

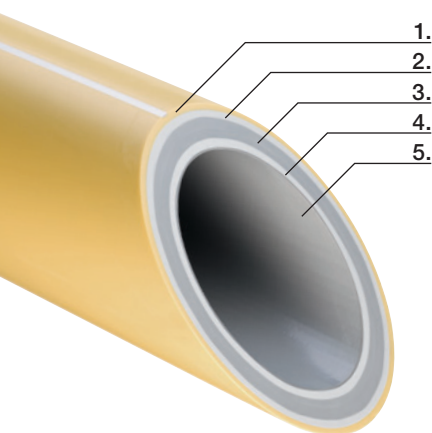
# 5-Layer Hot & Cold Water Piping

## POLO-POLYMUTAN ML<sup>5</sup>



### POLO-POLYMUTAN ML<sup>5</sup>. The development of PP-R multilayer technology

A new innovation has now been added to the successful polypropylene pipe system from POLOPLAST! The company's experience in multilayer technology proved particularly beneficial in developing this new type of pipe. The development of a polymer compound has also been applied. The newly devised 5-layer fibre composite pipe POLO-POLYMUTAN ML<sup>5</sup> combines the advantages of PP-R CT and glass-fibre reinforced PP-R in one product thanks to the sandwich structure.



5 layers – 5 benefits!  
Quality – made in Germany.

#### 1. External layer made from PP-R 80

The outer layer made from high grade polypropylene granulate features the colour coding of the pipe and is used to guarantee the renowned safe processing as well as to protect the inner layers.

#### 2. Second layer made from POLOPLAST compound HPCE

This PP-R glass fibre compound is the result of detailed research carried out at the POLOPLAST Polymer-Engineering division and is a new development in this field. The perfect interaction between the corresponding glass fibres and the PP-R provides outstanding properties in terms of linear expansion, deflection and low-temperature impact strength.

#### 3. Intermediate layer made from PP-R CT

The PP-R CT material is a Polypropylene-Random-Copolymer with a modified material structure. It allows improved long-term stress behaviour with longer periods of operation, especially at higher temperatures

#### 4. Intermediate layer made from POLOPLAST compound HPCE

This layer too offers outstanding properties in terms of linear expansion, deflection and low-temperature impact strength.

#### 5. Inner layer made from PP-R CT

Here, as in the middle layer, improved long-term stress behaviour over longer periods of operation is guaranteed at higher temperatures. The production process ensures a smooth inner surface which reduces deposits and encrustations.

### More layers, more benefits

**Smooth inner pipe surfaces** prevent the build-up of deposits and encrustations.

**Low weight design** ensures low-cost storage and relocation.

**Tried and trusted connecting technology** is compatible with POLO-POLYMUTAN PP-R for all areas of application.

**Lifespan** of at least 50 years (extrapolated).

**No special accessories required:** can be used with normal welding tools/ welding machines.

**Connection with normal moulded parts** from the POLO-POLYMUTAN assortment.

**Environmentally-friendly** thanks to the use of modern materials.

**Homogenous connection of the layers** - produced using one-time extrusion technology.

POLO-POLYMUTAN ML<sup>5</sup> is classified according to DIN EN ISO 21003 under application class 1 with 8 bar and under application class 2 with 6 bar and is available in the following dimensions:

| Dimension     | Art. No. |
|---------------|----------|
| 20 x 2,8 mm   | 10322    |
| 25 x 3,5 mm   | 10323    |
| 32 x 4,4 mm   | 10324    |
| 40 x 5,5 mm   | 10325    |
| 50 x 6,9 mm   | 10326    |
| 63 x 8,6 mm   | 10327    |
| 75 x 10,3 mm  | 10328    |
| 90 x 12,3 mm  | 10329    |
| 110 x 15,1 mm | 10330    |

## Focusing on linear expansion: top performance under a high pressure load

Fluctuating operating temperatures cause thermal linear expansion of the pipes. This linear expansion must be taken into account with all installation options in order to avoid potential tensile stress to the raw materials or damage to connections. The linear expansion of pipes embedded in walls or screed is absorbed by insulation in the bends. In general, the thermal expansion forces emitted by plastic pipes are extremely low compared to those of metal substances because the corresponding retention force effectively neutralises any expansion.

**The multilayer fibre reinforced pipe structure of the POLO-POLYMUTAN ML<sup>5</sup> reduces linear expansion by 75% compared to a standard PP-R pipe!**

Glass-fibre reinforced robustness. Under all conditions.

The linear expansion coefficient for the POLO-POLYMUTAN ML<sup>5</sup> fibre pipes is  $\alpha$  0,038 mm/mK.

The linear expansion was tested by the Austrian Research Institute for Chemistry and Technology (OFI) according to defined test apparatus (test number: 406.255-1).

**Linear expansion is calculated according to the following formula:**

| $\Delta l = \alpha \cdot L \cdot \Delta T$ |   |
|--|---|
| $\Delta l$                                 | Length variation [mm]   |
| L  | Length before temperature change [m]  |
| $\alpha$                                   | Linear expansion coefficient $\left[ \frac{\text{mm}}{\text{m} \cdot \text{K}} \right]$ |
| $\Delta T$                                 | Max. temperature difference between installation and operating temperature in K [K]     |

e.g.:

Fibre reinforced ML<sup>5</sup> pipe

Length: 30 m

Installation temperature: 20°C

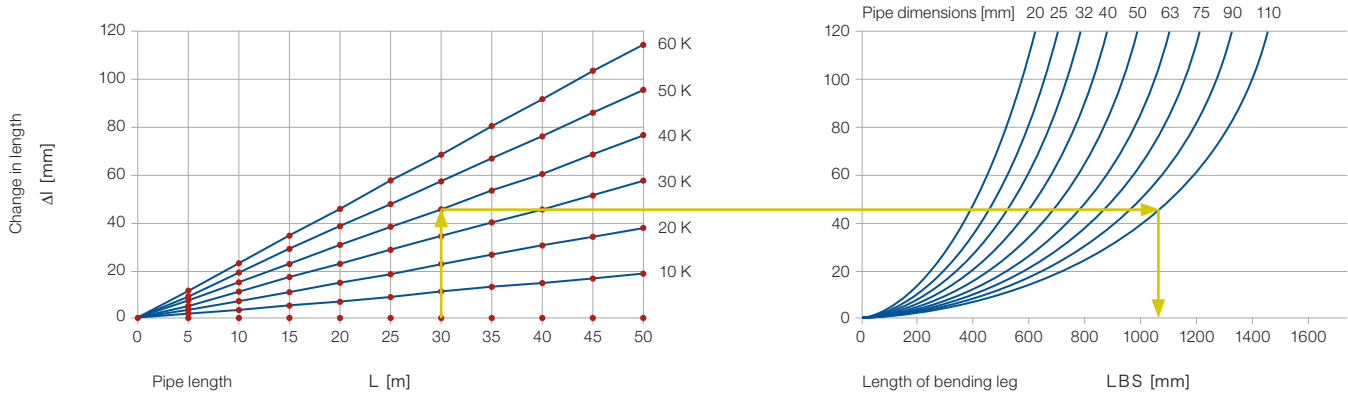
Operating temperature: 60°C

$$\Delta l = 0,038 \left[ \frac{\text{mm}}{\text{m} \cdot \text{K}} \right] \cdot 30\text{m} \cdot (60 - 20)\text{K}$$

$$\Delta l = 45,6 \text{ mm}$$

# POLO-POLYMUTAN ML<sup>5</sup>

Diagram for identifying temperature-influenced changes in length for POLO-POLYMUTAN ML<sup>5</sup>



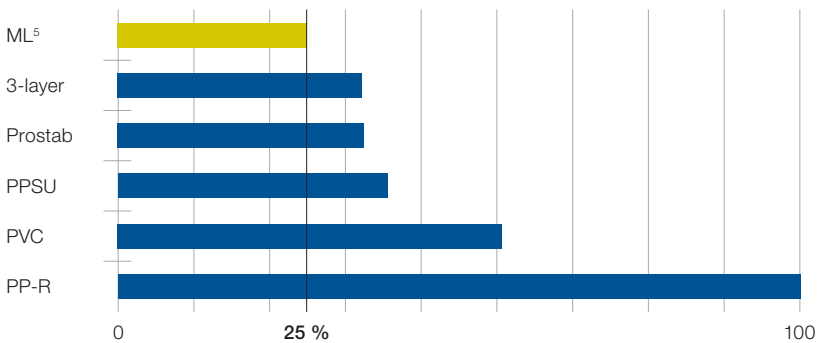
## Strictly regulated certification

- OFI certificate for linear expansion
- Strict controls by state recognised testing body for plastics (Süddeutsches Kunststoff-Zentrum – SKZ)
- KTW-tested based on recommendations of Federal Department for the Environment



## Clear proof – a comparison

A comparison graph against a standard PP-R pipe clearly shows that the temperature-influenced linear expansion is reduced by 75% with POLO-POLYMUTAN ML<sup>5</sup>.



## Focusing on span distance: stable and economical in all locations

The special multilayer pipe structure of POLO-POLYMUTAN ML<sup>5</sup> ensures a higher stability level which enables greater span distances and saves on costs and materials. No supports are required when laying POLO-POLYMUTAN ML<sup>5</sup>.

Please ensure that the specified distances are not exceeded with laying pipes horizontally.

| POLO-POLYMUTAN ML <sup>5</sup> / SDR 7,4 |                        |     |     |     |     |     |     |
|--|------------------------|-----|-----|-----|-----|-----|-----|
| Dimensions                               | Media temperature [°C] |     |     |     |     |     |     |
|  | 10                     | 20  | 30  | 40  | 50  | 60  | 70  |
|  | Span distances [cm]    |     |     |     |     |     |     |
| 20                                       | 110                    | 95  | 90  | 85  | 85  | 80  | 70  |
| 25                                       | 120                    | 105 | 105 | 95  | 95  | 90  | 80  |
| 32                                       | 140                    | 120 | 120 | 110 | 110 | 105 | 95  |
| 40                                       | 160                    | 140 | 135 | 125 | 125 | 120 | 110 |
| 50                                       | 185                    | 155 | 155 | 145 | 145 | 135 | 130 |
| 63                                       | 200                    | 175 | 175 | 165 | 165 | 155 | 145 |
| 75                                       | 215                    | 190 | 190 | 175 | 175 | 165 | 155 |
| 90                                       | 230                    | 210 | 210 | 195 | 195 | 180 | 180 |
| 110                                      | 250                    | 220 | 220 | 210 | 200 | 200 | 190 |

## Focusing on long-term internal pressure: Long-term temperature resistance

| Long-term stress behaviour with safety factor 1.25 |                                 |      |      |      |      |
|--|---------------------------------|------|------|------|------|
| Temperature °C                                     | Years of operation              |      |      |      |      |
|  | 1                               | 5    | 10   | 25   | 50   |
|  | Maximum service pressure in bar |      |      |      |      |
| 20 °C  | 28,5                            | 26,8 | 26,1 | 25,2 | 24,5 |
| 30 °C  | 24,2                            | 22,7 | 22,1 | 21,3 | 20,7 |
| 40 °C  | 20,6                            | 19,2 | 18,7 | 18   | 17,4 |
| 50 °C  | 17,4                            | 16,2 | 15,7 | 15,1 | 14,7 |
| 60 °C  | 14,7                            | 13,6 | 13,2 | 12,7 | 12,3 |
| 70 °C  | 12,3                            | 11,7 | 11,1 | 9,6  | 8,1  |
| 80 °C  | 10,3                            | 9,1  | 7,7  | 6,2  |      |
| 95 °C  | 7,3                             | 4,9  |      |      |      |

## POLO-POLYMUTAN ML<sup>5</sup>

### Pressure loss table for POLO-POLYMUTAN ML<sup>5</sup> / SDR 7,4

Roughness: 0,007 mm  
R = Pressure loss

Density: 998,29 kg/m<sup>3</sup>  
v = flow speed

Kinematic viscosity: 1,004 E-06 m<sup>2</sup>/s

Temperature: 20° C

|                      |                   |             | DN 15  | DN 20  | DN 25 | DN 32 | DN 40 | DN 50 | DN 50 | DN 65 | DN 80 |
|----------------------|-------------------|-------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|
| Dimensions in mm     |                   |             | 20     | 25     | 32    | 40    | 50    | 63    | 75    | 90    | 110   |
| Wall thickness in mm |                   |             | 2,8    | 3,5    | 4,4   | 5,5   | 6,9   | 8,6   | 10,3  | 12,3  | 15,1  |
| Inner diameter in mm |                   |             | 14,4   | 18,0   | 23,2  | 29,0  | 36,2  | 45,8  | 54,4  | 65,4  | 79,8  |
| Volume in l/m        |                   |             | 0,163  | 0,254  | 0,423 | 0,661 | 1,029 | 1,647 | 2,324 | 3,359 | 5,001 |
| l/s                  | m <sup>3</sup> /h |             |        |        |       |       |       |       |       |       |       |
| 0,01                 | 0,04              | R in mbar/m | 0,10   | 0,04   | 0,01  |       |       |       |       |       |       |
|                      |                   | v in m/s    | 0,06   | 0,04   | 0,02  |       |       |       |       |       |       |
| 0,02                 | 0,07              | R           | 0,30   | 0,11   | 0,03  | 0,01  |       |       |       |       |       |
|                      |                   | v           | 0,12   | 0,08   | 0,05  | 0,03  |       |       |       |       |       |
| 0,03                 | 0,11              | R           | 0,58   | 0,21   | 0,06  | 0,02  |       |       |       |       |       |
|                      |                   | v           | 0,18   | 0,12   | 0,07  | 0,05  |       |       |       |       |       |
| 0,04                 | 0,14              | R           | 0,93   | 0,33   | 0,10  | 0,04  | 0,01  |       |       |       |       |
|                      |                   | v           | 0,25   | 0,16   | 0,09  | 0,06  | 0,04  |       |       |       |       |
| 0,05                 | 0,18              | R           | 1,34   | 0,47   | 0,15  | 0,05  | 0,02  |       |       |       |       |
|                      |                   | v           | 0,31   | 0,20   | 0,12  | 0,08  | 0,05  |       |       |       |       |
| 0,06                 | 0,22              | R           | 1,82   | 0,64   | 0,20  | 0,07  | 0,03  | 0,01  |       |       |       |
|                      |                   | v           | 0,37   | 0,24   | 0,14  | 0,09  | 0,06  | 0,04  |       |       |       |
| 0,07                 | 0,25              | R           | 2,36   | 0,83   | 0,25  | 0,09  | 0,03  | 0,01  |       |       |       |
|                      |                   | v           | 0,43   | 0,28   | 0,17  | 0,11  | 0,07  | 0,04  |       |       |       |
| 0,08                 | 0,29              | R           | 2,96   | 1,04   | 0,32  | 0,11  | 0,04  | 0,01  |       |       |       |
|                      |                   | v           | 0,49   | 0,31   | 0,19  | 0,12  | 0,08  | 0,05  |       |       |       |
| 0,09                 | 0,32              | R           | 3,61   | 1,26   | 0,38  | 0,14  | 0,05  | 0,02  |       |       |       |
|                      |                   | v           | 0,55   | 0,35   | 0,21  | 0,14  | 0,09  | 0,05  |       |       |       |
| 0,10                 | 0,36              | R           | 4,32   | 1,51   | 0,46  | 0,16  | 0,06  | 0,02  | 0,01  |       |       |
|                      |                   | v           | 0,61   | 0,39   | 0,24  | 0,15  | 0,10  | 0,06  | 0,04  |       |       |
| 0,12                 | 0,43              | R           | 5,90   | 2,05   | 0,62  | 0,22  | 0,08  | 0,03  | 0,01  |       |       |
|                      |                   | v           | 0,74   | 0,47   | 0,28  | 0,18  | 0,12  | 0,07  | 0,05  |       |       |
| 0,14                 | 0,50              | R           | 7,70   | 2,67   | 0,81  | 0,28  | 0,10  | 0,03  | 0,02  |       |       |
|                      |                   | v           | 0,86   | 0,55   | 0,33  | 0,21  | 0,14  | 0,08  | 0,06  |       |       |
| 0,16                 | 0,58              | R           | 9,70   | 3,36   | 1,01  | 0,35  | 0,13  | 0,04  | 0,02  |       |       |
|                      |                   | v           | 0,98   | 0,63   | 0,38  | 0,24  | 0,16  | 0,10  | 0,07  |       |       |
| 0,18                 | 0,65              | R           | 11,91  | 4,11   | 1,24  | 0,43  | 0,15  | 0,05  | 0,02  | 0,01  |       |
|                      |                   | v           | 1,11   | 0,71   | 0,43  | 0,27  | 0,17  | 0,11  | 0,08  | 0,05  |       |
| 0,20                 | 0,72              | R           | 14,32  | 4,94   | 1,48  | 0,52  | 0,18  | 0,06  | 0,03  | 0,01  |       |
|                      |                   | v           | 1,23   | 0,79   | 0,47  | 0,30  | 0,19  | 0,12  | 0,09  | 0,06  |       |
| 0,30                 | 1,08              | R           | 29,30  | 10,01  | 2,98  | 1,03  | 0,36  | 0,12  | 0,05  | 0,02  | 0,01  |
|                      |                   | v           | 1,84   | 1,18   | 0,71  | 0,45  | 0,29  | 0,18  | 0,13  | 0,09  | 0,06  |
| 0,40                 | 1,44              | R           | 49,02  | 16,64  | 4,92  | 1,70  | 0,59  | 0,20  | 0,09  | 0,04  | 0,01  |
|                      |                   | v           | 2,46   | 1,57   | 0,95  | 0,61  | 0,39  | 0,24  | 0,17  | 0,12  | 0,08  |
| 0,50                 | 1,80              | R           | 73,35  | 24,77  | 7,29  | 2,50  | 0,87  | 0,29  | 0,13  | 0,05  | 0,02  |
|                      |                   | v           | 3,07   | 1,96   | 1,18  | 0,76  | 0,49  | 0,30  | 0,22  | 0,15  | 0,10  |
| 0,60                 | 2,16              | R           | 102,21 | 34,36  | 10,06 | 3,45  | 1,20  | 0,39  | 0,17  | 0,07  | 0,03  |
|                      |                   | v           | 3,68   | 2,36   | 1,42  | 0,91  | 0,58  | 0,36  | 0,26  | 0,18  | 0,12  |
| 0,70                 | 2,52              | R           | 135,57 | 45,40  | 13,24 | 4,52  | 1,57  | 0,51  | 0,23  | 0,09  | 0,04  |
|                      |                   | v           | 4,30   | 2,75   | 1,66  | 1,06  | 0,68  | 0,42  | 0,30  | 0,21  | 0,14  |
| 0,80                 | 2,88              | R           | 173,38 | 57,86  | 16,82 | 5,73  | 1,98  | 0,64  | 0,28  | 0,12  | 0,05  |
|                      |                   | v           | 4,91   | 3,14   | 1,89  | 1,21  | 0,78  | 0,49  | 0,34  | 0,24  | 0,16  |
| 0,90                 | 3,24              | R           | 215,63 | 71,73  | 20,78 | 7,06  | 2,43  | 0,79  | 0,35  | 0,15  | 0,06  |
|                      |                   | v           | 5,53   | 3,54   | 2,13  | 1,36  | 0,87  | 0,55  | 0,39  | 0,27  | 0,18  |
| 1,00                 | 3,60              | R           | 262,30 | 87,00  | 25,14 | 8,52  | 2,93  | 0,95  | 0,42  | 0,17  | 0,07  |
|                      |                   | v           | 6,14   | 3,93   | 2,37  | 1,51  | 0,97  | 0,61  | 0,43  | 0,30  | 0,20  |
| 1,10                 | 3,96              | R           | 313,36 | 103,67 | 29,87 | 10,11 | 3,47  | 1,12  | 0,49  | 0,21  | 0,08  |
|                      |                   | v           | 6,75   | 4,32   | 2,60  | 1,67  | 1,07  | 0,67  | 0,47  | 0,33  | 0,22  |

## POLO-POLYMUTAN ML<sup>5</sup>

|                      |                   |   | DN 15  | DN 20  | DN 25  | DN 32  | DN 40  | DN 50 | DN 50 | DN 65 | DN 80 |
|----------------------|-------------------|---|--------|--------|--------|--------|--------|-------|-------|-------|-------|
| Dimensions in mm     |                   |   | 20     | 25     | 32     | 40     | 50     | 63    | 75    | 90    | 110   |
| Wall thickness in mm |                   |   | 2,8    | 3,5    | 4,4    | 5,5    | 6,9    | 8,6   | 10,3  | 12,3  | 15,1  |
| Inner diameter in mm |                   |   | 14,4   | 18,0   | 23,2   | 29,0   | 36,2   | 45,8  | 54,4  | 65,4  | 79,8  |
| Volume in l/m        |                   |   | 0,163  | 0,254  | 0,423  | 0,661  | 1,029  | 1,647 | 2,324 | 3,359 | 5,001 |
| l/s                  | m <sup>3</sup> /h |   |        |        |        |        |        |       |       |       |       |
| 1,20                 | 4,32              | R | 368,81 | 121,73 | 34,99  | 11,82  | 4,05   | 1,31  | 0,58  | 0,24  | 0,09  |
|                      |                   | v | 7,37   | 4,72   | 2,84   | 1,82   | 1,17   | 0,73  | 0,52  | 0,36  | 0,24  |
| 1,30                 | 4,68              | R | 428,65 | 141,17 | 40,48  | 13,65  | 4,67   | 1,51  | 0,66  | 0,28  | 0,11  |
|                      |                   | v | 7,98   | 5,11   | 3,08   | 1,97   | 1,26   | 0,79  | 0,56  | 0,39  | 0,26  |
| 1,40                 | 5,04              | R | 492,86 | 162,00 | 46,35  | 15,60  | 5,33   | 1,72  | 0,76  | 0,31  | 0,12  |
|                      |                   | v | 8,60   | 5,50   | 3,31   | 2,12   | 1,36   | 0,85  | 0,60  | 0,42  | 0,28  |
| 1,60                 | 5,76              | R | 634,39 | 207,77 | 59,21  | 19,86  | 6,77   | 2,18  | 0,96  | 0,40  | 0,15  |
|                      |                   | v | 9,82   | 6,29   | 3,78   | 2,42   | 1,55   | 0,97  | 0,69  | 0,48  | 0,32  |
| 1,80                 | 6,48              | R | 793,36 | 259,03 | 73,57  | 24,61  | 8,37   | 2,69  | 1,18  | 0,49  | 0,19  |
|                      |                   | v | 11,05  | 7,07   | 4,26   | 2,73   | 1,75   | 1,09  | 0,77  | 0,54  | 0,36  |
| 2,00                 | 7,20              | R |        | 315,77 | 89,40  | 29,83  | 10,12  | 3,24  | 1,42  | 0,59  | 0,23  |
|                      |                   | v |        | 7,86   | 4,73   | 3,03   | 1,94   | 1,21  | 0,86  | 0,60  | 0,40  |
| 2,20                 | 7,92              | R |        | 377,96 | 106,70 | 35,52  | 12,02  | 3,85  | 1,68  | 0,69  | 0,27  |
|                      |                   | v |        | 8,65   | 5,20   | 3,33   | 2,14   | 1,34  | 0,95  | 0,65  | 0,44  |
| 2,40                 | 8,64              | R |        | 445,60 | 125,47 | 41,67  | 14,08  | 4,50  | 1,96  | 0,81  | 0,31  |
|                      |                   | v |        | 9,43   | 5,68   | 3,63   | 2,33   | 1,46  | 1,03  | 0,71  | 0,48  |
| 2,60                 | 9,36              | R |        | 518,69 | 145,71 | 48,30  | 16,29  | 5,19  | 2,26  | 0,93  | 0,36  |
|                      |                   | v |        | 10,22  | 6,15   | 3,94   | 2,53   | 1,58  | 1,12  | 0,77  | 0,52  |
| 2,80                 | 10,08             | R |        |        | 167,40 | 55,38  | 18,64  | 5,93  | 2,58  | 1,06  | 0,41  |
|                      |                   | v |        |        | 6,62   | 4,24   | 2,72   | 1,70  | 1,20  | 0,83  | 0,56  |
| 3,00                 | 10,80             | R |        |        | 190,56 | 62,93  | 21,15  | 6,72  | 2,92  | 1,20  | 0,46  |
|                      |                   | v |        |        | 7,10   | 4,54   | 2,91   | 1,82  | 1,29  | 0,89  | 0,60  |
| 3,50                 | 12,60             | R |        |        | 254,82 | 83,82  | 28,07  | 8,89  | 3,86  | 1,58  | 0,61  |
|                      |                   | v |        |        | 8,28   | 5,30   | 3,40   | 2,12  | 1,51  | 1,04  | 0,70  |
| 4,00                 | 14,40             | R |        |        | 328,14 | 107,58 | 35,90  | 11,33 | 4,91  | 2,01  | 0,77  |
|                      |                   | v |        |        | 9,46   | 6,06   | 3,89   | 2,43  | 1,72  | 1,19  | 0,80  |
| 4,50                 | 16,20             | R |        |        | 410,53 | 134,19 | 44,65  | 14,06 | 6,07  | 2,49  | 0,95  |
|                      |                   | v |        |        | 10,65  | 6,81   | 4,37   | 2,73  | 1,94  | 1,34  | 0,90  |
| 5,00                 | 18,00             | R |        |        |        | 163,65 | 54,32  | 17,05 | 7,36  | 3,01  | 1,15  |
|                      |                   | v |        |        |        | 7,57   | 4,86   | 3,03  | 2,15  | 1,49  | 1,00  |
| 5,50                 | 19,80             | R |        |        |        | 195,95 | 64,88  | 20,32 | 8,75  | 3,57  | 1,36  |
|                      |                   | v |        |        |        | 8,33   | 5,34   | 3,34  | 2,37  | 1,64  | 1,10  |
| 6,00                 | 21,60             | R |        |        |        | 231,09 | 76,36  | 23,86 | 10,26 | 4,18  | 1,60  |
|                      |                   | v |        |        |        | 9,08   | 5,83   | 3,64  | 2,58  | 1,79  | 1,20  |
| 6,50                 | 23,40             | R |        |        |        | 269,06 | 88,73  | 27,68 | 11,89 | 4,84  | 1,84  |
|                      |                   | v |        |        |        | 9,84   | 6,32   | 3,95  | 2,80  | 1,93  | 1,30  |
| 7,00                 | 25,20             | R |        |        |        | 309,86 | 102,00 | 31,76 | 13,62 | 5,54  | 2,11  |
|                      |                   | v |        |        |        | 10,60  | 6,80   | 4,25  | 3,01  | 2,08  | 1,40  |
| 7,50                 | 27,00             | R |        |        |        |        | 116,17 | 36,10 | 15,47 | 6,28  | 2,39  |
|                      |                   | v |        |        |        |        | 7,29   | 4,55  | 3,23  | 2,23  | 1,50  |
| 8,00                 | 28,80             | R |        |        |        |        | 131,24 | 40,72 | 17,42 | 7,07  | 2,68  |
|                      |                   | v |        |        |        |        | 7,77   | 4,86  | 3,44  | 2,38  | 1,60  |
| 8,50                 | 30,60             | R |        |        |        |        | 147,20 | 45,60 | 19,49 | 7,90  | 3,00  |
|                      |                   | v |        |        |        |        | 8,26   | 5,16  | 3,66  | 2,53  | 1,70  |
| 9,00                 | 32,40             | R |        |        |        |        | 164,05 | 50,75 | 21,67 | 8,77  | 3,32  |
|                      |                   | v |        |        |        |        | 8,74   | 5,46  | 3,87  | 2,68  | 1,80  |
| 9,50                 | 34,20             | R |        |        |        |        | 181,80 | 56,16 | 23,96 | 9,69  | 3,67  |
|                      |                   | v |        |        |        |        | 9,23   | 5,77  | 4,09  | 2,83  | 1,90  |
| 10,00                | 36,00             | R |        |        |        |        | 200,45 | 61,84 | 26,35 | 10,65 | 4,03  |
|                      |                   | v |        |        |        |        | 9,72   | 6,07  | 4,30  | 2,98  | 2,00  |



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