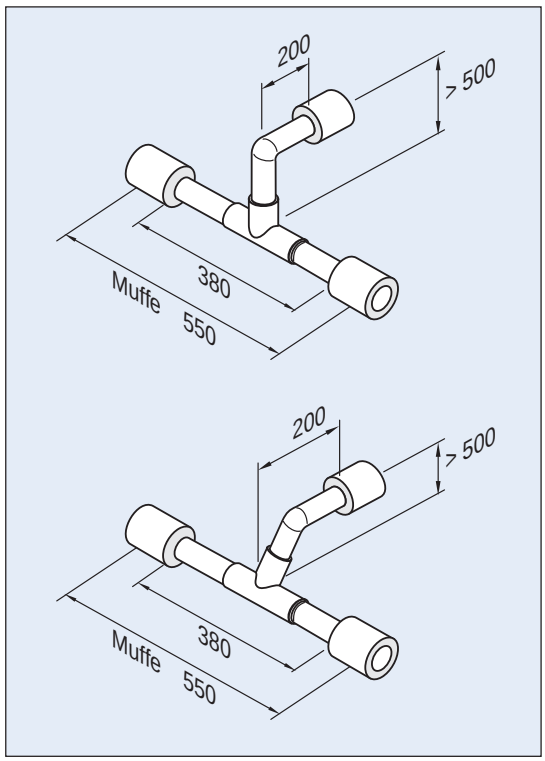
TMC

During branch pipe installation the maximum measures must be observed to use TMC.



TMC and BM

In case of branch pipe with offset, TMC and BM are used together. The maximum measures are stated below.



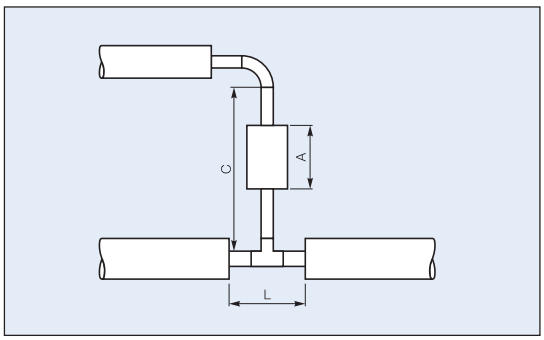
Version/07.2005.DK

Installation

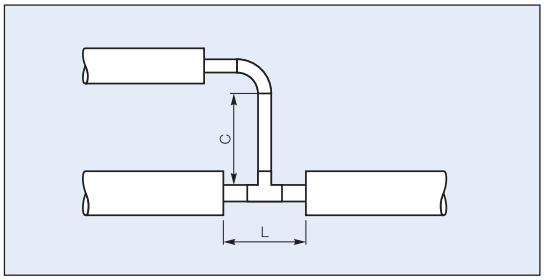
Branch pipe

Producthandling **1.4.2 - 6/7**

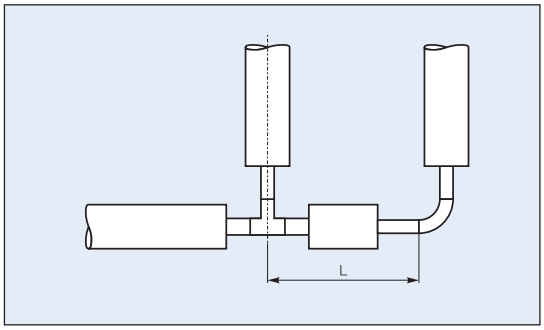
The examples below demonstrate how to shorten free ends or welded T-fittings, so that the stated measures are observed.



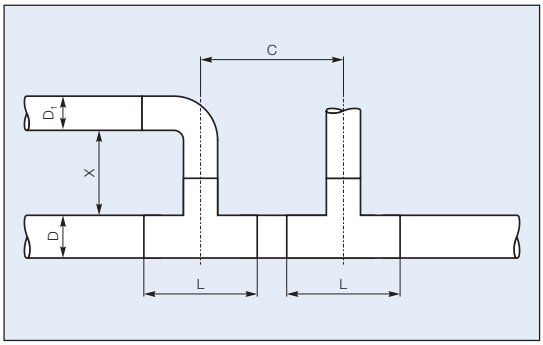
A = C-400, min. 100 mm.
L = Max. 380 mm.



C = Max. 400 mm without use of pre-insulated pipe section.
L = Max. 380



L = Min. 450 mm, at free end of 150 mm.



D = Jacket diameter
X = Min. D
C = Minimum 650 mm
L = 530 mm
$D_1 \leq D$

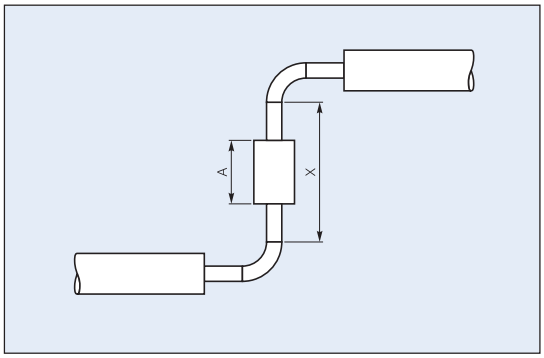
Version/07.2005.DK

Installation

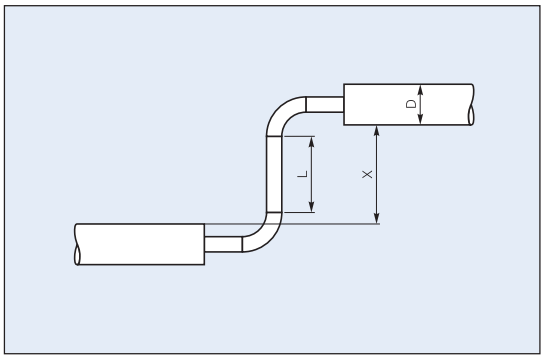
Z-offset and EC/DHEC

Z-offset

The examples below demonstrate how to install two BM units. These measures are valid at free ends of 150 mm and at a weld elbow radius of 1.5xd.



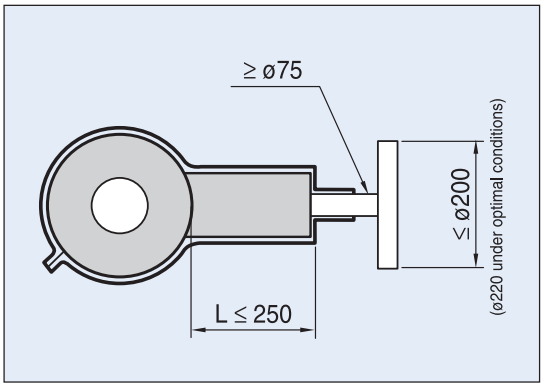
A = X – 400, min. 100 mm.

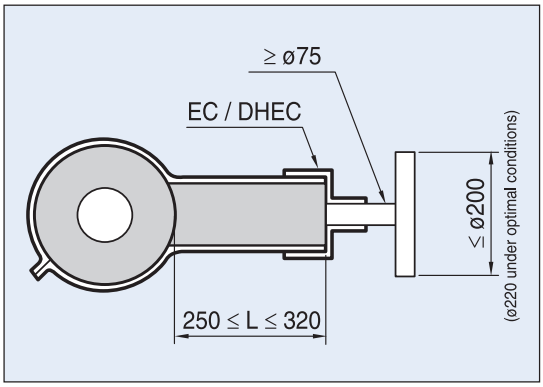


X = Min. D, but may also be carried out in cases, where welding fittings are welded directly together.

L = Pipe section. Max. 400 mm pipe section without using pre-insulated pipe sections.

EC/DHEC





Note: EC/DHEC must be installed before welding of flanges.

Version/07.2005.DK

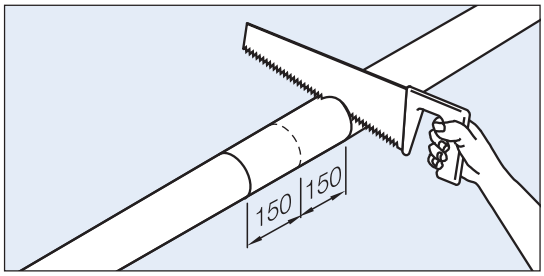
Shortening of pipes

LOGSTOR Industry

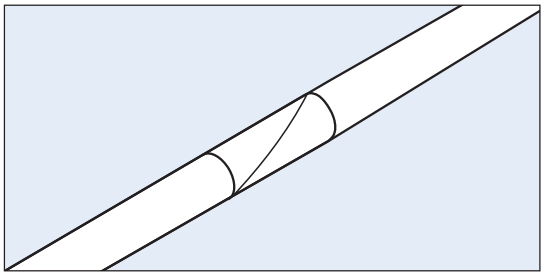
LG Scale Solar

Product handling 1.4.3 - 1/1

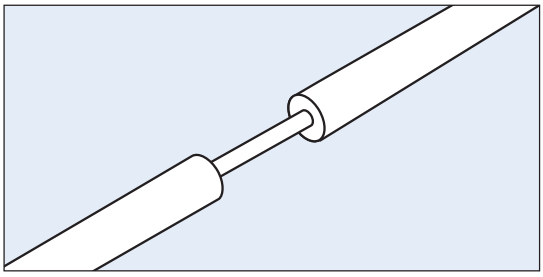
The following procedure is used when shortening pipes:



1. Place two cuts all the way round the jacket and insulation at a distance of 150 mm from either side of the cutting point. It is easiest to use a coarsely toothed hacksaw, handsaw or eclipse saw.



2. Place a diagonal cut through the jacket between the two circumferential cuts. Be careful not to damage the remaining jacket.



3. Remove the jacket and insulation material. Use a knife, a chisel or similar to remove the insulation material. Be careful not to damage any sensor wires installed.

4. Scrape off any remaining insulation residue and treat the carrier pipe until the exposed surface is completely clean. Use a steel brush, abrasive cloth, rotating brushes or similar. Cleaning the pipe prevents polyurethane from degassing/burning off during heat-treatment.

Before flame treatment, the insulation material must be protected against heat and against catching fire.

5. Cut the carrier pipe

When adapting a straight pipe to other components, the straight pipe is the one to be shortened.

Where a pipe is to be shortened, special zebra pipes can be used. This makes it easier to remove the insulation, and the risk of polyurethane degassing/burning off during heat-treatment is avoided.

Version/07.2005.DK

Pipe supports

LOGSTOR Industry

LG Scale Solar

Produkthandling 1.4.4 - 1/3

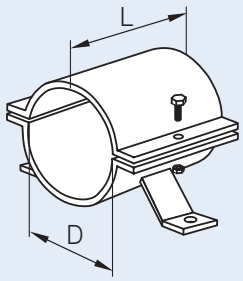
Logstor pre-insulated pipes have such an enormous pressure strength that the pipe supports are to be installed on the outside of the jacket.

This suspension system has the great advantage over traditionally pre-insulated systems, that it prevents problems deriving from heat and thermal bridges and penetration of water and moisture at the pipe supports from arising, thus avoiding corrosion of the steel pipe, which leads to unnecessary energy losses and heavy maintenance costs.

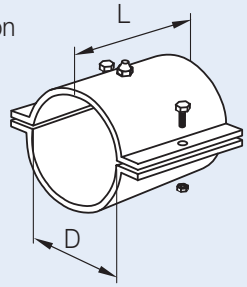
Logstor supplies pipe supports specially produced for pre-insulated pipe systems. These pipe supports can be directly installed on the walls and ceiling or in common racks.

Logstor keeps pipe supports as standard stock goods.They are available in a galvanized and a stainless version. Other qualities are available on order.

Model A is used for bolting



Model B is used for pendular suspension



Calculation of support width

The pipe supports,on the pre-insulated pipes, can be placed with the optimal support width. However, the maximum permissible surface pressure of the insulation material must be observed. The length of the support should be calculated as follows:

$$A = \frac{(G \cdot L_b + \Sigma Fv) \cdot g}{D \cdot \sin\beta/2 \cdot \sigma till.}$$

D = Jacket pipe diameter [mm]

G = Net weight of the pipe, incl. medium [kg/m]

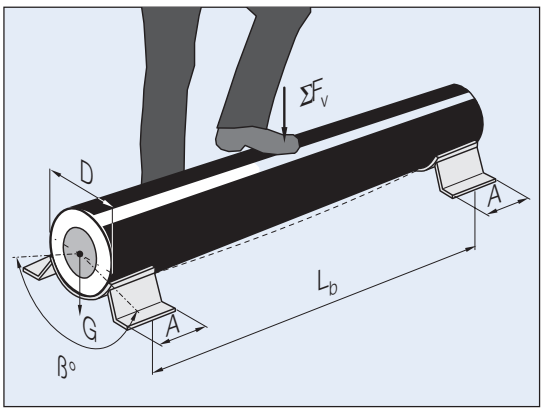
g = Gravity [9.82]

L_b = Distance between supports, or the pipe length to be supported [m]

β = Support angle [45° - 180°]
Logstor uses 180° as standard

ΣF_V = The sum of any vertical, external loads [kg] (snow, walk bridge or support to other pipes)

σ_{til} = Permissible surface pressure on the insulation material is 0.1 N/mm$_2$



Version/07.2005.DK

Pipe supports

Installation of pipe supports

It is important that the pipe either lies loosely in the support to allow unhindered movement, or that guides are used.

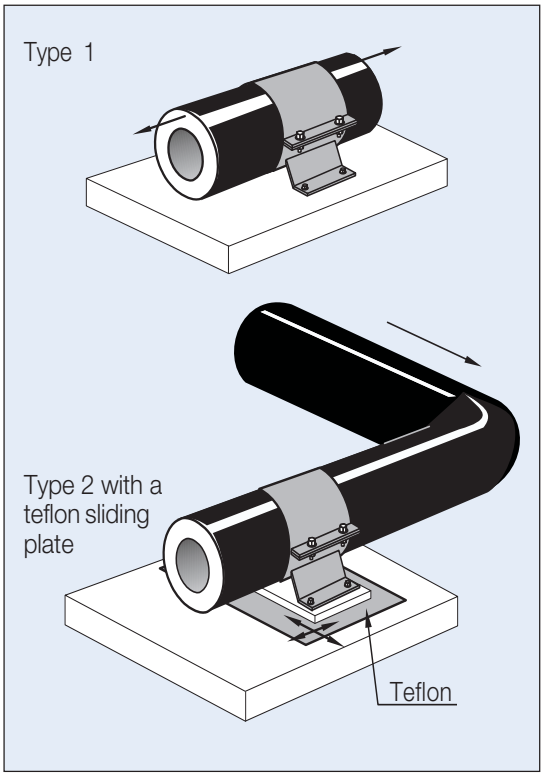
It is also possible to place a teflon sliding plate under the support.

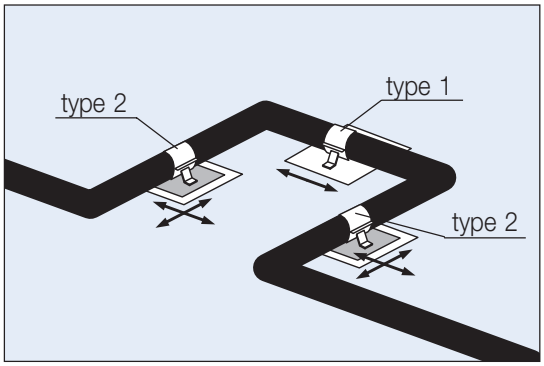
When the pipe is laid in such a way that it moves in the support, it is important not to place the supports on or near the joints, as these would otherwise be damaged by the movement of the pipe.

When expansion is absorbed in the joints, it is important that the support does not block the movement. The supports at the elbows must therefore be able to move in two directions. This can be done by letting the support slide on the plate.

Pendular suspensions are not permitted when using axial compensators.

Avoid placing the supports directly on or near the joint. If this is impossible use a support type 2.





Version/07.2005.DK

Pipe supports

Produkthandling 1.4.4 - 3/3

Supporting distance

Logstor recommends that the supporting distance of a pre-insulated pipe, is the same as the one applied on a pipe that has not been insulated.

Steel and threaded pipes

DN	Dimension	Max.distance,metre (max. temperature +210° C)			
		184°C		210°C	
		Water	Steam	Water	Steam
15	21.3 x 2.0 21.3 x 2.6	2.0 2.0	2.0 2.0	1.8 1.8	1.8 1.8
20	26.9 x 2.0 26.9 x 2.3 26.9 x 2.6	1.8 2.0 2.0	2.3 2.5 2.5	1.6 1.8 1.8	1.8 2.0 2.0
25	33.7 x 2.0 33.7 x 2.6 33.7 x 3.2	2.0 2.5 2.5	2.2 2.5 2.7	1.8 2.0 2.0	1.8 2.0 2.0
32	42.4 x 2.0 42.4 x 2.6 42.4 x 3.2	2.5 2.5 2.8	2.8 3.0 3.2	2.0 2.0 2.5	2.5 2.5 2.8
40	48.3 x 2.6 48.3 x 3.2	3.0 3.0	3.5 3.5	2.8 2.8	2.8 2.8
50	60.3 x 2.9 60.3 x 3.6	3.5 3.5	4.0 4.0	2.8 2.8	3.0 3.0
70	76.1 x 2.9	4.0	4.0	3.0	3.5
80	88.9 x 3.2 88.9 x 4.0	4.5 4.5	5.0 5.0	3.5 3.5	4.0 4.0
100	114.3 x 3.6	5.0	6.5	4.0	4.0
130	139.7 x 4.0	5.0	6.5	4.5	5.0
150	168.3 x 4.0	7.5	8.5	5.0	6.5
200	219.1 x 4.5 219.1 x 6.3	9.0 9.0	10.0 10.0	5.0 5.0	6.5 6.5
250	273 x 5	10.0	11.0	7.5	8.5
300	323.9 x 5.6	11.0	11.0	9.0	10.0

Copper pipes

Dimension (Carrier pipe)	Distance,metre
10 x 1 mm	1.0
12 x 1 mm	1.1
15 x 1 mm	1.2
18 x 1 mm	1.3
22 x 1 mm	1.4
28 x 1.2 mm	1.7
35 x 1.5 mm	1.8
42 x 1.5 mm	1.9
54 x 1.5 mm	2.2
70 x 2 mm	2.5
88.9 x 2.5 mm	2.6

Version/07.2005.DK

LOGSTOR Industry

LG Scale Solar

System description

NT – Normal temperature

NT technique **3.1.1 - 1/1**

Operating temperature from -60° C to +140° C

The steel systems can be used as freely suspended and directly buried systems. We refer to Logstor's district heating catalogue for choice of components and joints, if the steel pipe systems are to be directly buried. The laying of directly buried stainless pipes requires special attention.

Annealed copper pipes are applicable in directly buried pipe systems. Hard copper is only applicable in freely suspended pipe systems.

Flexible plastic pipe systems (PEX in coils) are only used in directly buried systems. PE80/PE100 are used in directly buried and freely suspended systems.

The NT system is applicable for media such as condensate, ammonia, diesel oil and dairy products. The system consists of pure polyurethane and has unique insulating properties ensuring low operating costs.

30% moisture in the foam and the joint, results in more than a doubling of the heat loss and a reduction of the mechanical properties of the PUR-foam. Therefore, it is very important to install the joints correctly, and to cover the foamed ends with end caps. This ensures low operating costs and long thermal life.

The HEC and HDHEC systems are applied at operating temperatures below -20° C (black) or -36° C (white) and at temperatures higher than 110° C.

The NT system is available in black or white. White is only for indoor use.

Version/07.2005.DK

Carrier pipe matrix

LOGSTOR Industry

LG Scale Solar

NT technique 3.1.2 - 1/2

The customer's specific wishes and requirements are decisive for the choice of carrier pipes. Logstor insulates carrier pipes designed to user specifications based on demands on insulation thickness. The customer is responsible for the choice of carrier pipe material, in which the medium is transported.

The standard types of industrial carrier pipes in this matrix are listed according to their typical application scopes. The carrier pipe matrix, which is intended as a guide, is based on Logstor's experience in this field.

The matrix indicates the following scopes of application:

Heating

Pipes used for room and process heating up to +140° C.

Product

Pipes applied for transport of liquid products such as dairy products.

Cooling

Pipes applied to cooling classified in the most applied refrigerants.

Water for domestic use

Pipes applied to water for domestic use. Approved for this specific use according to Danish regulations.

		Scope of application					
	Chapter	Heating (temp.)			Cooling (medium)		
LR Industrial pipe systems		<95°C	<120°C	<140°C	Ammonia	Brine	Water
Steel pipe system							
St. 37.0 BW	3.2.1	√	√	√	÷	(√)	√
St. 35.8 I	3.2.2	(√)	(√)	(√)	√	√	(√)
Stainless steel pipe system							
AISI 316 L	3.2.4	(√)	(√)	(√)	(√)	(√)	(√)
Dairy pipes	3.2.5	(√)	(√)	(√)	÷	(√)	(√)
Copper pipe system							
Hard	3.3.2	√	√	÷	÷	√	√
Soft	3.3.1	√	√	÷	÷	(√)	(√)
Plastic pipe system							
PEX	3.4.1	√	÷	÷	÷	(√)	(√)
HDPE	3.4.2	÷	÷	÷	÷	(√)	√

√ = Typical application.
Indicates the primary application of the pipe system.

(√) = Applicable.
Indicates that the pipe system may be applied for this purpose, but that the composition of the medium might require a closer examination of the solution.

\- = Irrelevant.
Indicates that it is more advantageous to use other pipe types, which typically are applied to this specific purpose.

÷ = Not applicable.
Indicates that the pipe type in question, must not be used due to temperature conditions and/or medium compositions.

Version/07.2005.DK

Carrier pipe matrix

NT technique 3.1.2 - 2/2

		Scope of application					
	Chapter	Product (temp.)			Cooling (medium)		Water, domestic use
LR Industrial pipe systems		<95°C	<120°C	<140°C	Co_2	N_2	
Steel pipe system							
St. 37.0 BW	3.2.1	√	√	√	÷	÷	-
St. 35.8 I	3.2.2	(√)	(√)	√	(√)	÷	-
Stainless steel pipe system							
AISI 316 L	3.2.4	√	√	√	(√)	√	(√)
Dairy pipes	3.2.5	√	√	√	(√)	(√)	√
Copper pipe system							
Hard	3.3.2	√	÷	÷	√	÷	-
Soft	3.3.1	√	√	÷	√	√	(√)
Plastic pipe system							
PEX	3.4.1	√	÷	÷	÷	÷	√
HDPE	3.4.2	÷	÷	÷	÷	÷	√

√ = Typical application.
Indicates the primary application of the pipe system.

(√) = Applicable.
Indicates that the pipe system may be applied for this purpose, but that the composition of the medium might require a closer examination of the solution.

- = Irrelevant.
Indicates that it is more advantageous to use other pipe types, which typically are applied to this specific purpose.

÷ = Not applicable.
Indicates that the pipe type in question, must not be used due to temperature conditions and/or medium compositions.

Version/07.2005.DK

Pipe

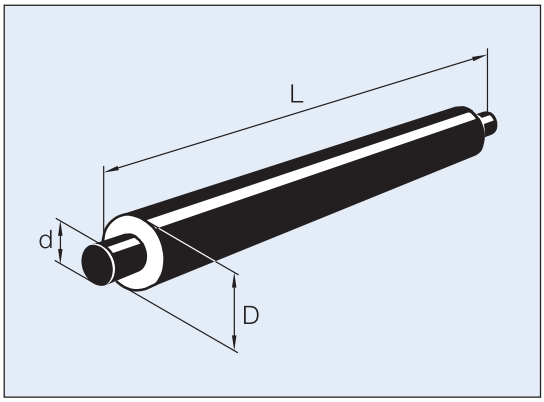
St. 37.0 BW

Supplied in lengths of 6, 12 and 16 m, depending on dimension.

Up to jacket dimension ø315, St. 37.0 BW is supplied as straight pipes and joints. Straight pipes, fittings and straight joints are supplied in dimensions exceeding ø315.

Pipes in jacket dimension ø90 are supplied with 100 mm exposed pipe ends.

Available with tracer pipes, see page 3.1.3.



Series 1

Component no. 20000L

Steel pipe diameter d, inch	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"
Steel pipe diameter d, mm	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3
Steel pipe wall thickn., mm	2.6	2.6	3.2	2.6	2.6	2.9	2.9	3.2	3.6	3.6	4.0
Jacket pipe diameter D, mm	90	90	90	110	110	125	140	160	200	225	250
Weight, kg/m	2.2	2.5	3.4	3.9	4.3	5.7	7.2	9.1	13.2	16.1	20.9
Water content, l/m	0.2	0.4	0.6	1.1	1.5	2.3	3.9	5.4	9.0	13.8	20.2

Steel pipe diameter d, inch	8"	10"	12"	14"	16"	20"
Steel pipe diameter d, mm	219.1	273.0	323.9	355.6	406.4	508.0
Steel pipe wall thickn., mm	4.5	5.0	5.6	5.6	6.3	6.3
Jacket pipe diameter D, mm	315	400	450	500	560	710
Weight, kg/m	31.1	45.0	58.3	66.3	84.4	114.0
Water content, l/m	34.7	54.3	76.8	93.2	121.8	192.8

Series 2

Steel pipe diameter d, inch	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"
Steel pipe diameter d, mm	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3
Steel pipe wall thickn., mm	2.6	2.6	3.2	2.6	2.6	2.9	2.9	3.2	3.6	3.6	4.0
Jacket pipe diameter D, mm	110	110	110	125	125	140	160	180	225	250	280
Weight, kg/m	2.9	3.2	4.0	4.5	4.3	6.5	8.1	10.1	14.9	18.1	23.6
Water content, l/m	0.2	0.4	0.6	1.1	1.5	2.3	3.9	5.4	9.0	13.8	20.2

Steel pipe diameter d, inch	8"	10"	12"	14"	16"	20"
Steel pipe diameter d, mm	219.1	273.0	323.9	355.6	406.4	508.0
Steel pipe wall thickn., mm	4.5	5.0	5.6	5.6	6.3	6.3
Jacket pipe diameter D, mm	355	450	500	560	630	800
Weight, kg/m	35.5	51.9	66.4	72.8	92.7	127.8
Water content, l/m	34.7	54.3	76.8	93.2	121.8	192.8

Version/07.2005.DK

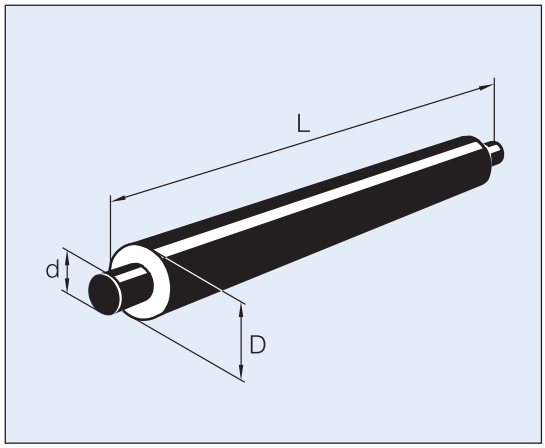
Pipe

St. 35.8 I

Up to jacket dimension ø315, St. 35.8 I is supplied as straight pipes and joints. Straight pipes, fittings and straight joints are supplied in dimensions exceeding ø315.

Pipes in jacket dimension ø90 are supplied with 100 mm exposed pipe ends.

Available with tracer pipes, see page 3.1.3.



Series 1

Component no. 20000L

Steel pipe diameter d, inch	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
Steel pipe diameter d, mm	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9
Steel pipe wall thickn., mm	2.0	2.3	2.6	2.6	2.6	2.9	2.9	3.2	3.6	4.0	4.5	6.3	6.3	7.1
Jacket pipe diameter D, mm	90	90	90	110	110	125	140	160	200	225	250	315	400	450
Weight, kg/m	1.9	2.3	2.9	3.8	4.2	5.6	7.1	9.0	13.0	17.1	22.6	39.8	53.3	69.8
Water content, l/m	0.2	0.4	0.6	1.1	1.5	2.3	3.9	5.3	9.0	13.6	19.9	33.5	53.3	75.3
Length L, m	6	6	6	6	6	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12

Series 2

Steel pipe diameter d, inch	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
Steel pipe diameter d, mm	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9
Steel pipe wall thickn., mm	2.0	2.3	2.6	2.6	2.6	2.9	2.9	3.2	3.6	4.0	4.5	6.3	6.3	7.1
Jacket pipe diameter D, mm	110	110	110	125	125	140	160	180	225	250	280	355	450	500
Weight, kg/m	2.3	2.7	3.3	4.1	4.5	6.1	7.6	9.5	13.9	18.3	24.1	43.1	57.6	74.7
Water content, l/m	0.2	0.4	0.6	1.1	1.5	2.3	3.9	5.3	9.0	13.6	19.9	33.5	53.3	75.3
Length L, m	6	6	6	6	6	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12

Series 3

Steel pipe diameter d, inch	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
Steel pipe diameter d, mm	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9
Steel pipe wall thickn., mm	2.0	2.3	2.6	2.6	2.6	2.9	2.9	3.2	3.6	4.0	4.5	6.3	6.3	7.1
Jacket pipe diameter D, mm	125	125	125	140	140	160	180	200	250	280	315	400	500	560
Weight, kg/m	2.6	3.0	3.6	4.6	5.0	6.6	8.1	10.2	15.1	19.9	26.1	46.6	62.5	81.2
Water content, l/m	0.2	0.4	0.6	1.1	1.5	2.3	3.9	5.3	9.0	13.6	19.9	33.5	53.3	75.3
Length L, m	6	6	6	6	6	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12	6/12

Version/07.2005.DK

Pipe

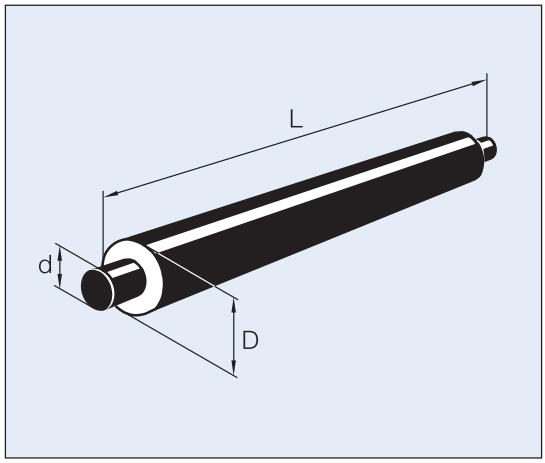
Mapress wst. 1.4404

Supplied in lengths of 6 m.

The pipe is supplied with minor insulation (PUR) on inquiry.

Pipes in jacket dimension ø90 are supplied with 100 mm exposed pipe ends.

Supplied as goods made to order.



Series 1

Component no. 20000L

Steel pipe diameter d, mm	15	18	22	28	35	42	54	76.1	88.9	108
Steel pipe wall thickn., mm	1.0	1.0	1.2	1.2	1.5	1.5	1.5	2.0	2.0	2.0
Jacket pipe diameter D, mm	90	90	90	90	110	110	125	140	160	180
Weight, kg/m	1.4	1.4	1.6	1.8	2.2	2.9	3.6	5.7	6.7	8.0
Water content, l/m	0.13	0.2	0.3	0.5	0.8	1.2	2.0	4.1	5.7	8.5

Series 2

Steel pipe diameter d, mm	15	18	22	28	35	42	54	76.1	88.9	108
Steel pipe wall thickn., mm	1.0	1.0	1.2	1.2	1.5	1.5	1.5	2.0	2.0	2.0
Jacket pipe diameter D, mm	110	110	110	110	125	125	140	160	180	200
Weight, kg/m	1.8	1.9	2.1	2.2	2.7	3.2	4.1	6.2	7.3	8.8
Water content, l/m	0.13	0.2	0.3	0.5	0.8	1.2	2.0	4.1	5.7	8.5

Series 3

Steel pipe diameter d, mm	15	18	22	28	35	42	54	76.1	88.9	108
Steel pipe wall thickn., mm	1.0	1.0	1.2	1.2	1.5	1.5	1.5	2.0	2.0	2.0
Jacket pipe diameter D, mm	125	125	125	125	140	140	160	180	200	225
Weight, kg/m	2.1	2.2	2.4	2.5	3.0	3.7	4.6	6.8	8.0	9.8
Water content, l/m	0.13	0.2	0.3	0.5	0.8	1.2	2.0	4.1	5.7	8.5

Version/07.2005.DK

LOGSTOR Industry

LG Scale Solar

Elbow 90°

St. 37.0 BW, St. 35.8 I

Pre-insulated elbows are produced according to EN 448.

Steel elbows for St. 37.0 BW are bended as follows: R= 2.5 x d

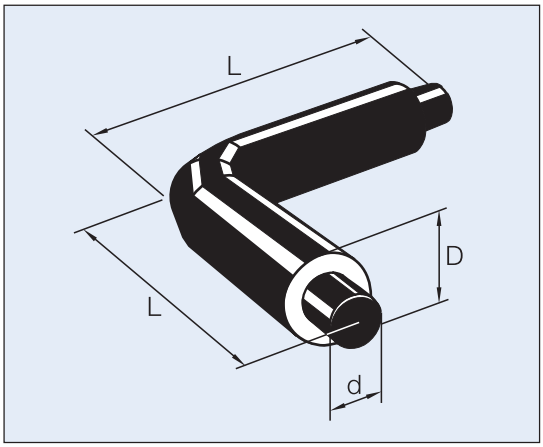
Steel elbows for St. 35.8 I are weld elbows according to DIN 2605 Bauart 3.

Jacket pipe elbows are produced by means of butt welding or extruder welding of jacket segments.

Pre-insulated elbows are not to be shortened.

Elbows with other angles can be supplied on order.

All fitting parts correspond to dimensions in chapter 1.



Component no. 25000L

Version/07.2005.DK

LOGSTOR Industry

LG Scale Solar

T-fitting straight

St. 37.0 BW and St. 35.8 I

NT components - Steel pipe system **3.2.11 - 1/1**

Pre-insulated T-fittings are produced according to EN 448.

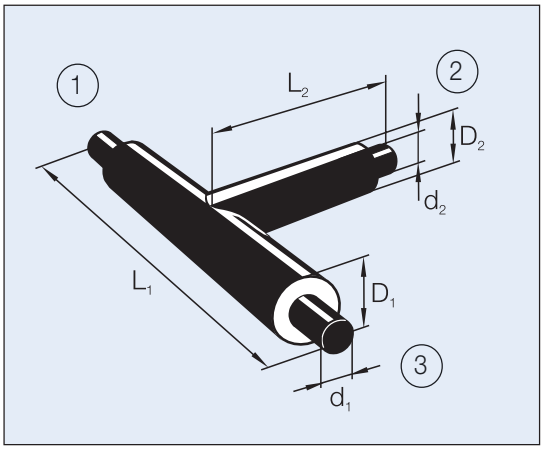
Steel branch pipes are produced by drawing a collar of the main pipe or by welding the branch pipe directly onto the main pipe.

According to DIN 2615, a weld T-fitting is applied when the branch and the main pipe are of the same dimensions.

Other dimensions are supplied on inquiry as goods made to order.

St. 35.8 I is supplied in d ≤ ø323.9.

All fitting parts correspond to dimensions in chapter 1.



Component no. 34000L

Version/07.2005.DK

Anchor

St. 37.0 BW, St. 35.8 I

NT components - Steel pipe system **3.2.14 - 1/1**

Logstor's anchors are produced according to EN 448.

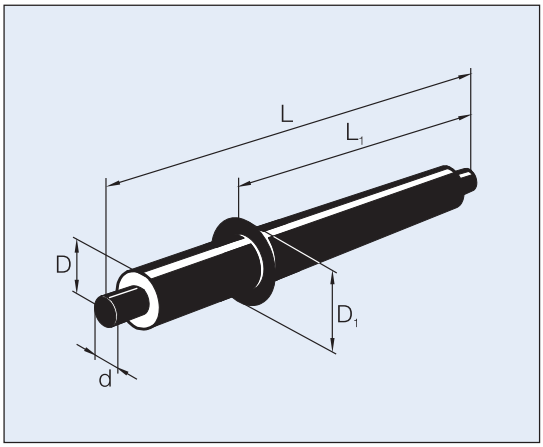
Anchors contain a steel anchor patch.

To avoid an excessive heat transfer from the steel patch to the PEH jacket, a stainless alu-wrap is welded onto the patch.

The component must not be shortened.

Available in series 1, 2 and 3.

Any detection wires are to be transferred through electrical insulation in the steel patch.



St. 37.0 BW, series 1

Component no. 40000L

Steel pipe diameter d, mm	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9	355.6	406.4	508
Jacket pipe dia. D, mm	110	110	125	140	160	200	225	250	315	400	450	500	560	710
Anchor flange dia. D_1, mm	215	215	215	240	260	300	300	350	415	500	550	600	660	810
Anchor flange area, cm^2	268	268	240	298	330	392	309	471	573	707	785	864	958	1068
Max. load, kN	49	56	78	100	129	188	231	310	455	631	840	924	1190	1490
Length L_1, mm	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1400	1400	1400
Total length L, mm	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2500	2500	2500

St. 35.8 I, series 1

Steel pipe diameter d, mm	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273	323.9
Jacket pipe dia. D, mm	110	110	125	140	160	200	225	250	315	400	450
Anchor flange dia. D_1, mm	215	215	215	240	260	300	300	350	415	500	550
Anchor flange area, cm^2	268	268	240	298	330	392	309	471	573	707	785
Max. load, kN	49	56	78	100	129	188	231	310	455	631	840
Length L_1, mm	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150	1150
Total length L, mm	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000

Version/07.2005.DK

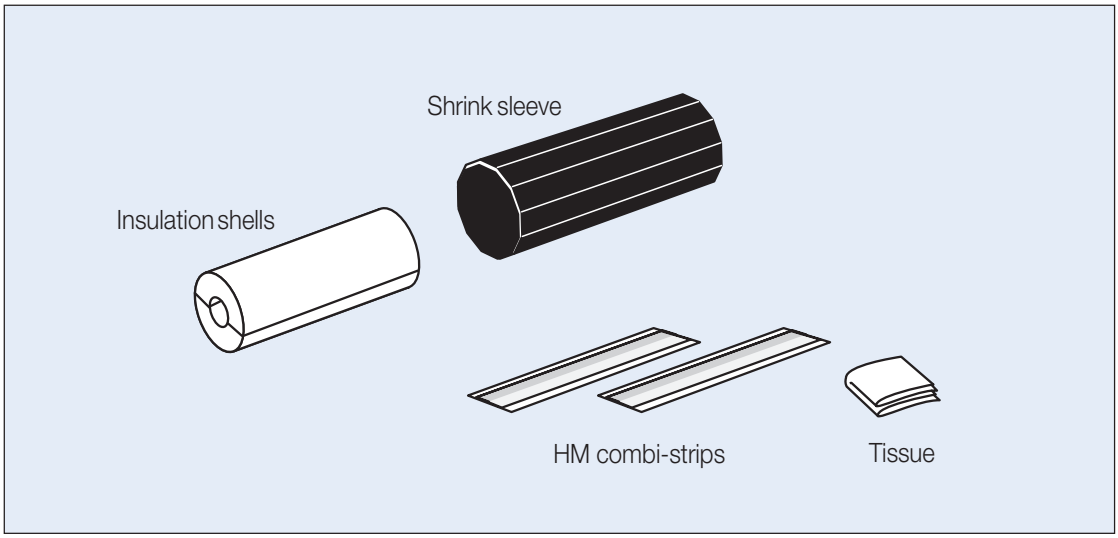
LOGSTOR Industry

LG Scale Solar

FXI

Joint with insulation shells, black

NT components - Joints **3.5.1 - 1/1**



Joint FXI

Component no. 5057C

Carrier pipe diameter D, mm	77	90	110	125	140	160	180	200	225	250	315
Shrink sleeve size	77-110	77-110	77-110	125-160	125-160	125-160	180-225	180-225	180-225	250-315	250-315
Shrink sleeve length, mm	500	500	500	500	500	500	500	500	500	500	500

The FX shrink sleeve is made of cross-linked PE (PEX) material. The joint cannot be pressure tested.

The shrink sleeve is wrapped up in a solid white PE foil at delivery. The foil is closed with white tape. The joint is sealed by the means of HM combi-strips.

Max. temperature of 70°C during transport and storage.

The FXI joint can be used for angles up to max. 5°.

The FXI joint is used for freely suspended systems.

FX joint for flexible systems is ordered as FX district heating.

Version/07.2005.DK

Løgstør Rør A/S · Danmarksvej 11 · DK-9670 Løgstør · Tel. +45 99 66 10 00 · Fax +45 99 66 11 80 · lrinfo@logstor.com

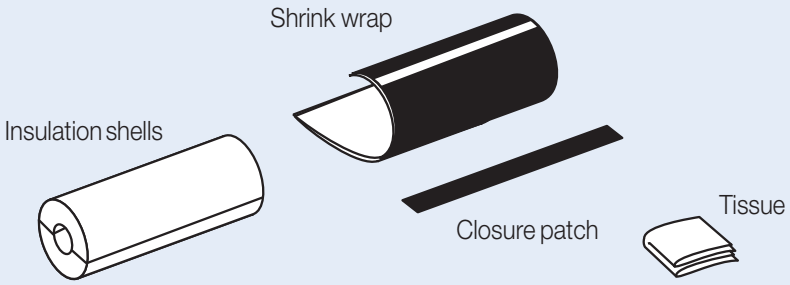
LOGSTOR Industry

LG Scale Solar

FXC

Repair joint with insulation shells, black

NT components - Joints **3.5.2 - 1/1**



Joint FXC

Component no. 5058

Jacket pipe diameter D, mm	77	90	110	125	140	160	180	200	225	250	315
Shrink wrap length, mm	500	500	500	500	500	500	500	500	500	500	500

The shink wrap is made from elastic shrinkable modified UV-stabilized PE (PEX) material.The joint cannot be pressure tested.

The shrink wrap and closure patch are wrapped up in a solid white PE foil at delivery. The foil is closed with white tape. The joint is sealed by means of shrink wrap.

Max. temperature of 70°C during transport and storage.

Version/07.2005.DK

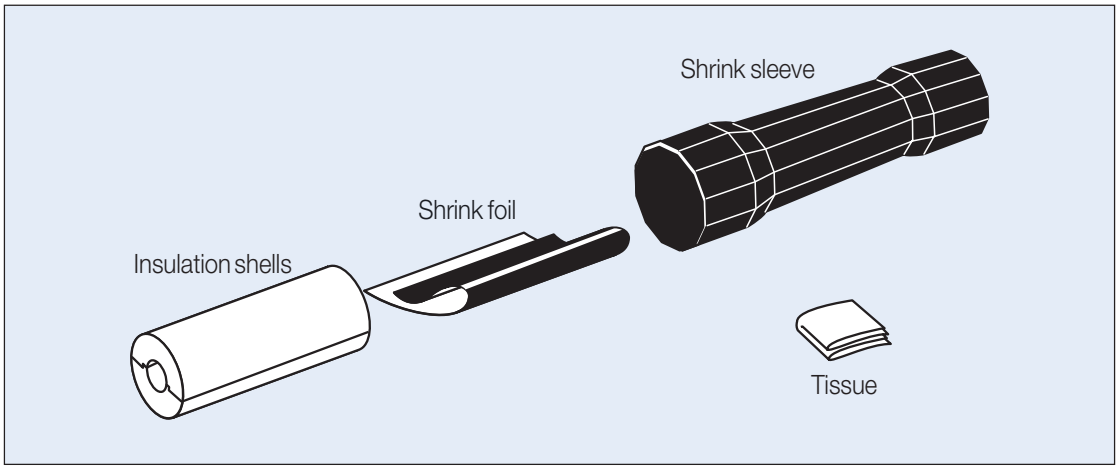
LOGSTOR Industry

LG Scale Solar

BX

Double sealed joint, black

NT components - Joints **3.5.3 - 1/1**



Joint BX

Component no. 50300L

Steel pipe diameter d, mm	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	219.1	273.0	323.9	355.6
Jacket pipe diameter D, mm	90	90	110	110	125	140	160	200	225	250	315	400	450	500
Shrink sleeve length, mm	580	580	580	580	580	580	580	580	580	580	580	580	780	780

Steel pipe diameter d, mm	406.4	457
Jacket pipe diameter D, mm	560	630
Shrink sleeve length, mm	780	780

Joint BX is also available in series 2 and 3.

The BX shrink sleeve is made of cross-linked PE (PEX).

The shrink sleeve is wrapped up in a solid white PE foil at delivery. The sleeve is resistant to soil shearing.

Max. temperature of 70°C during transport and storage.

The shrink sleeves must be stored upright.

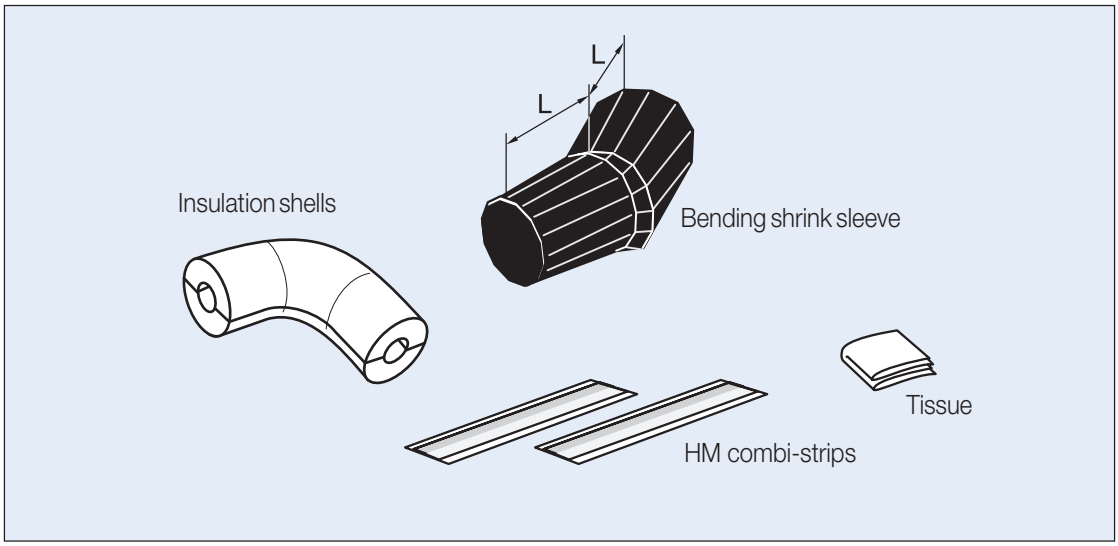
BX joint is designed for above ground as well as under ground installation.

The BX joint has been tested according to EN 489 to confirm that it is able to withstand forces due to the friction of soil and the pressure of ground water.

Version/07.2005.DK

BM

Elbow joint with insulation shells, black and white



Joint BM

Component no. 54000C

Jacket pipe diameter D, mm	40/50	66/77	90	110	125	140	160	180	200	225	250	280	315
Length L, mm	240	260	260	430	430	495	495	495	655	655	695	695	695

The BM bending shrink sleeve is made of cross-linked PE (PEX) material. The joint cannot be pressure tested.

White shrink sleeves are not UV-stabilized and is only for indoor installation.

The shrink sleeve is wrapped up in a solid white PE foil at delivery. The foil is closed with white tape. The joint is sealed by means of HM combi-strips.

Max. temperature of 70°C during transport and storage.

The BM joint is used for freely suspended systems.

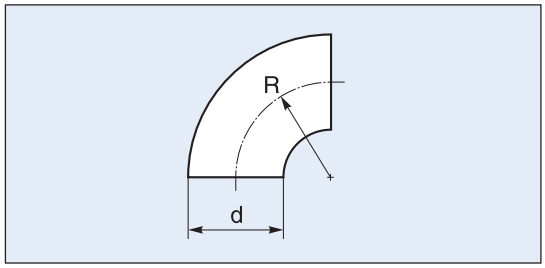
Insulation shells are stocked according to the weld elbows on the following pages.

Version/07.2005.DK

BM

Weld elbow 90° for BM

Logstor does not stock weld elbows. They are to be ordered from an external supplier according to the specifications of the tables.



St. 37.0 BW

d	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9
s	2.6	2.6	3.2	2.6	2.6	2.9	2.9	3.2
R	27.5	28.5	38	47.5	57	76	95	114

d	114.3	139.7	168.3	219.1
s	3.6	3.6	4.0	4.5
R	152	190	229	305

St. 35.8 I

d	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9
s	2.0	2.3	2.6	2.6	2.6	2.9	2.9	3.2
R	27.5	28.5	38	47.5	57	76	95	114

d	114.3	139.7	168.3	219.1
s	3.6	4.0	4.5	6.3
R	152	190	229	305

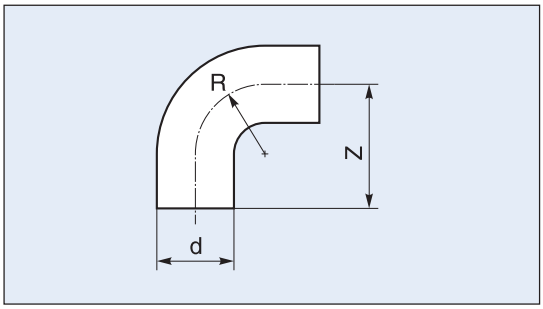
AISI 316 L - ISO dimension acc. to R-1651/ABE-211

d	21.3	26.9	33.7	42.4	48.3	60.3	76.1	88.9
s	2	2	2	2	2	2	2	2
R	27.5	28.5	38	47.5	57	76	95	114

d	114.3	139.7	168.3	219.1
s	2	2	2	2
R	152	190	229	305

AISI 316 L - metric dimension according to R-1651/ABE-111

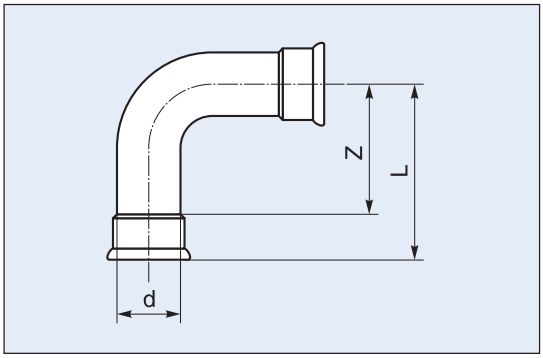
d	104	129	154	204
s	2.0	2.0	2.0	2.0
R	150	188	225	300



AISI 316L (Dairy pipes)

d	25	38	51	63.5	76	101.6
s	1.2	1.2	1.2	1.5	2.0	2.0
R	25	36	46	56	76	150
Z	55	70	82	105	110	150

Mapress



d	15	18	22	28	35	42	54	76.1
s	1.0	1.0	1.2	1.2	1.5	1.5	1.5	2.0
Z	29	33	40	49	96	136	165	182
L	49	53	61	72	122	166	200	235

d	88.9	108
s	2.0	2.0
Z	217	266
L	277	341

d = Weld elbow diameter,mm

s = Wall thickness, mm

R = Radius,mm

Z = Z- measures, mm

Version/07.2005.DK

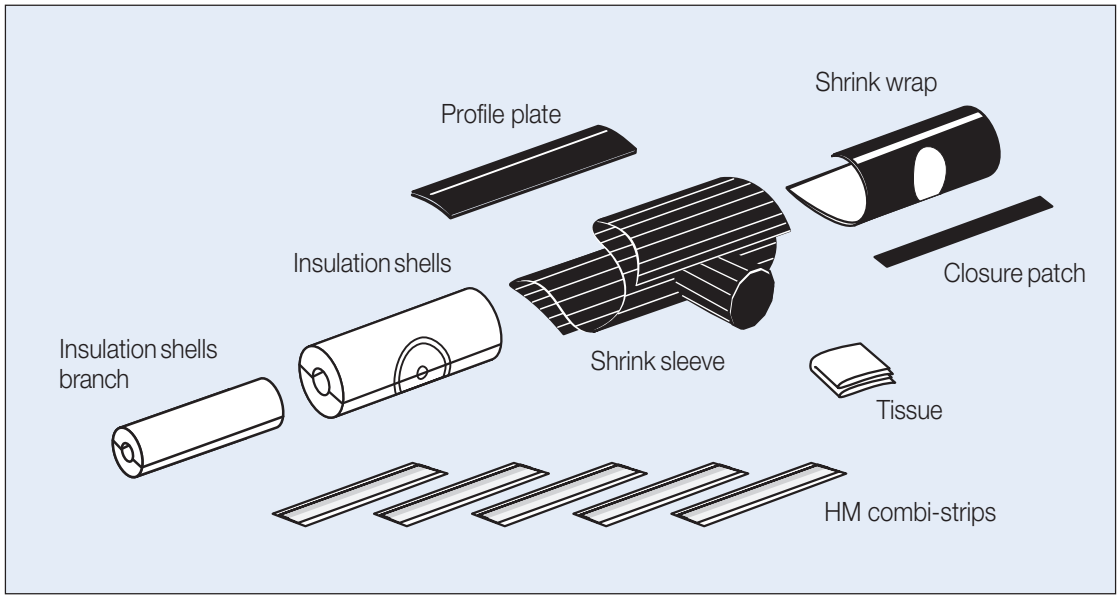
LOGSTOR Industry

LG Scale Solar

TMC-C

T-joint with insulation shells, black

NT components - Joints **3.5.8 - 1/1**



Joint TMC-C

Component no. 52600C

	Jacket diameter main pipe, mm						
	90	110	125	140	160	180	200
Branch							
90	X	X	X	X	X	X	X
110	X	X	X	X	X	X	X
125		X	X	X	X	X	X
140			X	X	X	X	X
160				X	X	X	X
180					X	X	X

The shrink sleeve is made of cross-linked PE (PEX) material. The joint cannot be pressure tested.

Retaining tools are necessary to carry out the installation. The tool is to be ordered separately.

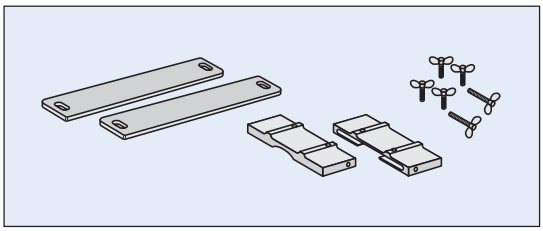
The shrink sleeve is wrapped up in a solid white PE foil at delivery. The foil is closed with white tape. The joint is sealed by means of HM combi-strips.

Max. temperature of 70°C during transport and storage.

The TMC-C joint is used for freely suspended systems.

Retaining tools for installation

Product code 9000 0000 027 003



Version/07.2005.DK

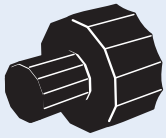
LOGSTOR Industry

LG Scale Solar

DHEC

End cap, black

NT components - Joints **3.5.10 - 1/1**



End cap

End cap DHEC

Component no. 56000L

Carrier pipe diameter d, mm	26.9	33.7	42.4	48.3	60.3	76.1	88.9	114.3	139.7	168.3	193.7	219.1	273.0	323.9	355.6
Jacket pipe diameter D, mm	90	90	110	110	125	140	160	200	225	250	280	315	400	450	500
DHEC no.	2100	2100	2200	2300	2400	2400	2500	2600	2700	2700	2800	2800	2900	3000	3000

The DHEC end cap is made of cross-linked PE (PEX) material. The joint cannot be pressure tested.

The end cap is applied for protection of the foamed ends against moisture penetration. Applicable for a max. carrier pipe temperature of 100°C.

Max. temperature of 70°C during transport and storage.

Version/07.2005.DK

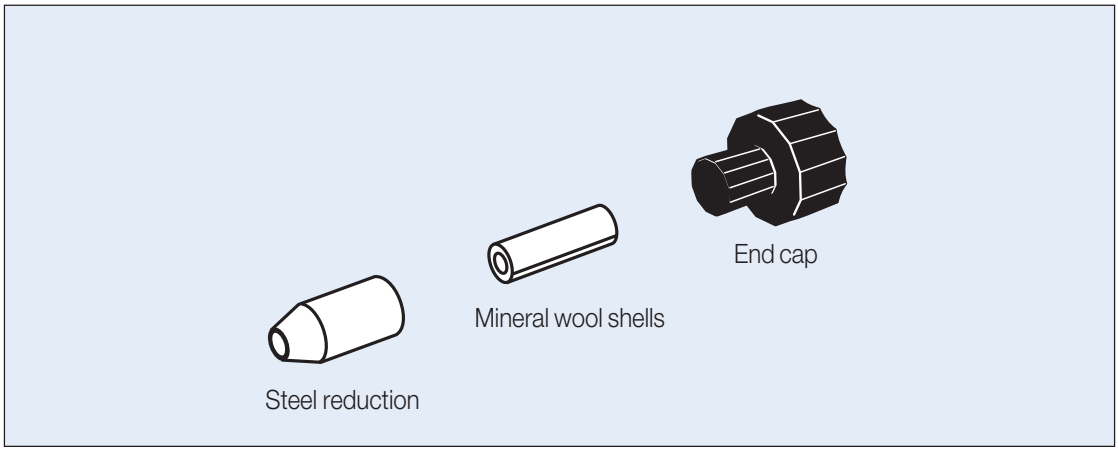
LOGSTOR Industry

LG Scale Solar

HDHEC

End cap, black

NT components - Joints **3.5.12 - 1/1**



End cap HDHEC

Component no. 55101L

The HDHEC end cap is made of cross-linked PE (PEX) material. The joint cannot be pressure tested.

The HDHEC end cap is applicable in temperature ranging from -200° to +140° C. Thw HDHEC must be applied in temperature ranging below -30° C and above +120° C.

HDHEC is applicable for freely suspended and directly buried systems.

The end cap is applied for protection of the foamed ends against moisture penetration. Is applicable for a max. carrier pipe temperature of 140°C.

Max. temperature of 70°C during transport and storage.

Version/07.2005.DK

Løgstør Rør A/S · Danmarksvej 11 · DK-9670 Løgstør · Tel. +45 99 66 10 00 · Fax +45 99 66 11 80 · lrinfo@logstor.com