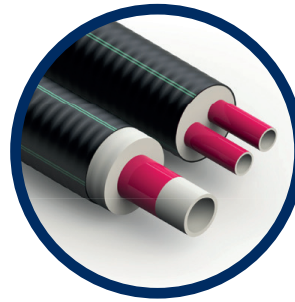


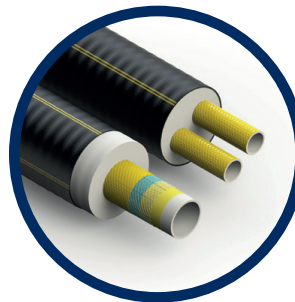
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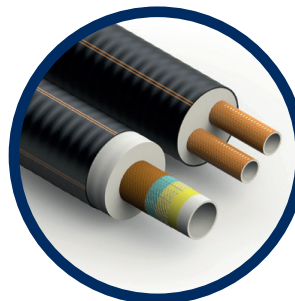
**HeatFlex**  
Page 1



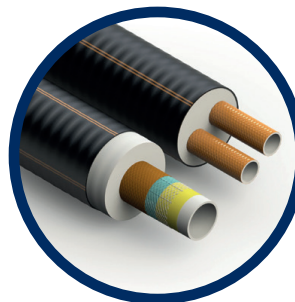
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# HeatFlex®

## TECHNICAL DATA SHEET

Pre-insulated, flexible HeatFlex PN6 plastic pipe system

Pre-insulated flexible PE-Xa pipe, thermal insulation of CFC-free polyurethane foam with blowing agent cyclo-pentane (Lambda50: 0.021 W/mK) and corrugated casing of black LLD-PE, manufactured in accordance with EN15632-1, 2 and technical specification OFI ZG 200-1, bonded pipe system with no axial expansion in the supply line, for a service life of min. 30 years, for design pressures up to 6 bar at maximum operating temperature, for time/temperature profiles according to ISO 13760, with peak operating temperatures up to 95°C, with a connection system with axial compression fittings and sliding sleeves.

|  |   |
|--|---|
| Service Pipe   | HeatFlex PN6<br>cross-linked polyethylene PE-Xa SDR11, EN ISO 15875-1, 2 with oxygen barrier (EVOH) according to EN 15632-2   |
| Casing   | Polyurethane insulation with<br>Corrugated LLD-PE extruded seamlessly   |
| Pipe connection system   | Axial press system with compression sleeves according to EN ISO 15875-3, 5 or clamp fittings  |
| Casing connection system   | Joint casing assembling according to EN 489-1 or half-shell system  |
| Delivery of the pipeline   | Max. Coil length according to manufacturer information or on customer request   |
| Lambda-insulation at 50 °C                                       | 0,021 W / m.K   |
| Temperature range  | -20°C bis +95°C   |
| Max. continuous operating temperature at max. operating pressure | + 80 °C at 6 bar or + 95 °C (variable)  |
| Maximum operating temperature                                    | +95°C (variable)  |
| Other properties   | self-compensating elongation through the bonded system  |
| Relevant standards:  | <ul style="list-style-type: none"> <li>- Service pipe corresponds to ofi ZG200-1 and EN15632-1, 2</li> <li>- Insulation and casing according to EN 15632-1, 2</li> <li>- Service pipe connection system according to EN ISO 15875-3, 5</li> </ul>                               |
| Certificates:  | <ul style="list-style-type: none"> <li>- ISO 9001:2015 (TÜV AUSTRIA, Cert.-No.: 20100193005997)</li> <li>- ISO 14001:2015 (TÜV AUSTRIA, Cert.-No.: 20104193005998)</li> <li>- ZG 200-1 (ofi, Cert.No.: 0457)</li> <li>- CSTB TD 08-02 (CSTB Cert.No.: 4163-254-2252)</li> </ul> |

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
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Long-term load HeatFlex PN6 without load changes based on EN15632-2: 2022 for pre-insulated district heating and district cooling applications:

| temperature in °C | Safety factor C |      | Pressure (bar)      |      |      |      |      |
|-------------------|-----------------|------|---------------------|------|------|------|------|
|                   |                 |      | Lifespan (years)    |      |      |      |      |
|                   |                 |      | HeatFlex PN6 (6bar) |      |      |      |      |
|                   |                 |      | 1                   | 5    | 10   | 25   | 50   |
| 10                | TD              | 1,50 | 14,9                | 14,6 | 14,5 | 14,4 | 14,2 |
| 20                |                 | 1,50 | 13,2                | 12,9 | 12,8 | 12,7 | 12,6 |
| 30                |                 | 1,50 | 11,7                | 11,5 | 11,4 | 11,3 | 11,2 |
| 40                |                 | 1,50 | 10,4                | 10,2 | 10,1 | 10,0 | 9,9  |
| 50                |                 | 1,50 | 9,3                 | 9,1  | 9,0  | 8,9  | 8,8  |
| 60                |                 | 1,50 | 8,3                 | 8,1  | 8,0  | 7,9  | 7,9  |
| 70                |                 | 1,50 | 7,4                 | 7,3  | 7,2  | 7,1  | 7,0  |
| 80                |                 | 1,50 | 6,6                 | 6,5  | 6,4  | 6,4  | -    |
| 90                | Tmax.           | 1,30 | 7,0                 | 6,8  | 6,7  | -    | -    |
| 95                | Tmal.           | 1,00 | 7,2                 | 7,0  | 7,0  | -    | -    |

According to EN15632-1, 2 and according to the technical specification OFI ZG200-1, the operating coefficient for the design of the pipeline is C = 1.5; Use C = 1.3 for the maximum temperature and C = 1 for the disorder. Other temperature / time profiles can be used in accordance with ISO 13760 (Miner's rule). See examples on page 3

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
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Application of Miner's rule - calculation of the service life of HeatFlex PN6 systems.

Pipe systems according to this document are designed for a service life of at least 30 years when operated with the temperature / time profile specified in Table E.1.

This appendix contains four examples of the expected service life when a piping system that meets the requirements of this document is operated at a temperature profile other than that specified in Table E.1.

The examples are calculated based on the reference lines and the given safety factors.

Furthermore, Miner's rule (EN ISO 13760) is used to calculate the expected service life of polymeric piping systems (PB-H and PE-Xa) as a function of temperatures and operating times.

The service life calculation applies under the condition that the maximum pressure for the pipeline system is not exceeded -> HeatFlex PN6.

The following selection of typical examples of temperature profiles should help to understand the influence of different temperatures on the calculated service life of HeatFlex PN6 systems.

The calculated service life as a calculation result depending on the design temperature and the corresponding annual operating times are given in Table E.1.

The pipe manufacturer should be contacted if more detailed information or support for specific temperature profiles is required.

Table E.1 - Examples for the calculated service life PE-Xa EN15632 - 1, 2 PN6 (SDR11) and OFI ZG200-1

| Examples of temperature profiles | Service life with max. operating pressure of 6 bar | T <sub>D</sub> |       | Annual operation | T <sub>max</sub> |       | T <sub>mal</sub> |       |
|----------------------------------|--|----------------|-------|------------------|------------------|-------|------------------|-------|
|                                  |  | °C             | Years |                  | °C               | hours | °C               | hours |
| Example 1                        | 30 years   | 80             | 29    | 365 days a year  | 90               | 7760  | 100              | 100   |
|                                  |  |                |       |                  | 95               | 1000  |                  |       |

| Examples of temperature profiles | Service life with max. operating pressure of 6 bar | Annual operation | °C | days/year |
|----------------------------------|--|------------------|----|-----------|
|                                  |  |                  | 65 | 22        |
| 70                               | 155  |                  |    |           |
| 75                               | 35   |                  |    |           |
| 80                               | 146  |                  |    |           |
| 85                               | 7  |                  |    |           |
| Example 3                        | 40 years   | 229 days a year  | 50 | 11        |
|                                  |  |                  | 60 | 10        |
|                                  |  |                  | 65 | 5         |
|                                  |  |                  | 70 | 5         |
|                                  |  |                  | 75 | 5         |
| Example 4                        | more than 100 years                                | 365 days a year  | 55 | 182,5     |
|                                  |  |                  | 65 | 182,5     |

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The system heat losses are determined under the following conditions:

|  |   |
|--|---|
| $t_v$ [°C] Flow temperature                    | 80 °C   |
| $t_R$ [°C] Return temperature                  | 60 °C   |
| $t_E$ [°C] Soil temperature                    | 10 °C   |
| $t_B$ [°C] middle operating temperature        | $t_B = (t_v + t_R)/2$   |
| $l_E$ Coefficient of thermal conductivity soil | 1,0 W/m.K   |
| $h$ [mm] Overlap amount                        | 800 mm  |
| $d$ [mm]                                       | Outer diameter of the service pipe  |
| $D$ [mm]                                       | outer diameter of the casing  |
| $U$ [W/mK]                                     | Heat transfer coefficient [W / m <sup>2</sup> K]<br>based on 1m pipe          |
| $Q$ [W/m]                                      | Heat loss (this is the total loss of 1 m of pipe) $Q = U (t_B - t_E)$ [W / m] |
| $l_U$ [m]                                      | Length of each section <sup>1</sup>   |
| Total heat loss of the system [W]              | calculated as $Q \times l_U$ [W]  |

<sup>1</sup> Meters of pipeline for calculation ie. with 2xd25 100 m are counted, with 1xd75 200 m per 100 m distance are counted.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
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Heat loss table for HeatFlex PN6

| Service pipe |                       | Casing  | Bending radius | Heat transfer coefficient | Heat loss trench at an average operating temperature of 70°C |
|--------------|-----------------------|---------|----------------|---------------------------|--|
| d[mm]        | Wall thickness s [mm] | OD [mm] | r [m]          | [W/m K]                   | [W]  |
| 2x d25       | 2,3                   | 91      | 0,9            | 0,1821                    | 10,93  |
|              | 2,3                   | 111     | 0,9            | 0,1394                    | 8,36   |
| 2x d32       | 2,9                   | 111     | 0,9            | 0,1936                    | 11,62  |
|              | 2,9                   | 126     | 1,0            | 0,1599                    | 9,59   |
| 2x d40       | 3,7                   | 126     | 1,0            | 0,2203                    | 13,22  |
|              | 3,7                   | 142     | 1,1            | 0,1786                    | 10,72  |
| 2x d50       | 4,6                   | 162     | 1,2            | 0,2010                    | 12,06  |
|              | 4,6                   | 182     | 1,3            | 0,1677                    | 10,06  |
| 2x d63       | 5,8                   | 182     | 1,3            | 0,2431                    | 14,59  |
|              | 5,8                   | 202     | 1,4            | 0,1975                    | 11,85  |
| 2x d75       | 6,8                   | 202     | 1,4            | 0,2784                    | 16,70  |
|              | 6,8                   | 225     | 1,6            | 0,2185                    | 13,11  |

| d[mm] | Wall thckn. s [mm] | OD [mm] | r [m] | [W/m K] | [W]   |
|-------|--------------------|---------|-------|---------|-------|
| d25   | 2,3                | 76      | 0,7   | 0,1129  | 6,77  |
|       | 2,3                | 91      | 0,9   | 0,0972  | 5,83  |
| d32   | 2,9                | 76      | 0,7   | 0,1431  | 8,59  |
|       | 2,9                | 91      | 0,9   | 0,1189  | 7,13  |
| d40   | 3,7                | 91      | 0,9   | 0,1487  | 8,92  |
|       | 3,7                | 111     | 0,9   | 0,1209  | 7,25  |
| d50   | 4,6                | 111     | 0,9   | 0,1521  | 9,13  |
|       | 4,6                | 126     | 1,0   | 0,1324  | 7,94  |
| d63   | 5,8                | 126     | 1,0   | 0,1723  | 10,34 |
|       | 5,8                | 142     | 1,1   | 0,1487  | 8,92  |
| d75   | 6,8                | 142     | 1,1   | 0,1851  | 11,12 |
|       | 6,8                | 162     | 1,2   | 0,1564  | 9,38  |
| d90   | 8,2                | 162     | 1,2   | 0,1995  | 11,97 |
|       | 8,2                | 182     | 1,3   | 0,1695  | 10,17 |
| d110  | 10,0               | 162     | 1,2   | 0,2864  | 17,18 |
|       | 10,0               | 182     | 1,3   | 0,2284  | 13,70 |
|       | 10,0               | 202     | 1,4   | 0,2014  | 12,08 |
| d125  | 11,4               | 182     | 1,3   | 0,2933  | 17,60 |
|       | 11,4               | 202     | 1,4   | 0,2369  | 14,21 |

The specified values are based on an average specific heat capacity [cm] of the water of 4,187 J / (kg · K).  
All values are based on an overburden [ÜH] of 0.80 m, a conductivity of the soil [IE] of 1.0 W / (m · K), a soil temperature [TE] of 10 ° C and, for individual pipes, a pipe spacing of 100 mm.  
Average temperature TM = (TVL + TRL): 2

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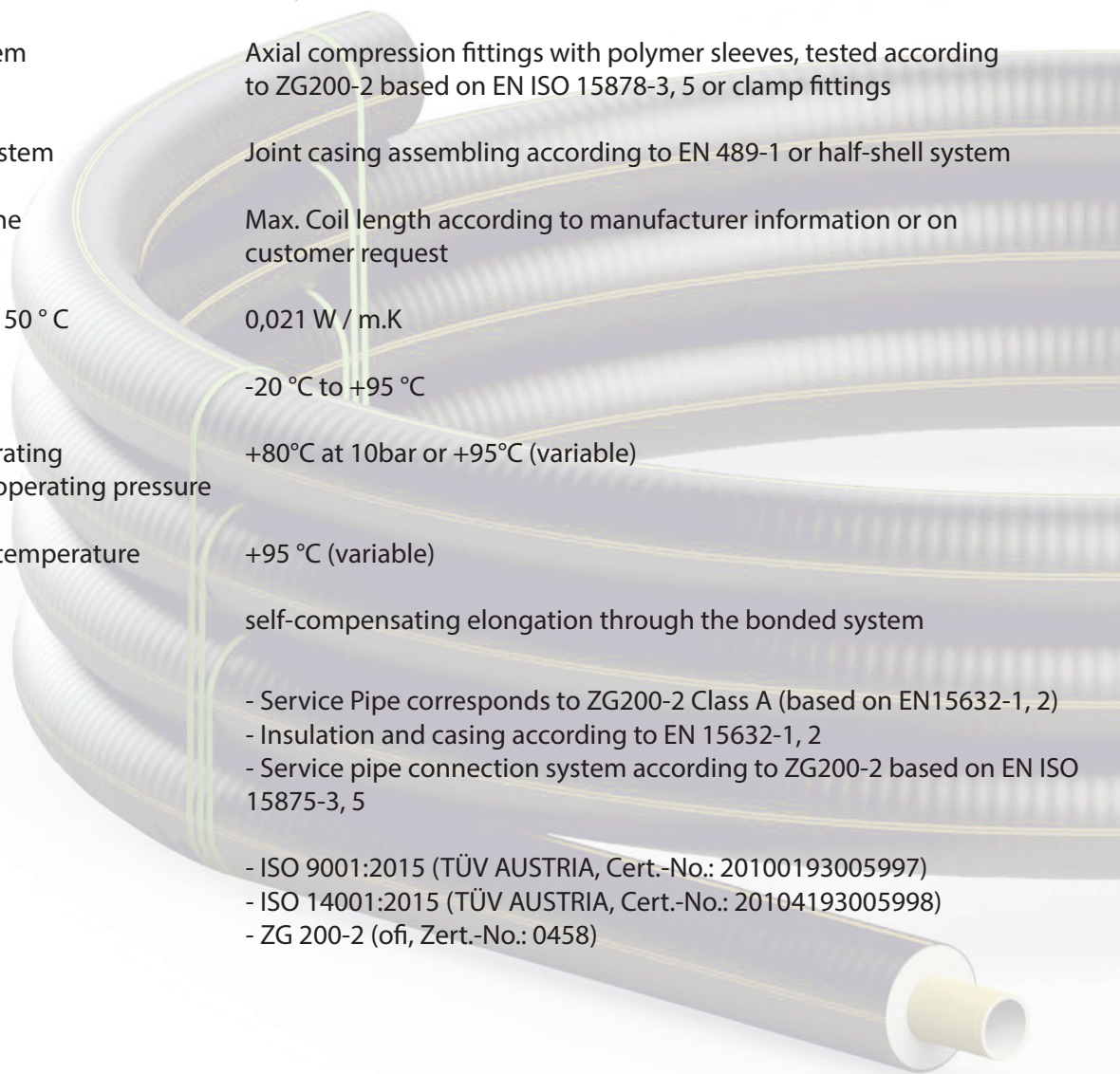
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# FibreFlex®

## TECHNICAL DATA SHEET Pre-insulated, flexible FibreFlex PN10 plastic pipe system

Pre-insulated flexible PE-Xa pipe reinforced with fiber mesh of aramid, thermal insulation of CFC-free polyurethane foam with blowing agent cyclo-pentane ( $\lambda_{50}$ : 0.021 W/mK) and corrugated casing of black LLD-PE, manufactured in accordance with technical specification OFI ZG 200-2 Class A, bonded pipe system without axial expansion in the supply line, for a service life of min. 30 years, for design pressures up to 10bar at maximum operating temperature, for time/temperature profiles according to ISO 13760, with peak operating temperatures up to 95°C, with a connection system with axial compression fittings and polymer sleeves.

|  |   |
|--|---|
| Service Pipe   | FibreFlex PN10<br>cross-linked polyethylene PE-Xa reinforced with fiber mesh of aramid with oxygen barrier (EVOH) according to ZG 200-2   |
| Casing   | Polyurethane insulation with corrugated LLD-PE extruded seamlessly  |
| Pipe connection system   | Axial compression fittings with polymer sleeves, tested according to ZG200-2 based on EN ISO 15878-3, 5 or clamp fittings   |
| Casing connection system   | Joint casing assembling according to EN 489-1 or half-shell system  |
| Delivery of the pipeline   | Max. Coil length according to manufacturer information or on customer request   |
| Lambda-insulation at 50 °C                                       | 0,021 W / m.K   |
| Temperature range  | -20 °C to +95 °C  |
| Max. continuous operating temperature at max. operating pressure | +80°C at 10bar or +95°C (variable)  |
| Maximum operating temperature                                    | +95 °C (variable)   |
| Other properties   | self-compensating elongation through the bonded system  |
| Relevant standards:  | <ul style="list-style-type: none"> <li>- Service Pipe corresponds to ZG200-2 Class A (based on EN15632-1, 2)</li> <li>- Insulation and casing according to EN 15632-1, 2</li> <li>- Service pipe connection system according to ZG200-2 based on EN ISO 15875-3, 5</li> </ul> |
| Certificates:  | <ul style="list-style-type: none"> <li>- ISO 9001:2015 (TÜV AUSTRIA, Cert.-No.: 20100193005997)</li> <li>- ISO 14001:2015 (TÜV AUSTRIA, Cert.-No.: 20104193005998)</li> <li>- ZG 200-2 (ofi, Zert.-No.: 0458)</li> </ul>  |





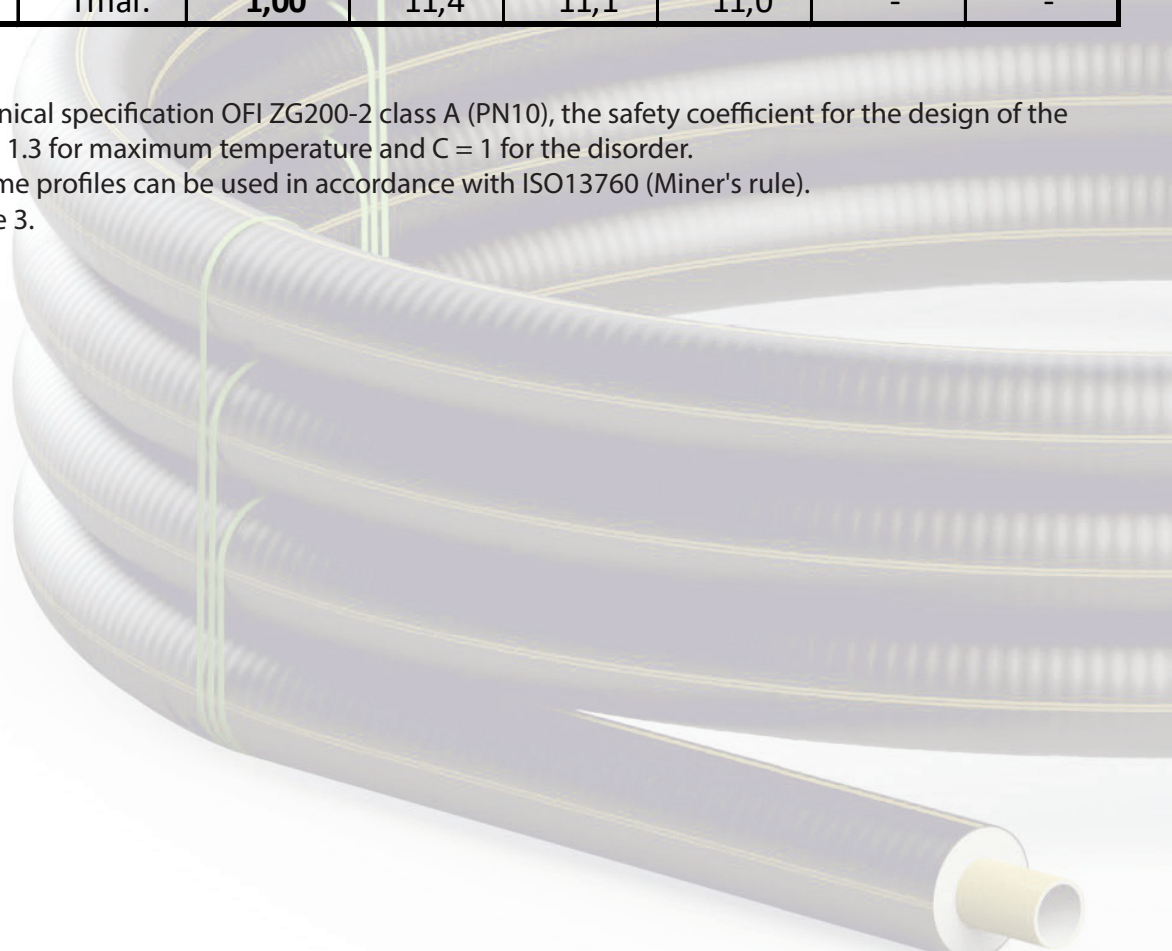
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Long-term load FibreFlex PN10 Pipe without load changes based on ofi ZG200-2 Class A (based on EN15632-2:2022) for pre-insulated district heating and district cooling applications:

| temperature in °C | Safety factor C |      | Pressure (bar)         |      |      |      |      |
|-------------------|-----------------|------|------------------------|------|------|------|------|
|                   |                 |      | Lifespan (years)       |      |      |      |      |
|                   |                 |      | FibreFlex PN10 (10bar) |      |      |      |      |
|                   |                 |      | 1                      | 5    | 10   | 25   | 50   |
| 10                | TD              | 1,50 | 23,6                   | 23,2 | 23,0 | 22,8 | 22,6 |
| 20                |                 | 1,50 | 20,9                   | 20,5 | 20,4 | 20,1 | 20,0 |
| 30                |                 | 1,50 | 18,5                   | 18,2 | 18,1 | 17,9 | 17,7 |
| 40                |                 | 1,50 | 16,5                   | 16,2 | 16,1 | 15,9 | 15,7 |
| 50                |                 | 1,50 | 14,7                   | 14,4 | 14,3 | 14,1 | 14,0 |
| 60                |                 | 1,50 | 13,1                   | 12,9 | 12,8 | 12,6 | 12,5 |
| 70                |                 | 1,50 | 11,8                   | 11,5 | 11,4 | 11,3 | 11,2 |
| 80                |                 | 1,50 | 10,5                   | 10,3 | 10,2 | 10,1 | -    |
| 90                | Tmax.           | 1,30 | 11,2                   | 10,9 | 10,8 | -    | -    |
| 95                | Tmal.           | 1,00 | 11,4                   | 11,1 | 11,0 | -    | -    |

According to the technical specification OFI ZG200-2 class A (PN10), the safety coefficient for the design of the pipeline is C = 1.5; C = 1.3 for maximum temperature and C = 1 for the disorder. Other temperature/time profiles can be used in accordance with ISO13760 (Miner's rule). See examples on page 3.



Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

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Application of Miner's rule - calculation of the service life of FibreFlex PN10 systems.

Pipe systems according to this document are designed for a service life of at least 30 years when operated with the temperature / time profile specified in Table E.1.

This appendix contains five examples of the expected service life when a piping system that meets the requirements of this document is operated at a temperature profile other than that specified in Table E.1.

The examples are calculated based on the reference lines and the given safety factors.

Furthermore, Miner's rule (EN ISO 13760) is used to calculate the expected service life of polymeric piping systems (PB-H and PE-Xa) as a function of temperatures and operating times.

The service life calculation applies under the condition that the maximum pressure for the pipeline system is not exceeded -> FibreFlex PN10.

The following selection of typical examples of temperature profiles should help to understand the influence of different temperatures on the calculated service life of FibreFlex PN10 systems.

The calculated service life as a calculation result depending on the design temperature and the corresponding annual operating times are given in Table E.1.

The pipe manufacturer should be contacted if more detailed information or support for specific temperature profiles is required.

**Table E.1. Examples for the calculated service life TRSP, class of use A PN10**

| Examples of temperature profiles | Service life with max. operating pressure of 10 bar | T <sub>D</sub> |       | Annual operation | T <sub>max</sub> |       | T <sub>mal</sub> |       |
|----------------------------------|---|----------------|-------|------------------|------------------|-------|------------------|-------|
|                                  |   | °C             | Years |                  | °C               | hours | °C               | hours |
| Example 1                        | 30 years  | 80             | 29    | 365 days a year  | 90               | 7760  | 100              | 100   |
|                                  |   |                |       |                  | 95               | 1000  |                  |       |

| Examples of temperature profiles | Service life with max. operating pressure of 10 bar | Annual operation | °C        | days/year |
|----------------------------------|---|------------------|-----------|-----------|
|                                  |   |                  | Example 2 | 49 years  |
| Example 2                        | 49 years  | 365 days a year  | 70        | 155       |
|                                  |   |                  | 75        | 35        |
|                                  |   |                  | 80        | 146       |
|                                  |   |                  | 85        | 7         |
|                                  |   |                  | Example 3 | 41 years  |
| Example 3                        | 41 years  | 229 days a year  | 60        | 10        |
|                                  |   |                  | 65        | 5         |
|                                  |   |                  | 70        | 5         |
|                                  |   |                  | 75        | 5         |
|                                  |   |                  | 80        | 5         |
|                                  |   |                  | 85        | 188       |
| Example 4                        | more than 100 years                                 | 365 days a year  | 55        | 182,5     |
|                                  |   |                  | 65        | 182,5     |

**Examples for the calculated service life TRSP, class of use A PN10 but max. operation with PN6**

| Examples of temperature profiles | Service life with max. operating pressure of 6 bar | T <sub>D</sub> |       | Annual operation | T <sub>max</sub> |       | T <sub>mal</sub> |       |
|----------------------------------|--|----------------|-------|------------------|------------------|-------|------------------|-------|
|                                  |  | °C             | years |                  | °C               | hours | °C               | hours |
| Example 5                        | 50 years   | 80             | 29    | 365 days a year  | 90               | 7760  | 100              | 100   |
|                                  |  |                |       |                  | 95               | 1000  |                  |       |

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A-4300 St. Valentin  
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The system heat losses are determined under the following conditions:

|  |  |
|--|--|
| $t_v$ [°C] Flow temperature                    | 80 °C  |
| $t_R$ [°C] Return temperature                  | 60 °C  |
| $t_E$ [°C] Soil temperature                    | 10 °C  |
| $t_B$ [°C] middle operating temperature        | $t_B = (t_v + t_R)/2$  |
| $l_E$ Coefficient of thermal conductivity soil | 1,0 W/m.K  |
| $h$ [mm] Overlap amount                        | 800 mm   |
| $d$ [mm]                                       | Outer diameter of the service pipe   |
| $D$ [mm]                                       | Outer diameter of the casing   |
| $U$ [W/mK]                                     | Heat transfer coefficient [W / m <sup>2</sup> K] based on 1m pipe            |
| $Q$ [W/m]                                      | Heat loss (this is the total loss of 1m of pipe) $Q = U (t_B - t_E)$ [W / m] |
| $l_U$ [m]                                      | Length of each section <sup>1</sup>  |
| Total heat loss of the system [W]              | calculated as $Q \times l_U$ [W]   |

<sup>1</sup> Meters of pipeline for calculation i.e. with 2x25 100 m are counted, with 1x75 200 m per 100 m distance are counted.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
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Heat loss table for FibreFlex PN10

| Service pipe |                      |                       | Casing  | Bending radius | Heat transfer coefficient | Heat loss trench at an average operating temperature 70°C |
|--------------|----------------------|-----------------------|---------|----------------|---------------------------|---|
| d[mm]        | Nominal size da [mm] | Wall thickness s [mm] | OD [mm] | r [m]          | [W/m K]                   | [W]   |
| 2x d25       | 25,0                 | 2,2                   | 91      | 0,9            | 0,1821                    | 10,93   |
|              | 25,0                 | 2,2                   | 111     | 0,9            | 0,1395                    | 8,37  |
| 2x d32       | 32,0                 | 2,5                   | 111     | 0,9            | 0,1937                    | 11,62   |
|              | 32,0                 | 2,5                   | 126     | 1,0            | 0,1599                    | 9,59  |
| 2x d40       | 40,0                 | 2,8                   | 126     | 1,0            | 0,2206                    | 13,24   |
|              | 40,0                 | 2,8                   | 142     | 1,1            | 0,1788                    | 10,73   |
| 2x d50       | 47,6                 | 3,6                   | 162     | 1,2            | 0,1866                    | 11,20   |
|              | 47,6                 | 3,6                   | 182     | 1,3            | 0,1580                    | 9,48  |
| 2x d63       | 58,5                 | 4,0                   | 182     | 1,3            | 0,2116                    | 12,66   |
|              | 58,5                 | 4,0                   | 202     | 1,4            | 0,1773                    | 10,64   |
| 2x d75       | 69,5                 | 4,6                   | 202     | 1,4            | 0,2353                    | 14,12   |
|              | 69,5                 | 4,6                   | 225     | 1,6            | 0,1928                    | 11,57   |
| 2x d90       | 84,0                 | 6,0                   | 225     | 1,6            | 0,2781                    | 16,69   |

| d[mm] | Nominal s. da [mm] | Wall thckn. s [mm] | OD [mm] | r [m] | [W/m K] | [W]   |
|-------|--------------------|--------------------|---------|-------|---------|-------|
| d25   | 25,0               | 2,2                | 76      | 0,7   | 0,1129  | 6,77  |
|       | 25,0               | 2,2                | 91      | 0,9   | 0,0973  | 5,84  |
| d32   | 32,0               | 2,5                | 76      | 0,7   | 0,1434  | 8,60  |
|       | 32,0               | 2,5                | 91      | 0,9   | 0,1190  | 7,14  |
| d40   | 40,0               | 2,8                | 91      | 0,9   | 0,1492  | 8,95  |
|       | 40,0               | 2,8                | 111     | 0,9   | 0,1213  | 7,28  |
| d50   | 47,6               | 3,6                | 111     | 0,9   | 0,1442  | 8,65  |
|       | 47,6               | 3,6                | 126     | 1,0   | 0,1264  | 7,58  |
| d63   | 58,5               | 4,0                | 126     | 1,0   | 0,1577  | 9,46  |
|       | 58,5               | 4,0                | 142     | 1,1   | 0,1377  | 8,26  |
| d75   | 69,5               | 4,6                | 142     | 1,1   | 0,1680  | 10,08 |
|       | 69,5               | 4,6                | 162     | 1,2   | 0,1440  | 8,64  |
| d90   | 84,0               | 6,0                | 162     | 1,2   | 0,1813  | 10,88 |
|       | 84,0               | 6,0                | 182     | 1,3   | 0,1562  | 9,37  |
| d110  | 101,0              | 6,5                | 162     | 1,2   | 0,2432  | 14,59 |
|       | 101,0              | 6,5                | 182     | 1,3   | 0,2001  | 12,01 |
|       | 101,0              | 6,5                | 202     | 1,3   | 0,1722  | 10,33 |
| d125  | 116,0              | 6,8                | 182     | 1,3   | 0,2536  | 15,22 |
|       | 116,0              | 6,8                | 202     | 1,4   | 0,2103  | 12,62 |
| d140  | 127,0              | 7,1                | 202     | 1,6   | 0,2460  | 14,76 |
|       | 127,0              | 7,1                | 225     | 1,6   | 0,2050  | 12,30 |
| d160  | 144,0              | 7,5                | 225     | 1,6   | 0,2550  | 15,30 |

The specified values are based on an average specific heat capacity [cm] of the water of 4,187 J / (kg · K).  
All values are based on an overburden [ÜH] of 0.80 m, a conductivity of the soil [IE] of 1.0 W / (m · K), a soil temperature [TE] of 10 ° C and for individual pipes, a pipe spacing of 100 mm.  
Average temperature TM = (TVL + TRL): 2

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

# FibreFlex® Pro

## TECHNICAL DATA SHEET

### Pre-insulated, flexible FibreFlex Pro PN10 plastic pipe system

Pre-insulated flexible PE-Xa pipe reinforced with high temperature fiber mesh of aramid, thermal insulation of CFC-free polyurethane foam with blowing agent cyclo-pentane ( $\lambda_{50}$ : 0.021 W/mK) and corrugated casing of black LLD-PE, manufactured in accordance with OFI ZG 200-2 Class B technical specification, bonded pipe system without axial expansion in the supply line, for a service life of min. 30 years, for design pressures up to 10 bar at maximum operating temperature, for time/temperature profiles according to ISO 13760, with peak operating temperatures up to 115°C, with a connection system with axial compression fittings and polymer sleeves, optionally equipped with a network monitoring system consisting of two flat ribbon cables with two copper wires each.

|  |   |
|--|---|
| Service Pipe   | FibreFlex Pro PN10<br>cross-linked polyethylene PE-Xa reinforced with fiber mesh of aramid with oxygen barrier (EVOH) according to ZG 200-2   |
| Casing   | Polyurethane insulation with corrugated LLD-PE extruded seamlessly  |
| Pipe connection system   | Axial compression fittings with polymer sleeves, tested according to ZG200-2 based on EN ISO 15878-3, 5 or clamp fittings   |
| Casing connection system   | Joint casing assembling according to EN 489-1 or half-shell system  |
| Delivery of the pipeline   | Max. Coil length according to manufacturer information or on customer request   |
| Lambda-insulation at 50 °C                                       | 0,021 W / m.K   |
| Temperature range  | -20 °C to +115 °C (variable)  |
| Max. continuous operating temperature at max. operating pressure | +95°C at 10 bar or +115°C (variable)  |
| Maximum operating temperature                                    | +115 °C (variable)  |
| Other properties   | self-compensating elongation through the bonded system<br>If required with alarm wire for network monitoring  |
| Relevant standards:  | - Service Pipe corresponds to ZG200-2 Class B (based on EN15632-1, 2)<br>- Insulation and casing according to EN 15632-1, 2<br>- Service pipe connection system according to ZG200-2 based on EN ISO 15875-3, 5 |
| Certificates:  | - ISO 9001:2015 (TÜV AUSTRIA, Cert.-No.: 20100193005997)<br>- ISO 14001:2015 (TÜV AUSTRIA, Cert.-No.: 20104193005998)<br>- ZG 200-2 (of, Zert.-No.: 0555)   |

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

Long-term load FibreFlex Pro PN10 Pipe without load changes based on ofi ZG200-2 Class B (based on EN15632-2:2022) for pre-insulated district heating and district cooling applications:

| temperature in °C | Safety factor C |      | Pressure (bar)             |      |      |      |      |      |
|-------------------|-----------------|------|----------------------------|------|------|------|------|------|
|                   |                 |      | Lifespan (years)           |      |      |      |      |      |
|                   |                 |      | FibreFlex Pro PN10 (10bar) |      |      |      |      |      |
|                   |                 |      | 1                          | 5    | 10   | 20   | 30   | 50   |
| 40                | TD              | 1,50 | 25,0                       | 22,3 | 21,2 | 20,2 | 19,6 | 18,9 |
| 45                |                 | 1,50 | 24,1                       | 21,4 | 20,3 | 19,3 | 18,7 | 18,0 |
| 50                |                 | 1,50 | 23,1                       | 20,4 | 19,3 | 18,3 | 17,8 | 17,1 |
| 55                |                 | 1,50 | 22,2                       | 19,5 | 18,4 | 17,4 | 16,8 | 16,1 |
| 60                |                 | 1,50 | 21,2                       | 18,5 | 17,4 | 16,4 | 15,9 | 15,2 |
| 65                |                 | 1,50 | 20,2                       | 17,5 | 16,5 | 15,5 | 14,9 | 14,3 |
| 70                |                 | 1,50 | 19,2                       | 16,6 | 15,5 | 14,5 | 14,0 | 13,4 |
| 75                |                 | 1,50 | 18,2                       | 15,6 | 14,5 | 13,6 | 13,1 | 12,4 |
| 80                |                 | 1,50 | 17,2                       | 14,6 | 13,6 | 12,6 | 12,1 | 11,5 |
| 85                |                 | 1,50 | 16,2                       | 13,6 | 12,6 | 11,7 | 11,2 | 10,6 |
| 90                | Tmax.           | 1,30 | 17,4                       | 14,5 | 13,4 | 12,4 | 11,8 | -    |
| 95                |                 | 1,30 | 16,2                       | 13,4 | 12,3 | 11,3 | -    | -    |
| 100               |                 | 1,30 | 15,0                       | 12,2 | 11,2 | -    | -    | -    |
| 105               |                 | 1,30 | 13,8                       | 11,1 | -    | -    | -    | -    |
| 110               |                 | 1,30 | 12,6                       | -    | -    | -    | -    | -    |
| 115               |                 | 1,30 | 11,4                       | -    | -    | -    | -    | -    |
| 120               | T mal.          | 1,00 | 13,2                       | -    | -    | -    | -    | -    |

According to the technical specification OFI ZG200-2 class A (PN10), the safety coefficient for the design of the pipeline is C = 1.5; C = 1.3 for maximum temperature and C = 1 for the disorder. Other temperature/time profiles can be used in accordance with ISO13760 (Miner's rule). See examples on page 3.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

Application of Miner's rule - calculation of the service life of FibreFlex Pro PN10 systems.

Pipe systems according to this document are designed for a service life of at least 30 years when operated with the temperature / time profile specified in Table E.1.

This appendix contains four examples of the expected service life when a piping system that meets the requirements of this document is operated at a temperature profile other than that specified in Table E.1. The examples are calculated based on the reference lines and the given safety factors.

Furthermore, Miner's rule (EN ISO 13760) is used to calculate the expected service life of polymeric piping systems (PB-H and PE-Xa) as a function of temperatures and operating times.

The service life calculation applies under the condition that the maximum pressure for the pipeline system is not exceeded -> FibreFlex Pro PN10.

The following selection of typical examples of temperature profiles should help to understand the influence of different temperatures on the calculated service life of FibreFlex Pro PN10 systems.

The calculated service life as a calculation result depending on the design temperature and the corresponding annual operating times are given in Table E.1.

The pipe manufacturer should be contacted if more detailed information or support for specific temperature profiles is required.

| Lifespan at 30y (50y)<br>Examples of temp. profiles | T <sub>D</sub> |       | T <sub>max</sub> |       | T <sub>mal</sub> |       |
|---|----------------|-------|------------------|-------|------------------|-------|
|   | °C             | years | °C               | hours | °C               | hours |
| Example1  | 90             | 29    | 100              | 8760  | 115              | 100   |
| Example2  | 70             | 23    | 115              | 1000  | 120              | 100   |
|   | 80             | 3,5   |                  |       |                  |       |
|   | 90             | 2     |                  |       |                  |       |
|   | 100            | 1     |                  |       |                  |       |
|   | 110            | 0,4   |                  |       |                  |       |
| Example3  | 70             | 19    | 115              | 4380  | 120              | 100   |
|   | 80             | 3,5   |                  |       |                  |       |
|   | 90             | 3     |                  |       |                  |       |
|   | 100            | 2,5   |                  |       |                  |       |
|   | 110            | 1,5   |                  |       |                  |       |
| Example4  | 80             | 19,8  | 115              | 1000  | 120              | 100   |
|   | 95             | 10    |                  |       |                  |       |
| Example5  | 70             | 25    | 115              | 1000  | 120              | 100   |
|   | 80             | 15    |                  |       |                  |       |
|   | 90             | 4,8   |                  |       |                  |       |
|   | 95             | 5     |                  |       |                  |       |

In addition, Miner's rule (EN ISO 13760) should be applied to calculate the expected service life as a function of temperatures and operating times.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

The system heat losses are determined under the following conditions:

|  |  |
|--|--|
| $t_v$ [°C] Flow temperature                    | 80 °C  |
| $t_R$ [°C] Return temperature                  | 60 °C  |
| $t_E$ [°C] Soil temperature                    | 10 °C  |
| $t_B$ [°C] middle operating temperature        | $t_B = (t_v + t_R)/2$  |
| $l_E$ Coefficient of thermal conductivity soil | 1,0 W/m.K  |
| $h$ [mm] Overlap amount                        | 800 mm   |
| $d$ [mm]                                       | Outer diameter of the service pipe   |
| $D$ [mm]                                       | Outer diameter of the casing   |
| $U$ [W/mK]                                     | Heat transfer coefficient [W / m <sup>2</sup> K] based on 1m pipe            |
| $Q$ [W/m]                                      | Heat loss (this is the total loss of 1m of pipe) $Q = U (t_B - t_E)$ [W / m] |
| $l_U$ [m]                                      | Length of each section <sup>1</sup>  |
| Total heat loss of the system [W]              | calculated as $Q \times l_U$ [W]   |

<sup>1</sup> Meters of pipeline for calculation i.e. with 2x25 100 m are counted, with 1x75 200 m per 100 m distance are counted.



Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

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Heat loss table for FibreFlex Pro PN10

| Service pipe |                      |                       | Casing  | Bending radius | Heat transfer coefficient | Heat loss trench at an average operating temperature 70°C |
|--------------|----------------------|-----------------------|---------|----------------|---------------------------|---|
| d[mm]        | Nominal size da [mm] | Wall thickness s [mm] | OD [mm] | r [m]          | [W/m K]                   | [W]   |
| 2x d32       | 32,0                 | 2,9                   | 111     | 0,9            | 0,1936                    | 11,62   |
|              | 32,0                 | 2,9                   | 126     | 1,0            | 0,1599                    | 9,59  |
| 2x d40       | 40,0                 | 3,7                   | 126     | 1,0            | 0,2203                    | 13,22   |
|              | 40,0                 | 3,7                   | 142     | 1,1            | 0,1786                    | 10,72   |
| 2x d50       | 47,6                 | 3,6                   | 162     | 1,2            | 0,1866                    | 11,20   |
|              | 47,6                 | 3,6                   | 182     | 1,3            | 0,1580                    | 9,48  |
| 2x d63       | 58,5                 | 4,0                   | 182     | 1,3            | 0,2116                    | 12,70   |
|              | 58,5                 | 4,0                   | 202     | 1,4            | 0,1773                    | 10,67   |
| 2x d75       | 69,5                 | 4,6                   | 202     | 1,4            | 0,2353                    | 14,12   |
|              | 69,5                 | 4,6                   | 225     | 1,6            | 0,1928                    | 11,57   |
| 2x d90       | 84,0                 | 6,0                   | 225     | 1,6            | 0,2781                    | 16,69   |

| d[mm] | Nominal s. da [mm] | Wall thickn s [mm] | OD [mm] | r [m] | [W/m K] | [W]   |
|-------|--------------------|--------------------|---------|-------|---------|-------|
| d32   | 32,0               | 2,9                | 76      | 0,7   | 0,1431  | 8,59  |
|       | 32,0               | 2,9                | 91      | 0,9   | 0,1189  | 7,13  |
| d40   | 40,0               | 3,7                | 91      | 0,9   | 0,1487  | 8,92  |
|       | 40,0               | 3,7                | 111     | 0,9   | 0,1209  | 7,25  |
| d50   | 47,6               | 3,6                | 111     | 0,9   | 0,1442  | 8,65  |
|       | 47,6               | 3,6                | 126     | 1,0   | 0,1264  | 7,58  |
| d63   | 58,5               | 4,0                | 126     | 1,0   | 0,1577  | 9,46  |
|       | 58,5               | 4,0                | 142     | 1,1   | 0,1377  | 8,26  |
| d75   | 69,5               | 4,6                | 142     | 1,1   | 0,1680  | 10,08 |
|       | 69,5               | 4,6                | 162     | 1,2   | 0,1440  | 8,64  |
| d90   | 84,0               | 6,0                | 162     | 1,2   | 0,1813  | 10,88 |
|       | 84,0               | 6,0                | 182     | 1,3   | 0,1562  | 9,37  |
| d110  | 101,0              | 6,5                | 162     | 1,2   | 0,2432  | 14,59 |
|       | 101,0              | 6,5                | 182     | 1,3   | 0,2001  | 12,01 |
|       | 101,0              | 6,5                | 202     | 1,3   | 0,1722  | 10,33 |
| d125  | 116,0              | 6,8                | 182     | 1,3   | 0,2536  | 15,22 |
|       | 116,0              | 6,8                | 202     | 1,4   | 0,2103  | 12,62 |
| d140  | 127,0              | 7,1                | 202     | 1,4   | 0,2460  | 14,76 |
|       | 127,0              | 7,1                | 225     | 1,6   | 0,2050  | 12,30 |
| d160  | 144,0              | 7,5                | 225     | 1,6   | 0,2550  | 15,30 |

The specified values are based on an average specific heat capacity [cm] of the water of 4,187 J / (kg · K).  
All values are based on an overburden [ÜH] of 0.80 m, a conductivity of the soil [IE] of 1.0 W / (m · K), a soil temperature [TE] of 10 ° C and, for individual pipes, a pipe spacing of 100 mm.  
Average temperature TM = (TVL + TRL): 2

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

# FibreFlex® Pro16

## TECHNICAL DATASHEET

Pre-insulated, flexible FibreFlex Pro PN16 plastic pipe system

Pre-insulated flexible PE-Xa pipe reinforced with high temperature fiber mesh of aramid, thermal insulation of CFC-free polyurethane foam with blowing agent cyclo-pentane ( $\lambda_{50}$ : 0.021 W/mK) and corrugated casing of black LLD-PE, manufactured in accordance with technical specification OFI ZG 200-2 Class B, bonded pipe system without axial expansion in the supply line, for a service life of min. 30 years, for design pressures up to 16 bar at maximum operating temperature, for time/temperature profiles according to ISO 13760, with peak operating temperatures up to 115°C, with a connection system with axial compression fittings with polymer sleeves, optionally equipped with a network monitoring system consisting of two flat ribbon cables with two copper wires each.

|  |   |
|--|---|
| Service Pipe   | FibreFlex Pro PN16<br>cross-linked polyethylene PE-Xa reinforced with high temperature fiber mesh of aramid with oxygen barrier (EVOH) according to ZG 200-2  |
| Casing   | Polyurethane insulation with corrugated LLD-PE extruded seamlessly  |
| Pipe connection system   | Axial compression fittings with polymer sleeves, tested according to ZG200-2 based on EN ISO 15878-3, 5 or clamp fittings   |
| Casing connection system   | Joint casing assembling according to EN 489-1 or half-shell system  |
| Delivery of the pipeline   | Max. Coil length according to manufacturer information or on customer request   |
| Lambda-insulation at 50 °C                                       | 0,021 W / m.K   |
| Temperature range  | -20°C to +115 °C (variable)   |
| Max. continuous operating temperature at max. operating pressure | +95°C at 16 bar or +115°C (variable)  |
| Maximum operating temperature                                    | +115 °C   |
| Other properties   | self-compensating elongation through the bonded system<br>If required with alarm wire for network monitoring  |
| Relevant standards:  | - Service Pipe corresponds to ZG200-2 Class B (based on EN15632-1, 2)<br>- Insulation and casing according to EN 15632-1, 2<br>- Service pipe connection system according to ZG200-2 based on EN ISO 15875-3, 5 |
| Certificates:  | - ISO 9001:2015 (TÜV AUSTRIA, Cert.-No.: 20100193005997)<br>- ISO 14001:2015 (TÜV AUSTRIA, Cert.-No.: 20104193005998)<br>- ZG 200-2 (ofi, Zert.-No.: 0555)  |

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

Long-term load FibreFlex Pro PN16 Pipe without load changes based on ofi ZG200-2 Class B (based on EN15632-2:2022) for pre-insulated district heating and district cooling applications:

| temperature in °C | Safety factor C |      | Pressure (bar)               |      |      |      |      |      |
|-------------------|-----------------|------|------------------------------|------|------|------|------|------|
|                   |                 |      | Lifespan (years)             |      |      |      |      |      |
|                   |                 |      | FibreFlex Pro - PN16 (16bar) |      |      |      |      |      |
|                   |                 |      | 1                            | 5    | 10   | 20   | 30   | 50   |
| 40                | TD              | 1,50 | 40,0                         | 35,6 | 33,9 | 32,3 | 31,4 | 30,3 |
| 45                |                 | 1,50 | 38,5                         | 34,2 | 32,5 | 30,8 | 29,9 | 28,8 |
| 50                |                 | 1,50 | 37,0                         | 32,7 | 31,0 | 29,3 | 28,4 | 27,3 |
| 55                |                 | 1,50 | 35,5                         | 31,1 | 29,4 | 27,8 | 26,9 | 25,8 |
| 60                |                 | 1,50 | 33,9                         | 29,6 | 27,9 | 26,3 | 25,4 | 24,3 |
| 65                |                 | 1,50 | 32,4                         | 28,1 | 26,4 | 24,8 | 23,9 | 22,9 |
| 70                |                 | 1,50 | 30,8                         | 26,5 | 24,8 | 23,3 | 22,4 | 21,4 |
| 75                |                 | 1,50 | 29,2                         | 24,9 | 23,3 | 21,7 | 20,9 | 19,9 |
| 80                |                 | 1,50 | 27,5                         | 23,3 | 21,7 | 20,2 | 19,4 | 18,4 |
| 85                |                 | 1,50 | 25,9                         | 21,7 | 20,2 | 18,7 | 17,9 | 16,9 |
| 90                | Tmax.           | 1,30 | 27,9                         | 23,2 | 21,5 | 19,8 | 18,9 | -    |
| 95                |                 | 1,30 | 26,0                         | 21,4 | 19,7 | 18,1 | -    | -    |
| 100               |                 | 1,30 | 24,0                         | 19,6 | 17,9 | -    | -    | -    |
| 105               |                 | 1,30 | 22,1                         | 17,8 | -    | -    | -    | -    |
| 110               |                 | 1,30 | 20,1                         | -    | -    | -    | -    | -    |
| 115               |                 | 1,30 | 18,2                         | -    | -    | -    | -    | -    |
| 120               | Tmal.           | 1,00 | 21,1                         | -    | -    | -    | -    | -    |

According to the technical specification OFI ZG200-2 class A (PN16), the safety coefficient for the design of the pipeline is C = 1.5; C = 1.3 for maximum temperature and C = 1 for the disorder. Other temperature/time profiles can be used in accordance with ISO13760 (Miner's rule). See examples on page 3.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

Application of Miner's rule - calculation of the service life of FibreFlex Pro PN16 systems.

Pipe systems according to this document are designed for a service life of at least 30 years when operated with the temperature / time profile specified in Table E.1.

This appendix contains five examples of the expected service life when a piping system that meets the requirements of this document is operated at a temperature profile other than that specified in Table E.1.

The examples are calculated based on the reference lines and the given safety factors.

Furthermore, Miner's rule (EN ISO 13760) is used to calculate the expected service life of polymeric piping systems (PB-H and PE-Xa) as a function of temperatures and operating times.

The service life calculation applies under the condition that the maximum pressure for the pipeline system is not exceeded -> FibreFlex Pro PN16.

The following selection of typical examples of temperature profiles should help to understand the influence of different temperatures on the calculated service life of FibreFlex Pro PN16 systems.

The calculated service life as a calculation result depending on the design temperature and the corresponding annual operating times are given in Table E.1.

The pipe manufacturer should be contacted if more detailed information or support for specific temperature profiles is required.

Table E.1 - Examples of calculated service life TRSP, service class B

| Lifespan at 30y (50y)<br>Examples of temp. profiles | T <sub>D</sub> |       | T <sub>max</sub> |       | T <sub>mal</sub> |       |
|---|----------------|-------|------------------|-------|------------------|-------|
|   | °C             | years | °C               | hours | °C               | hours |
| Example1  | 90             | 29    | 100              | 8760  | 115              | 100   |
| Example2  | 70             | 23    | 115              | 1000  | 120              | 100   |
|   | 80             | 3,5   |                  |       |                  |       |
|   | 90             | 2     |                  |       |                  |       |
|   | 100            | 1     |                  |       |                  |       |
|   | 110            | 0,4   |                  |       |                  |       |
| Example3  | 70             | 19    | 115              | 4380  | 120              | 100   |
|   | 80             | 3,5   |                  |       |                  |       |
|   | 90             | 3     |                  |       |                  |       |
|   | 100            | 2,5   |                  |       |                  |       |
|   | 110            | 1,5   |                  |       |                  |       |
| Example4  | 80             | 19,8  | 115              | 1000  | 120              | 100   |
|   | 95             | 10    |                  |       |                  |       |
| Example5  | 70             | 25    | 115              | 1000  | 120              | 100   |
|   | 80             | 15    |                  |       |                  |       |
|   | 90             | 4,8   |                  |       |                  |       |
|   | 95             | 5     |                  |       |                  |       |

In addition, Miner's rule (EN ISO 13760) should be applied to calculate the expected service life as a function of temperatures and operating times.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
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The system heat losses are determined under the following conditions:

|  |  |
|--|--|
| $t_v$ [°C] Flow temperature                    | 80 °C  |
| $t_R$ [°C] Return temperature                  | 60 °C  |
| $t_E$ [°C] Soil temperature                    | 10 °C  |
| $t_B$ [°C] middle operating temperature        | $t_B = (t_v + t_R)/2$  |
| $l_E$ Coefficient of thermal conductivity soil | 1,0 W/m.K  |
| h [mm] Overlap amount                          | 800 mm   |
| d [mm]   | Outer diameter of the service pipe   |
| D [mm]   | Outer diameter of the casing   |
| U [W/mK]                                       | Heat transfer coefficient [W / m <sup>2</sup> K] based on 1m pipe            |
| Q [W/m]  | Heat loss (this is the total loss of 1m of pipe) $Q = U (t_B - t_E)$ [W / m] |
| $l_U$ [m]                                      | Length of each section <sup>1</sup>  |
| Total heat loss of the system [W]              | calculated as $Q \times l_U$ [W]   |

<sup>1</sup> Meters of pipeline for calculation ie. with 2xd25 100 m are counted, with 1xd75 200 m per 100 m distance are counted.

Adresse: Gollensdorf 24,  
A-4300 St. Valentin  
TEL.: +43 (0) 7435/93080  
FAX: +43 (0) 7435/93080-218  
E-Mail: office@radius-kelit.com

www.radius-kelit.com

### Heat loss table for FibreFlex Pro PN16

| Service pipe |                      |                       | Casing  | Bending radius | Heat transfer coefficient | Heat loss trench at an average operating temperature 70°C |
|--------------|----------------------|-----------------------|---------|----------------|---------------------------|---|
| d[mm]        | Nominal size da [mm] | Wall thickness s [mm] | OD [mm] | r [m]          | [W/m K]                   | [W]   |
| 2x d50       | 47,6                 | 3,6                   | 162     | 1,2            | 0,1866                    | 11,20   |
|              | 47,6                 | 3,6                   | 182     | 1,3            | 0,1580                    | 9,48  |
| 2x d63       | 58,5                 | 4,0                   | 182     | 1,3            | 0,2116                    | 12,70   |
|              | 58,5                 | 4,0                   | 202     | 1,4            | 0,1773                    | 10,64   |
| 2x d75       | 69,5                 | 4,6                   | 202     | 1,4            | 0,2353                    | 14,12   |
|              | 69,5                 | 4,6                   | 225     | 1,6            | 0,1928                    | 11,57   |
| 2x d90       | 84,0                 | 6,0                   | 225     | 1,6            | 0,2781                    | 16,69   |

| Service pipe |                      |                       | Casing  | Bending radius | Heat transfer coefficient | Heat loss trench at an average operating temperature 70°C |
|--------------|----------------------|-----------------------|---------|----------------|---------------------------|---|
| d[mm]        | Nominal size da [mm] | Wall thickness s [mm] | DA [mm] | r [m]          | [W/m K]                   | [W]   |
| d50          | 47,6                 | 3,6                   | 111     | 0,9            | 0,1442                    | 8,65  |
|              | 47,6                 | 3,6                   | 126     | 1,0            | 0,1264                    | 7,58  |
| d63          | 58,5                 | 4,0                   | 126     | 1,0            | 0,1577                    | 9,46  |
|              | 58,5                 | 4,0                   | 142     | 1,1            | 0,1377                    | 8,26  |
| d75          | 69,5                 | 4,6                   | 142     | 1,1            | 0,1680                    | 10,08   |
|              | 69,5                 | 4,6                   | 162     | 1,2            | 0,1440                    | 8,64  |
| d90          | 84,0                 | 6,0                   | 162     | 1,2            | 0,1813                    | 10,88   |
|              | 84,0                 | 6,0                   | 182     | 1,3            | 0,1562                    | 9,37  |
| d110         | 101,0                | 6,5                   | 162     | 1,2            | 0,2432                    | 14,59   |
|              | 101,0                | 6,5                   | 182     | 1,3            | 0,2001                    | 12,01   |
|              | 101,0                | 6,5                   | 202     | 1,3            | 0,1722                    | 10,33   |

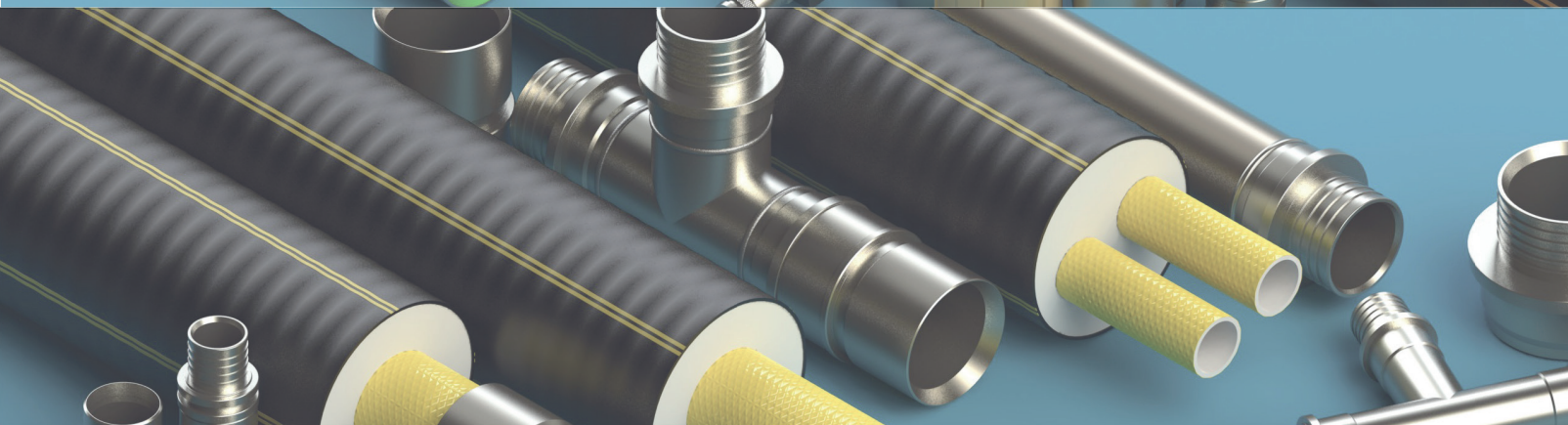
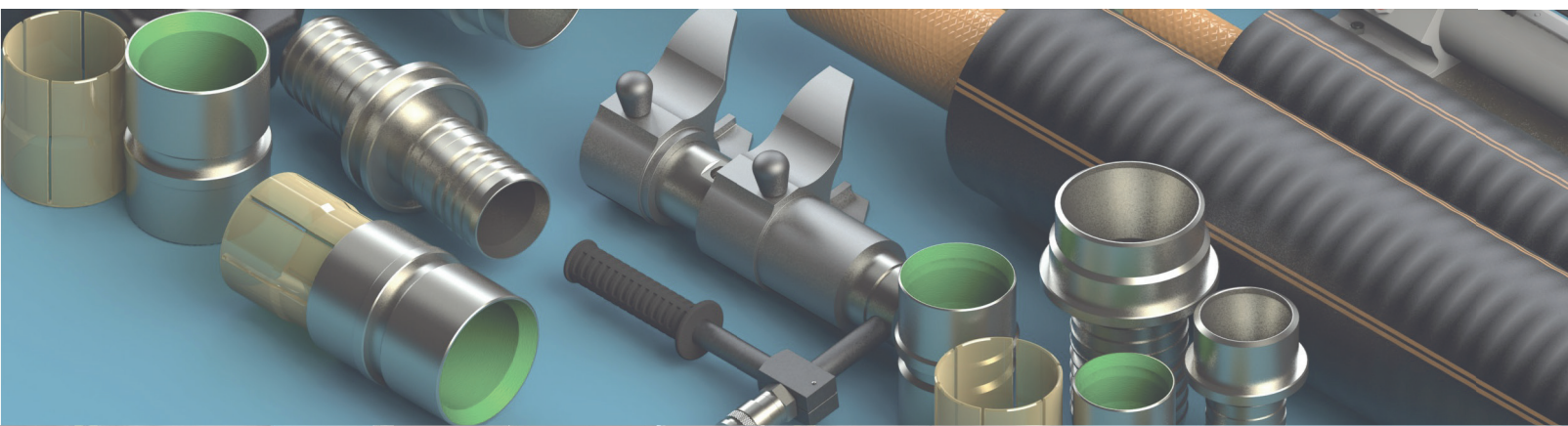
The specified values are based on an average specific heat capacity [cm] of the water of 4,187 J / (kg • K).

All values are based on an overburden [ÜH] of 0.80 m, a conductivity of the soil [IE] of 1.0 W / (m • K), a soil temperature [TE] of 10 ° C and, for individual pipes, a pipe spacing of 100 mm.

Average temperature TM = (TVL + TRL): 2



**Radius - Kelit**  
Infrastructure



**Radius-Kelit Infrastructure GesmbH**

**Adress:** Gollensdorf 24,  
A-4300 St. Valentin  
**TEL.:** +43 (0) 7435/93080  
**FAX:** +43 (0) 7435/93080-218  
**E-Mail:** [office@radius-kelit.com](mailto:office@radius-kelit.com)