PIPE AND FITTINGS IN POLYPROPYLENE COP-RANDOM
INTRODUCTION

Coprax is a system of pipes and fittings made from VESTOLEN P9421 random copolymer polypropylene, specially developed for this use. The system's characteristics make it suitable for the construction of heating and water supply systems of the most widely varying forms, with outstanding reliability over time.

One special feature of the Coprax system is the assembly technique, in which the parts to be connected are welded by melting. After welding, the pipe and fitting form a single, continuous body, with none of the problems which may derive from potential leakage points. The assembly method, the wide range of sizes and fittings available, the versatility of the system and its excellent chemical and physical properties make Coprax a product of exceptional quality, proven by years of experience.

CONTENTS

1. MAIN CHARACTERISTICS OF THE SYSTEM
2. COPRAX + ALUMINIUM SYSTEM
3. NORMS, DIRECTIVES AND GUARANTEE
4. DIMENSIONAL CHARACTERISTICS
5. TECHNICAL GUIDELINES
6. PROCESSING
7. RESISTANCE TO CHEMICALS
8. TESTING OF THE INSTALLATION

EDITION 1:04/07
The Coprax system is made from VESTOLEN P9421, a Random Copolymer Polypropylene (PP-R) approved for the production of pipes according to DIN 8078 standards (Polypropylene Pipes. General Quality Requirements - Tests).

The raw material is supplied in granules already coloured in the exclusive PRANDELLI BLUE.

Before processing, the granule is submitted to specific tests in our laboratories to verify its suitability for use (ISO/R 1133 procedure 18. Melt index MFI 190/5).

VESTOLEN P9421 is a thermoplastic resin which is transformed into the finished product by a rise in temperature, which plasticizes the material, allowing the pipe to be produced by means of extrusion, and the fittings by moulding. These processes are carried out inside our factory, under the control of skilled, qualified staff. The dimensions of the pipes and fittings, with the relative processing tolerances, are established in accordance with DIN 8077 (Pipes in polypropylene, PP, dimensions).

### The Raw Material

<table>
<thead>
<tr>
<th>Property Test Method</th>
<th>Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 1628 T3</td>
<td>430</td>
</tr>
<tr>
<td>ISO 1133 procedure 18</td>
<td>0.5</td>
</tr>
<tr>
<td>ISO 1133 procedure 12</td>
<td>0.3</td>
</tr>
<tr>
<td>ISO 1183</td>
<td>1.5</td>
</tr>
<tr>
<td>DIN 53736 B2</td>
<td>0.898</td>
</tr>
<tr>
<td>ISO 527 speed 50 mm/min</td>
<td></td>
</tr>
<tr>
<td>DIN 8078</td>
<td>700</td>
</tr>
<tr>
<td>VDE 0304 Section 1 § 4</td>
<td></td>
</tr>
<tr>
<td>DIN 52612</td>
<td>1.5 x 10⁻⁴</td>
</tr>
<tr>
<td>Adiabatic calorimeter</td>
<td>0.24</td>
</tr>
<tr>
<td>DIN 53483</td>
<td>2.0</td>
</tr>
<tr>
<td>DIN 53483</td>
<td>&lt; 5 x 10⁻⁴</td>
</tr>
<tr>
<td>DIN 53482</td>
<td>≥ 2.3</td>
</tr>
<tr>
<td>DIN 53481</td>
<td>≥ 1 x 10¹⁶</td>
</tr>
</tbody>
</table>

### Fields of Application

The Coprax system is suitable for transporting hot and cold fluids.

The Coprax system is suitable for transporting hot and cold fluids in industrial plants, and for conditioning systems in residential and industrial buildings.

This capability makes it ideal for the construction of water supply, heating and air-conditioning systems, in residential and industrial buildings.

It is also suitable for transporting fluids for human consumption and other applications where the technical characteristics of the end-product are demanding.

### Operating Conditions

See chapter 5 of this Guide for a more complete description of the operating conditions the system is able to withstand.

Coprax has many characteristics which make it an ideal system for constructing modern plants at the technological state of the art.

### Fields of Application

The Coprax system is suitable for transporting hot and cold fluids under pressure for long periods of time. This capability makes it ideal for the construction of water supply, heating and air-conditioning systems, in residential and industrial buildings.

It is also suitable for transporting fluids for human consumption and other applications where the technical characteristics of the end-product are demanding.

### Operating Conditions

See chapter 5 of this Guide for a more complete description of the operating conditions the system is able to withstand.

Coprax has many characteristics which make it an ideal system for constructing modern plants at the technological state of the art.
Coprax is chemically inert and highly resistant to a wide range of acids and bases. This makes it suitable for contact with the materials normally used in the construction sector, such as lime or cement, with no need for specific protection.

For transport or contact with special substances, please refer to check the chemical resistance of the polypropylene, consulting the table provided on page 47.

Due to the density of just 0.898 g/cm³, pipes and fittings are very light.

Combined with the wide range of fittings available, this enables complete installations to be made easily and safely, with considerable time savings compared to conventional products.

The system is composed of non-toxic and compliant with current standards of Vendotex P.9421, the raw material used for production of the Coprax system, is completely non-toxic and complies with current standards of the international level.

The material's high sound insulation value, the noise level of the system is considerably reduced both with particularly high water flow speeds and when water hammers are present. This means the water hammer is not transmitted to the rest of the installation, reducing noise and thus improving the comfort of users.

Due to the material's high sound insulation, the noise level of the material is extremely low, making it ideal for use in zones with a high concentration of electrostatic currents. The material is unaffected by stray currents, which may cause dangerous punctures in metal pipes.

Finally, it takes longer for the water to freeze when the outdoor temperature drops, thanks to the material's high sound insulation, which reduces the formation of condensation on the outside of the pipes and the risk of frost damage.

For installation of the system, it is recommended to consult the technical documentation provided on pages 7-11, as well as any other necessary documents, before starting the installation.
Alongside the Coprax line, Prandelli has also developed another system in random copolymer polypropylene, under the trade mark of Coprax + Aluminium. This product is made from the same raw material as the basic line, VESTOLEN P9421, which is used to produce pipes bonded on the outside during extrusion with a sheet of aluminium. This part is then given a further coating of a PP-R layer by a co-extrusion process. This surface layer protects the aluminium sheet from any degradation processes which might affect it when in service.

**INTRODUCTION**

The sheet of aluminium helps to keep the pipe's thermal expansion coefficient low, which makes it ideal for use in service. The composite pipe is very easy to bend into shape, aiding installation with clocking and installation of the materials inside walls or floors. The aluminium sheet and outer PP-R coating give the Coprax + Aluminium pipe greater shear strength, providing greater protection for the underlying pipe. The composite pipe is very easily bent into shape, aiding installation with little or no further changes.

**PROPERTIES**

- **SHEAR STRENGTH**: Excellent
- **LOW THERMAL EXPANSION**: Excellent
- **WORKABILITY**: Excellent

This product is made from the same raw materials as the basic line, Coprax + Aluminium, in random copolymer polypropylene. Under the trade mark of Coprax, the company introduces this new developed composite system as well as the characteristics already mentioned for the conventional system. 

**PROPERTIES**

- **LOW THERMAL EXPANSION**: 2.8 9°C
- **SHEAR STRENGTH**: Excellent
- **WORKABILITY**: Excellent

The sheet of aluminium helps to keep the pipe's thermal expansion coefficient low, which makes it ideal for use in service. The composite pipe is very easy to bend into shape, aiding installation with little or no further changes.

**LOW THERMAL EXPANSION**: 2.8 9°C

**SHEAR STRENGTH**: Excellent

**WORKABILITY**: Excellent
DIN 1988

DIN 4109, sheet 5
Soundproofing in the construction sector (complementary regulations).
Soundproofing in water piping.

DIN 16774
Thermoplastic mass: polypropylene PP.

DIN 53735
Tests of plastic materials; determination of melt index of thermoplastics.

DIN 16962
Polypropylene (PP) pipes and fittings.
Sheet 5: general quality requirements - tests.
Sheet 6: moulded elbows for welding with couplings, dimensions.
Sheet 7: moulded union tees for welding with couplings, dimensions.
Sheet 8: moulded caps and couplings for welding with couplings, dimensions.
Sheet 9: moulded pipe fittings and reductions for welding with couplings, dimensions.
Sheet 10: collars, flanges and seals for welding with couplings, dimensions.

KTW RECOMMENDATIONS
Communication of the German Ministry of Health concerning the admissibility of plastic materials and other non-metal materials in the context of the law on food products and the drinking water sector.
Recommendations concerning plastic materials and drinking water (KTW) of the German Ministry of Health.

DIN 2000
Directives concerning the requirements for drinking water.
Design, development and operation of installations.

NORMS AND DIRECTIVES
DIN 8076
Pressurized thermoplastic pipelines.
Compression type metal fittings.

DIN 8077
Polypropylene PP pipes, dimensions.

DIN 8078
Polypropylene pipes. General quality requirements - tests.

DIN 16960
Welding of thermoplastic materials, PP type 1 and type 2, pipes and accessories.

DVS 2203
Tests of thermoplastic pipe fittings for welding.

DVS 2207, part 1
Welding of thermoplastic materials, PP type 2, pipes and accessories.

DVS 2208, part 1
Machinery and equipment for welding thermoplastics, welding with hot elements.

W 328
Realization of drinking water installations inside buildings.
Specifications.
Regulations on the general conditions for water pipes, from 20.06.1980.

VOB part C DIN 18381
Installation of gas, water and waste pipes inside houses.
The following GUARANTEE is provided for the Coprax system when used for heating and water supply installations, in a manner compatible with the technical characteristics of the product and in accordance with the installation instructions in the relative publication:

1. Through insurance cover with a leading insurance company, Prandelli, manufacturer of the Coprax system, will compensate injury or damage caused by breakage of pipes and fittings due to obvious manufacturing defects up to a maximum of €500,000, for a period of 10 YEARS after the date marked on the pipe.

2. The conditions governing this GUARANTEE are:
   a) the pipe and fittings must be installed in accordance with the installation instructions provided by us, further to checking for possible faults or tampering which have occurred after production due to accidental causes.
   b) The operating conditions (pressure and temperature) must be within the technical limits stated by the latest Coprax Guide.
   c) The product must carry the Coprax identification mark.

3. The GUARANTEE DOES NOT APPLY in the following cases:
   a) failure to comply with our recommended installation instructions.
   b) Connection of the pipe and fittings to heat sources with even accidental temperature and pressure limits not compatible with the characteristics of the pipe and fittings.
   c) Use of obviously unsuitable material (pipes and fittings which are old, scratched, etc.)
   d) Use of one or more components not manufactured by us in construction of the system.
   e) Poor welds produced using unsuitable equipment.

4. INSTRUCTIONS FOR REQUESTING AFTERSALES SERVICE UNDER GUARANTEE
   In case of a breakage of the Coprax system due solely to obvious manufacturing defects, users must send us a registered letter, sending a copy to their local agent. This letter must contain:
   - date and place of installation;
   - specifications and identification mark of the pipe and fittings;
   - information about the operating conditions (pressure and temperature);
   - sample of the pipe or fitting on which the breakage has occurred;
   - name and address of the installer who constructed the system.

   We will send a technician to check the causes of the breakage within a reasonable period of time after receipt of the registered letter.

   If the breakage is covered by the terms of the GUARANTEE, we will put the matter in the hands of our insurance company, which will pay compensation after checking the cause and amount of the damage.

   If the breakage is not covered by the GUARANTEE, we will charge the expenses we have incurred to the customer.
The correspondence with dimensions in inches refers to the outside diameter of the pipe.

To establish flow-rates, refer to the "loss of pressure" graph on page 18.

TABLE OF DIMENSIONS OF COPRAX SYSTEM PIPES PN20

The Coprax system comprises a wide range of fittings, which can be subdivided into two groups, depending on their intended use:

- A_ Fitting in PP-R for welding
- B_ PP-R fitting with metal insert

### FITTINGS

#### TABLE OF DIMENSIONS OF COPRAX SYSTEM PIPES PN10

<table>
<thead>
<tr>
<th>DIMENSION</th>
<th>INCHES *</th>
<th>1/2&quot;</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1.1/4&quot;</th>
<th>1.1/2&quot;</th>
<th>2&quot;</th>
<th>2.1/2&quot;</th>
<th>3&quot;</th>
<th>4&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTSIDE DIAMETER mm</td>
<td></td>
<td>16</td>
<td>20</td>
<td>25</td>
<td>32</td>
<td>40</td>
<td>50</td>
<td>63</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>TOLERANCE mm</td>
<td>+ 0.3</td>
<td>+ 0.3</td>
<td>+ 0.3</td>
<td>+ 0.3</td>
<td>+ 0.4</td>
<td>+ 0.5</td>
<td>+ 0.6</td>
<td>+ 0.7</td>
<td>+ 0.9</td>
<td>+ 1.0</td>
</tr>
<tr>
<td>THICKNESS mm</td>
<td>2.7</td>
<td>3.4</td>
<td>4.2</td>
<td>5.4</td>
<td>6.7</td>
<td>8.4</td>
<td>10.5</td>
<td>12.5</td>
<td>15.0</td>
<td>18.3</td>
</tr>
<tr>
<td>TOLERANCE mm</td>
<td>+ 0.4</td>
<td>+ 0.5</td>
<td>+ 0.6</td>
<td>+ 0.7</td>
<td>+ 0.8</td>
<td>+ 1.0</td>
<td>+ 1.2</td>
<td>+ 1.4</td>
<td>+ 1.6</td>
<td>+ 2.0</td>
</tr>
<tr>
<td>INSIDE DIAMETER mm</td>
<td>10.6</td>
<td>13.2</td>
<td>16.6</td>
<td>21.2</td>
<td>26.6</td>
<td>33.2</td>
<td>42.0</td>
<td>50.0</td>
<td>60.0</td>
<td>73.4</td>
</tr>
<tr>
<td>AVERAGE WEIGHT Kg/100m</td>
<td>11.2</td>
<td>17.6</td>
<td>27.0</td>
<td>44.4</td>
<td>68.6</td>
<td>103.7</td>
<td>168.9</td>
<td>225.0</td>
<td>335.0</td>
<td>490.0</td>
</tr>
</tbody>
</table>

#### DIMENSIONAL CHARACTERISTICS

- **EXT. DIAMETER WITHOUT AL.SH. mm:**
  - 16
  - 20
  - 25
  - 32
  - 40
  - 50
  - 63
  - 75
  - 90
  - 110

- **PIPE WALL THICK. WITHOUT AL.SH. mm:**
  - 2.2
  - 2.8
  - 3.5
  - 4.4
  - 5.5
  - 6.9
  - 8.6
  - 10.3
  - 12.3
  - 15.1

- **PIPE INTERNAL DIAMETER mm:**
  - 11.6
  - 14.4
  - 18.0
  - 23.2
  - 29.0
  - 36.2
  - 45.8
  - 54.4
  - 65.4
  - 79.8

- **EXT. DIAMETER WITH AL.SH. mm:**
  - 17.7
  - 21.7
  - 26.7
  - 33.7
  - 41.7
  - 51.7
  - 64.6
  - 76.6
  - 91.6
  - 112.5

- **SUPPLIED IN:**
  - Rotoli 100 m
  - Barre 4 m

- **PN:**
  - 16
The main parameters affecting the behavior of plastics are:

- Mechanical stress = Pressure
- Thermal stress = Temperature
- Duration of stress = Time

These parameters are linked together by means of the regression curves shown below.

**Operating conditions** for **VESTOLEN P4421** regression curves:

- Pressure = 10 bar
- Temperature = 60°C
- Time = 50 years

Coprax pipes and fittings must be used and installed in accordance with these operating conditions. The operating class, PN20, belongs to the Primo operating class. It must be remembered that CoPrax belongs to the Primo operating class and fittings must be used and installed in accordance with these operating conditions. The parameters are linked together by means of the regression curves shown below.
Calculation of the loss of pressure is a fundamental step in the design of heating and water supply systems. This parameter is closely linked to the delivery rate of the system, meaning the amount of water which reaches the individual users in the unit of time.

Loss of pressure may be continuous or localized. The sum of these two components provides the total loss of pressure of the system. Continuous loss of pressure are generated by the continuous resistances which a fluid encounters as it travels along a pipe. These consist of the internal frictions of the fluid itself, due to viscosity, and those generated by contact with the inside surface of the pipe.

Continuous headlosses are measured in pressure units (pascal, bar, metres or millimetres of water column). In general, the measurement refers to a unit length of pipe, and the second generally the flow rate of the fluid.

The continuous loss of pressure are determined by means of the graphs given on the facing page (measured for water at 20°C). To use the monogram, at least two quantities will have to be established, one of which is the size of the pipe and the second generally the flow rate or speed.

Example:

- Tube PN 20: ø 32 x 5,4
- ø int. = mm 21,2 (point A)
- speed 1 m/s (point B)
- By joining points A and B with a straight line, points C and D are found which indicate a flow resistance $J = 0,075 \text{ m/m}$ and flow rate $Q = 0,35 \text{ l/s}$.
Note: the simultaneous delivery rates take into account the probability that the taps will be turned on simultaneously.

### Examples of Dimensions of a Cold Water Supply Network

<table>
<thead>
<tr>
<th>Appliances</th>
<th>Ø 25</th>
<th>Ø 32</th>
<th>Ø 40</th>
<th>Ø 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Washbasin</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
</tr>
<tr>
<td>1 WC with cistern</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
</tr>
<tr>
<td>1 Bidet</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
</tr>
<tr>
<td>1 Bath</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
</tr>
<tr>
<td>1 Sink</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
<td>0.2 l/s</td>
</tr>
<tr>
<td>1 Dishwasher</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
</tr>
<tr>
<td>1 Washing machine</td>
<td>1.0 l/s</td>
<td>1.0 l/s</td>
<td>1.0 l/s</td>
<td>1.0 l/s</td>
</tr>
<tr>
<td>7 Appliances</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
<td>0.1 l/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ø 25</th>
<th>Ø 32</th>
<th>Ø 40</th>
<th>Ø 50</th>
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</thead>
<tbody>
<tr>
<td>28 appliances</td>
<td>21 appliances</td>
<td>14 appliances</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water at 60 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Speed</td>
</tr>
<tr>
<td>m/s</td>
</tr>
<tr>
<td>1.0</td>
</tr>
<tr>
<td>2.0</td>
</tr>
<tr>
<td>3.0</td>
</tr>
<tr>
<td>4.0</td>
</tr>
</tbody>
</table>

### TECHNICAL GUIDELINES

**SPEED**

- **FLOW RESISTANCE**
- **INTERNAL DIAMETER**
- **FLOW RATE**

**EXAMPLES OF DIMENSIONS OF A COLD WATER SUPPLY NETWORK**

**CONNECTED APPLIANCES AND RELATIVE DELIVERY RATES (UNI 9182-87)**

**NET WORK**

- **FLOW RATE**
- **INTERNAL DIAMETER**

**FLOW RESISTANCE**

<table>
<thead>
<tr>
<th>Water Speed</th>
<th>Flow Rate</th>
<th>Flow Resistance</th>
<th>Internal Diameter</th>
<th>Total Delivery Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>m/s</td>
<td>l/s</td>
<td>m/m</td>
<td>(mm)</td>
<td>l/s</td>
</tr>
<tr>
<td>1.0</td>
<td>0.55</td>
<td>25</td>
<td>Ø 25</td>
<td>7 appliances</td>
</tr>
<tr>
<td>2.0</td>
<td>0.76</td>
<td>32</td>
<td>Ø 32</td>
<td>7 appliances</td>
</tr>
<tr>
<td>3.0</td>
<td>0.99</td>
<td>40</td>
<td>Ø 40</td>
<td>7 appliances</td>
</tr>
<tr>
<td>4.0</td>
<td>1.12</td>
<td>50</td>
<td>Ø 50</td>
<td>7 appliances</td>
</tr>
</tbody>
</table>
Localized loss of pressure are generated by the irregularities which a fluid encounters as it flows along the pipeline (bends, valves, reductions, etc.).

There are various ways of expressing localized loss of pressure; in our discussion, we consider those which refer to the measurement of the so-called "localized resistance coefficient" associated to the Coprax range of pipe fittings.

### Localized Loss of Pressure

<table>
<thead>
<tr>
<th>Number</th>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coupling</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reduction until 2 dim.</td>
<td></td>
</tr>
<tr>
<td>2a</td>
<td>Reduction ≥ 3 dim.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Elbow 90°</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Elbow 45°</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Union tee</td>
<td></td>
</tr>
<tr>
<td>5a</td>
<td>Reduced union Tee</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Union tee</td>
<td></td>
</tr>
<tr>
<td>6a</td>
<td>Reduced union Tee</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Union tee</td>
<td></td>
</tr>
<tr>
<td>7a</td>
<td>Reduced union Tee</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Union tee</td>
<td></td>
</tr>
<tr>
<td>8a</td>
<td>Reduced union Tee</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Threaded Tee</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Male threaded joint</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Red. male threaded joint</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Male threaded elbow</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Red. male threaded elbow</td>
<td></td>
</tr>
</tbody>
</table>

### Localized Resistance Coefficients

**Graphical symbols**

**Loss of pressure z in relation to r = 1 with water at 10°C for various speeds v**

<table>
<thead>
<tr>
<th>Flowing Speed v (m/s)</th>
<th>Loss of pressure z (mbar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>33.8</td>
</tr>
<tr>
<td>0.2</td>
<td>36.5</td>
</tr>
<tr>
<td>0.3</td>
<td>39.2</td>
</tr>
<tr>
<td>0.4</td>
<td>42.1</td>
</tr>
<tr>
<td>0.5</td>
<td>45</td>
</tr>
<tr>
<td>0.6</td>
<td>48</td>
</tr>
<tr>
<td>0.7</td>
<td>51</td>
</tr>
<tr>
<td>0.8</td>
<td>55</td>
</tr>
<tr>
<td>0.9</td>
<td>58</td>
</tr>
<tr>
<td>1.0</td>
<td>61</td>
</tr>
<tr>
<td>1.1</td>
<td>65</td>
</tr>
<tr>
<td>1.2</td>
<td>68</td>
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<td>2.4</td>
<td>120</td>
</tr>
<tr>
<td>2.5</td>
<td>125</td>
</tr>
</tbody>
</table>

### Formula

\[
\text{z} = \sum r \cdot v^2 \cdot \frac{\gamma}{2g} \approx 5 \cdot \sum r \cdot v^2 (\text{mbar})
\]

Where:

- \( \gamma \) = 999.7 kg/m³ specific weight of water
- \( g = 9.81 \text{ m/s}^2 \) gravity acceleration
- \( v \) = speed of water in m/s

The flow diagram illustrates the methods for expressing localized loss of pressure in our regulations.
As already mentioned, the total system headloss is obtained by adding together the continuous and localized loss of pressure:

\[ \Delta P = l \cdot R + z \cdot 10 \]

where:
- \( \Delta P \) = total loss of pressure (mm c.a.)
- \( l \) = pipeline length (m)
- \( R \) = continuous loss of pressure (mm c.a./m)
- \( z \) = localized loss of pressure (mbar)

Each material which undergoes a variation in temperature over time reacts by modifying its size to varying degrees. This phenomenon is called thermal expansion; the body will increase in volume when the temperature rises, or contract when it decreases.

Thermal expansion may be linear, superficial or cubic, depending on whether it mainly affects one, two or all three of the body's dimensions. In the case of pipelines, the expansion is mainly linear, since their length far exceeds their other dimensions.

The parameter which provides guidance on a pipe's tendency to expand or contract in case of a temperature variation is its linear expansion coefficient. Therefore, when designing and constructing installations it is essential to know the value of this coefficient in order to calculate the amount of expansion or contraction in the material, and to ensure that it will not damage the piping.

5. TECHNICAL GUIDELINES

### TOTAL LOSS OF PRESSURE

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>EXPANSION AND CONTRACTION IN COPRAX AND COPRAX + ALUMINIUM SYSTEM PIPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPANSION AND CONTRACTION IN COPRAX AND COPRAX + ALUMINIUM SYSTEM PIPES</td>
<td>NATURALLY</td>
</tr>
</tbody>
</table>

Coprax and Coprax + Aluminium system pipes are not immune to thermal expansion, and so this must be carefully evaluated during design and installation.

- Installation under concrete: the effect of the expansion is negligible, since the material is able to absorb it, and no special measures are required.
- Installation externally (visible): the effect of the expansion must be considered, since the material is exposed to considerable variations in temperature.

In the first case, the effect of the expansion is negligible, since the material is able to absorb it, and no special measures are required. On the other hand, when pipes are installed outside the walls and exposed to considerable variations in temperature, it is essential to adopt the necessary measures to ensure that the material will not be damaged.

The parameter which provides guidance on a pipe's tendency to expand or contract in case of a temperature variation is its linear expansion coefficient. Therefore, when designing and constructing installations it is essential to know the value of this coefficient in order to calculate the amount of expansion or contraction in the material, and to ensure that it will not damage the piping.

### Expansion and Contraction

For each material which undergoes a variation in temperature over time, the above formula applies:

\[ \Delta P = R \cdot Z \cdot 10 \]

where:
- \( \Delta P \) = total loss of pressure
- \( R \) = continuous loss of pressure (mm c.a./m)
- \( Z \) = expanded length
- \( 10 \) = total loss of pressure (mbar)

Naturally, Coprax and Coprax + Aluminium system pipes are not immune to thermal expansion, and so this must be carefully evaluated during design and installation.

First, it is important to distinguish between the two alternative installation modes:

- **Installation under concrete**: the effect of the expansion is negligible, since the material is able to absorb it, and no special measures are required.
- **Installation externally (visible)**: when pipes are installed outside the walls and exposed to considerable variations in temperature, it is essential to allow for the thermal expansion by proceeding as described hereafter.
TECHNICAL GUIDELINES

In this case, the pipe expands, increasing its initial length.

\[ \Delta L = \alpha \cdot L \cdot \Delta T \]

From which we obtain:

\[ \Delta L = 0.15 \cdot 6 \cdot 55 = 49.5 \text{ mm (Coprax pipe)} \]
\[ \Delta L = 0.06 \cdot 6 \cdot 55 = 19.8 \text{ mm (Coprax + Aluminium pipe)} \]

EXAMPLE 1: EXPANSION

The parameter \( \Delta L \) can also be calculated using the graph shown below.

\[ \Delta L = \alpha \cdot L \cdot \Delta T \]

From which we obtain:

\[ \Delta L = 0.15 \cdot 6 \cdot (-25) = -22.5 \text{ mm (Coprax pipe)} \]
\[ \Delta L = 0.06 \cdot 6 \cdot (-25) = -9.0 \text{ mm (Coprax + Aluminium pipe)} \]

EXAMPLE 2: CONTRACTION

The variation in length \( \Delta L \) of a pipe of a given material can be calculated using the graph shown below.

\[ \Delta L = \alpha \cdot L \cdot \Delta T \]

where:

- \( \alpha \) is the linear expansion coefficient of the material
- \( L \) is the length of the pipe section free to expand (m)
- \( \Delta T \) is the difference in temperature between the time of installation and the operating temperature (°C)

The parameter \( \Delta L \) can also be calculated using the following formula:

\[ \Delta L = \alpha \cdot L \cdot \Delta T \]

where:

- \( \alpha \) is the linear expansion coefficient of the material
- \( L \) is the length of the pipe section free to expand (m)
- \( \Delta T \) is the difference in temperature between the time of installation and the operating temperature (°C)

The variation in length \( \Delta L \) of a Coprax pipe further to a temperature variation can be calculated using the following formula:

\[ \Delta L = \alpha \cdot L \cdot \Delta T \]

where:

- \( \alpha \) is the linear expansion coefficient of the material
- \( L \) is the length of the pipe section free to expand (m)
- \( \Delta T \) is the difference in temperature between the time of installation and the operating temperature (°C)
Sliding points allow the pipe to move axially in both directions. They therefore have to be positioned well away from joints made using pipe fittings, on a free length of the pipe's surface. The collar which forms the sliding support point must be absolutely free from parts which might damage the outside surface of the pipe.

Sliding points also provide support and ensure (provided enough of them are installed) that the pipe remains straight in spite of thermal stresses.

See "stirrup distances".

Once the variation in length of the piping has been calculated, the necessary measures must be taken to ensure that its effects do not cause problems for the piping itself. The following procedures may be used:

- provision of fixed and sliding points;
- compensation with expansion arms.

These are the fixtures which secure the piping to the masonry structure of the building, totally or partially preventing the movements generated by thermal expansion.

Fixed points prevent pipes from moving, and so must provide a rigid connection between the installation on the one hand and the masonry on the other. They are constructed using rigid collars consisting of a gripping element on one side and a component on the other which prevent the friction on the one hand and the masonry on the other.

In order to prevent dangerous cutting of the surface of the pipe, these points must be adequately secured from the point which supports it: the collar when located on a free length of the pipe, the fitting when located on a joint. The collar must be provided with a rubber or another similar material part intended to prevent damage to the pipe.

Fixed points normally be positioned next to any joint in the piping, and especially to one made using a coupling or any other welded fitting.

Obviously, the fixed points limit the length of the section of pipe free to expand, and thus reduce the relative ΔL value.

A coupling or other welded fitting should always be provided next to any joint in the piping, and especially to one made using a coupling or any other welded fitting. The collar must be located on the free length of the pipe, and in the case of a welded fitting, the collar must be positioned in the groove of the masonry structure.

Fixed points must normally be positioned next to any joint in the piping, and especially to one made using a coupling or any other welded fitting. The collar must be located on the free length of the pipe, and in the case of a welded fitting, the collar must be positioned in the groove of the masonry structure.
To allow correct installation of Coprax and Coprax + Aluminium system pipes on the outside of walls, the following is the graph used to calculate the stirrup distances between points. These distances remain the same regardless of whether the pipes are horizontal or vertical.

### TECHNICAL GUIDELINES

#### THE STIRRUP DISTANCES

<table>
<thead>
<tr>
<th>PIPE EXTERNAL DIAMETER (mm)</th>
<th>STIRRUP DISTANCES (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When Coprax + Aluminium pipes are used, the reduced expansion of these pipes allows the distances between points to be increased.

To calculate the expansion arm length for a section of COPRAX pipe where:

- \( d = 40 \text{ mm} \) (outside diameter);
- \( L = 6 \text{ m} \);
- \( \Delta T = 55 \text{°C} \)

Previous calculations have given \( \Delta L = 49.5 \text{ mm} \)

Therefore:

\[
LS = F \cdot \sqrt{d \cdot \Delta L} = 30 \cdot \sqrt{(40 \cdot 49.5)} = 1335 \text{ mm}
\]

### EXAMPLE

Note: when Coprax + Aluminium pipe is used in the same conditions and with the same \( F \) value, the expansion arm will be shorter than for Coprax. This is because of the lower thermal expansion coefficient, which means that the increase in pipe length is reduced.

With this technique, the pipe run is designed to allow any expansion to be absorbed. To ensure this, expansion arms, where the pipe is able to expand in case of thermal stresses, are installed at points where the direction changes (elbows, tees, etc.).

The specifications of these expansion arms are calculated using the following formula:

\[
LS = F \cdot \sqrt{d \cdot \Delta L}
\]

where:

- \( LS \) = expansion arm length (mm)
- \( F \) = constant of the material (for PP = 30)
- \( d \) = pipe outside diameter (mm)
- \( \Delta L \) = pipe length variation (mm)

**Example of expansion arm**

![Example of expansion arm](image)

To draw correct installations of Coprax and Coprax + Aluminium system pipes in the span distance between points, these distances remain the same on the outside of walls. The following is the graph used to calculate the stirrup distances between points.
The following are some examples of correct installation of the Coprax system on the outside of walls, with the various techniques adopted to allow for the thermal expansion of the material.

**TECHNICAL GUIDELINES**

**CALCULATING EXPANSION ARM LENGTH USING GRAPHS (COPRAX SYSTEM)**

<table>
<thead>
<tr>
<th>Temperature difference in °C</th>
<th>Minimum expansion arm length in mm</th>
</tr>
</thead>
</table>

**DIAGRAM EXAMPLES**
The following specific equipment is required for the construction of installations using Coprax system components:

**PROCESSING**

- Welder for electric couplings
- Welding machine or an electric welder and suitable electric couplings.

**WELDING WELDS**

Coprax system elements can be welded together using the welding machine or an electric welder and suitable electric couplings.

**Welding using the welding machine**

Sequence of operations:

1. Preparing the welding machine
2. Inserting the pipe into the welding machine
3. Positioning the fitting on the welding machine
4. Heating the outside surface of the pipe and the inside surface of the fitting simultaneously on the welding machine die.
5. Inserting the pipe in the fitting, to create a socket joint.

Sequence of operations:

1. Preparing the welding machine
2. Heating the outside surface of the pipe and the inside surface of the fitting simultaneously on the welding machine die.
3. Inserting the pipe in the fitting, to create a socket joint.

**Technical Guidelines**

The following specific equipment is required for the construction of installations using Coprax system components:

- Welding machine
- Welder for electric couplings
- Pipe cutter
- PRISMA bench welder
- Welding using the welding machine
Wait until the green light on the machine goes out, indicating that the welding machine has reached the working temperature.

N.B.: The heating time is calculated from the moment when the pipe and fitting make contact on the dies.

Coprax + Aluminium can be processed in the same way as Coprax, but the outer layer of PP-R and the underlying aluminium sheet must be removed. As an alternative, the special set-dropping unions can be used.

The outer layer of PP-R and the underlying aluminium sheet must be removed. As an alternative, the special set-dropping unions can be used.

After checking that the special set-dropping unions are or dropped, the parts to be connected are cleaned with a clean cloth.

After heating, remove the elements from the dies and make the joint.

After checking that the welding machine is ready, fit the pipe and the fitting simultaneously into the dies of the corresponding size, following the working conditions stated in the table in page 37.

Making a joint with the welding machine

<table>
<thead>
<tr>
<th>DIA.</th>
<th>COPRAX</th>
<th>COPRAX + ALUMINIUM</th>
<th>COPRAX + ALUMINIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
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<td>90</td>
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<tr>
<td>110</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>

Heating and cooling times

<table>
<thead>
<tr>
<th>DIA.</th>
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<th>COPRAX + ALUMINIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
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<td>18</td>
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<tr>
<td>50</td>
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<tr>
<td>63</td>
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<td>30</td>
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<tr>
<td>75</td>
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<td>30</td>
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<tr>
<td>90</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>110</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Heating and cooling times
To ensure that the scraper blade only removes the aluminium and outer PP-R cladding, it is very important to adjust the blade using the screw provided, with the aid of the setting template. When scraping, it is also essential to take care not to reduce the thickness of the PP-R pipe.

**Scraping mechanically**

**Scraping by hand**

6.

Joints to a manifold or a threaded component in general are made by fitting first the nut and then the sealing washer onto the end of the pipe. The hose connection is then inserted until its ridge makes contact with the end of the pipe. The joint is then made by screwing the locking nut onto the outlet of the manifold or the threaded part of a union or a valve. During this procedure, the nut squeezes the plastic sealing washer, which squashes the pipe below so that it forms a perfect seal against the hose connection.

This type of fitting can be used both with the relative manifolds available from our company, and with other manifolds or threaded components from other companies. When using manifolds with hose connections, the nuts of the unions must be made by means of special self-adapting unions, available in diameters 1/2", 3/4", and 1". They consist of three main parts:

- the lock nut;
- the plastic sealing washer;
- the body with hose connection and seal.

The fittings consist of three main parts:

- the lock nut;
- the plastic sealing washer;
- the body with hose connection and seal.

Joints can also be made mechanically, with no need to remove the outer layers of PP-R and aluminium, with the aid of special self-adapting unions. When using manifolds with hose connections, the nuts of the unions must be made by means of special self-adapting unions, available in diameters 1/2", 3/4", and 1". These fittings consist of three main parts:

- the lock nut;
- the plastic sealing washer;
- the body with hose connection and seal.

Joints can also be made mechanically, with no need to remove the outer layers of PP-R and aluminium, with the aid of special self-adapting unions.

**PRECAUTIONS WHEN MAKING WELDS WITH THE WELDING MACHINE**

Adjusting the blade

3) Making the weld

The weld is then made following the procedures described previously.

**PROCESSING**

Making joints with self-adapting unions
When heating and welding, ensure that pressure is applied to the elements gradually and in line with the pipe axis. Do not twist. Small corrections to the reciprocal positions of the pipe and union are only possible during the first few moments after welding, and excessive movements must not be made.

The weld must be left to cool gradually, without sudden variations in temperature, which might generate considerable internal stresses.

The electric coupling is the only Copax system fitting which slides along the pipe when cold.

Sequence of operations

1) Prepare the pipes to be welded so that they are cut perpendicular to their length, using the special pipe cutter. Then scrape the entire circumference of the pipe in the area to be welded, using the hand scraper provided. Large shavings should be produced which remain attached to the pipe, and when removed by scratching a light score on the part to be welded, the pipes are removed by causing a slight movement of the cooper, which results in a small gap. This gap is then gripped by the cooper's teeth, which slide along the pipe as the weld is made.

2) Clean the joint area with a clean rag. Then scrape the entire circumference of the pipe in the area to be welded, using the hand scraper provided. Large shavings should be produced which remain attached to the pipe, and when removed by scratching a light score on the part to be welded, the pipes are removed by causing a slight movement of the cooper, which results in a small gap. This gap is then gripped by the cooper's teeth, which slide along the pipe as the weld is made.

3) After marking the connection depth on the pipes, fit them into the coupling, ensuring that the ends of the pipes are as close to each other as possible and properly aligned.

4) Prepare the Cooper welder, making sure that it is connected to a mains power supply of 220 V 50 Hertz and that the power supply lead is connected to a phase other than that which is connected to the electric coupling. The Cooper welder is the only Cooper system fitting which slides along the pipe when cold.

5) Connect the wire terminals to the terminals on the coupling, ensuring that the weight of the wires does not rest on the joint. The Cooper welder can be used for repairs or welds after installation of the pipes, using the special welder.

6) Start welding, following the instructions on the welder.
7) Make sure that no stresses are applied to the pipes during welding and the subsequent cooling phase (at least 10 minutes).

8) Wait at least 1 hour before putting under pressure the system.

**PROCESSING**

- The elements must be clean and free from moisture; take special care over this, as otherwise a good weld cannot be obtained.

- For the same reasons, after scraping take care not to touch the welding zone. Any traces of dirt/grease due to accidental causes must be removed using a specific detergent for polypropylene/polyethylene (e.g. Henkel Tangit KS). Use of oil-based solvents is forbidden, since they leave a film on the surface of the pipes which prevents welding.

- For optimum welding, the pipes must be inserted in the coupling by the same amount, and must be perfectly aligned with it.

- Check that the working diameter set on the machine is the same as the real one, and must be perfectly aligned with it.

- If several welding cycles have to be performed on the same coupling, wait for the weld to cool completely between one cycle and the next.

### PRECAUTIONS FOR MAKING WELDS USING THE ELECTRIC COUPLING WELDER

If a hole is accidentally made in the coupling between one cycle and the next, the real diameter of the elements to be joined may be reduced.

1. Check that the working diameter set on the machine is the same as the real one.
2. Wait at least 1 hour before putting under pressure the system.
3. Use the hole repairing die to repair the pipe.
4. Clean and dry the part to be repaired.
5. Insert the male part of the hole repairing die into the hole; it must melt the surface to be welded. The die has a metal bush which can be adjusted by the operator to suit the pipe thickness, to ensure that the die cannot be inserted too far and melt the other side of the hole. To make this adjustment, undo the screw which fixes the bush and then move it along the die.
6. At the same time as the male part of the die melts the area around the hole, the female part melts the repair bar usually supplied with the die.
7. Make sure that no stresses are applied to the pipes during welding and the subsequent cooling phase (at least 10 minutes).
8. Wait at least 1 hour before putting under pressure the system.
LAVORAZIONE

- Once the heating time has passed (5 sec.) the repair bar must be inserted in the hole. When this operation is complete, wait for everything to cool and then cut off the excess part of the repair bar. If the diameter of the hole to be repaired is greater than that of the die, or both sides of the pipe are punctured, the piece of pipe must be cut out and the repair made using normal pipe fittings, or more easily using the electric couplings.

INSTRUCTIONS FOR USE / REF K 47 COPRAX

1) PREPARING THE PIPE SURFACE

- The section to be affected by the deviation must be cleaned of all traces of dirt.
- The surface to be welded must be scraped, using an appropriate scraper. The scraping process is essential for removing the external film of the pipe, that over time, has oxidized and which will prevent a good weld from being achieved.
- Boring the pipe can be done using a standard drill tip. The size of this tip must always be 1 mm smaller than the size of the opening in the pipe which should be made. The die must always be mounted on the end of the tip in order to prevent the surface from being overheated.

2) PROCEDURE FOR BORRING THE PIPE

- The size of the hole must always be 1 mm smaller than the size of the opening in the pipe which should be made.
- The use of a saddle fitting enables derivations to be applied to previously installed tracts of piping whose diameter is larger than the requirements of the new fitting tracts to be made.

3) DIES FOR POLYFUSE WELDING AND FUSION

- To carry out the required welding, it is imperative that the appropriate dies for polyfuse welding are used. These dies have been designed so that the surfaces to be welded are properly fused together.
- With normal polyfuse welding the dies must be mounted bearing the concave element on the external surface of the pipe on which the derivations will be made. The convex element acts on the fitting made for the derivation.
- After verifying that the polyfuse welding device has reached working conditions, indicated by the green indicator light going off, at the same time exert a light pressure until the surfaces of the dies fit perfectly.

PROCEDEURE WELDING AND FUSION
6.46 47 to together with those of the pipe and fitting. The time required for this operations is shown in the table, bearing in mind that the heating time indicated must be calculated from the moment the surfaces come into contact with each other. Once the set period of time has elapsed, the seams of the fused material will appear.

PROCESSING

VESTOLEN P9421 polypropylene has high resistance to a large number of aggressive substances, and is therefore particularly suitable for special applications.

The table below provides the resistance of VESTOLEN P9421 to various chemicals.

The table refers to the raw material only (VESTOLEN P9421), not subjected to outside mechanical stresses and at atmospheric pressure.

For transport of combustible fluids, comply with any legal regulations in force.

Take care when the installation is to carry water with chlorine content over the limits permitted by law and/or contains elements which induce oxidation in general.

Once the heating time has elapsed, the dies must be removed from the elements to be joined and, exerting an even pressure, bring the pipe-fitting elements together within the time indicated in the table, keeping them pressed for at least an additional 30 seconds.

At the end of the welding operation, avoid either mechanical or heat stress to the joint for the time of cooling which must take place at ambient temperature.

4) WELDING OPERATION

5) COOLING

DERIVATION

DIAMETER

mm

20

25

32

120

180

240

COOLING TIME

sec.

4

4

6

WORKING TIME

sec.

HEATING TIME

sec.

5

7

8

DRILL TIP

mm

19

24

31

6) ESTIMATED TIMES AND TIP DIAMETERS

7. RESISTANCE TO CHEMICALS

TABLE OF CHEMICAL AGENTS

RESISTANCE OF POLYPROPYLENE VESTOLEN P9421

<table>
<thead>
<tr>
<th>CONCENTRATION</th>
<th>TEMPERATURE (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>sol. sat. (4.9)</td>
<td>+</td>
</tr>
<tr>
<td>sol. sat.</td>
<td>Ω−</td>
</tr>
<tr>
<td>t</td>
<td>++</td>
</tr>
<tr>
<td>conc.</td>
<td>+</td>
</tr>
<tr>
<td>t</td>
<td>+</td>
</tr>
</tbody>
</table>

**SYMBOLS**

+ = highly resistant
⊕ = resistant
Ο = fairly resistant
Θ = scarcely resistant
− = non resistant

sol. sat. = saturated solution

t = all %
s = it loses colour

Examination of the welds is to be carried out after 24 hours from the moment of cooling; the U-shaped test specimen is to be removed from the weld before performing this test.
7. RESISTANCE TO CHEMICALS

### CONCENTRATION

<table>
<thead>
<tr>
<th>%</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>sol. sat.</strong></td>
<td>100</td>
</tr>
<tr>
<td>high conc.</td>
<td>100</td>
</tr>
<tr>
<td>low conc.</td>
<td>100</td>
</tr>
<tr>
<td>sol. sat.</td>
<td>100</td>
</tr>
<tr>
<td>sol. sat.</td>
<td>100</td>
</tr>
</tbody>
</table>

### SYMBOLS

- = highly resistant
⊕ = resistant
Ο = fairly resistant
Θ = scarcely resistant
− = non resistant

sol. sat. = saturated solution

t = all %

s = it loses colour

---

### EXAMINED SUBSTANCES

- Ammonium, nitrate
- Ammonium, sulphate
- Starch
- Amber, acid
- Aniline
- Antifreeze
- Silver, salt
- Aspirin ®
- Asphalt
- Barium, chloride
- Benzaldehyde
- Benzaldehyde, liquid
- Benzol
- Benzoid, acid
- Ethyl, benzol
- Beer
- Borax
- Boric, acid
- Bromine, liquid
- Bromine, dry steam
- Butane, liquid
- Butane gas
- Butyl, gas
- Butanol
- Butter
- Butyl, alcohol
- Cacao
- Calcium, chloride
- Calcium, nitrate
- Quinine
- Bleach
- Coffee
- Limestone
- Sulphure, carbon
- Chlorine, liquid
- Chlorine, dry gas
- Chlorine, wet gas
- Chloroform
- Chlorosulfonic, acid
- Benzoyl chloride

---

### TEMPERATURE (°C)

20 60 100
<table>
<thead>
<tr>
<th>CONCENTRATION (%)</th>
<th>RESISTANCE TO CHEMICALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-51</td>
<td>Iodine, tincture</td>
</tr>
<tr>
<td>50-51</td>
<td>Lanolin</td>
</tr>
<tr>
<td>50-51</td>
<td>Milk</td>
</tr>
<tr>
<td>50-51</td>
<td>Lactic acid</td>
</tr>
<tr>
<td>50-51</td>
<td>Liquors</td>
</tr>
<tr>
<td>50-51</td>
<td>Lemonades</td>
</tr>
<tr>
<td>50-51</td>
<td>Magnesium, salt</td>
</tr>
<tr>
<td>50-51</td>
<td>Margarine</td>
</tr>
<tr>
<td>50-51</td>
<td>Jam</td>
</tr>
<tr>
<td>50-51</td>
<td>Mayonnaise</td>
</tr>
<tr>
<td>50-51</td>
<td>Menthol</td>
</tr>
<tr>
<td>50-51</td>
<td>Methanol</td>
</tr>
<tr>
<td>50-51</td>
<td>Methyl chloride</td>
</tr>
<tr>
<td>50-51</td>
<td>Methyl-ethy-ketone</td>
</tr>
<tr>
<td>50-51</td>
<td>Mercury</td>
</tr>
<tr>
<td>50-51</td>
<td>Muriatic acid</td>
</tr>
<tr>
<td>50-51</td>
<td>Naphta</td>
</tr>
<tr>
<td>50-51</td>
<td>Naphtalene</td>
</tr>
<tr>
<td>50-51</td>
<td>Nitric acid</td>
</tr>
<tr>
<td>50-51</td>
<td>Nitrobenzene</td>
</tr>
<tr>
<td>50-51</td>
<td>Nickel, salt</td>
</tr>
<tr>
<td>50-51</td>
<td>Oleic acid</td>
</tr>
<tr>
<td>50-51</td>
<td>Oleum</td>
</tr>
<tr>
<td>50-51</td>
<td>Peanut oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Animal oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Camphor oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Combustible oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Coconut oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Almond oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Cod oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Motor oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Peppermint oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Mais oil</td>
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<tr>
<td>50-51</td>
<td>Linseed oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Cloves oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Rosin oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Olive oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Oxalic oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Silicone oil</td>
</tr>
<tr>
<td>50-51</td>
<td>Oil of turpenthine</td>
</tr>
<tr>
<td>50-51</td>
<td>Paraffin oil</td>
</tr>
</tbody>
</table>

**SYMBOLS**
- = non resistant
- = scarcely resistant
⊕ = fairly resistant
++) = resistant
+++ = highly resistant
s= it loses colour

**CONCENTRATION (%)**
- 50-51
- 100
- 1000
- 10000
- 100000
- 1000000
- 10000000
- 100000000
- 1000000000

**EXAMINED SUBSTANCES**
- Octane
- Ozone
- Cream
- Paraffin
- Petroleum
- Pepper
- Perfume
- Propane, liquid
- Propane gas
- Pyridine
- Potassium carbonate
- Potassium chlorate
- Potassium chlorite
- Potassium chromate
- Potassium iodide
- Potassium nitrate
- Potassium permanganate
- Potassium persulfate
- Potassium sulfate
- Copper, salt
- Copper, nitrate
- Salt dry
- Soap liquid
- Mustard
- Soda water
- Soda caustic
- Sodium bicarbonate
- Sodium carbonate
- Sodium chlorate
- Sodium hypochlorite
- Sodium chloride
- Sodium chlorite
- Sodium nitrate
- Sodium perborate
- Sodium sulphate
- Sodium phosphate
- Sodium sulphite
- Sodium thiosulphate
- Tin II chloride
- Apple juice
- Orange juice
7. RESISTANCE TO CHEMICALS

<table>
<thead>
<tr>
<th>CONCENTRATION (%)</th>
<th>TEMPERATURE (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

**SYMBOLS**
- (+++) = highly resistant
- (++) = resistant
- (+) = fairly resistant
- (Θ) = scarcely resistant
- (-) = non-resistant
- (sol. sat.) = saturated solution
- (t) = all %
- (s) = it loses colour

**EXAMINED SUBSTANCES**
- Lemon juice
- Fruit juice
- Tea
- Turpentine
- Carbon, tetrachloride
- Tetra-chlorine-ethylen
- Tetradowhiline
- Naphtalene, trachloride
- Thiophene
- Trichlorethylene
- Tricresylphosphate
- Urea
- Vanilla
- Vaseline
- Xylene

**PRECAUTIONS**

Use of a system of plastic pipes and fittings offers a series of advantages from various points of view, as fully described in "Main features of the COPRAX system", Chapter 2 (page 6).

However, in order to enjoy all the benefits of these properties, the user must be well aware of every aspect relating to the product to be used.

To assist the COPRAX system user, we have prepared a number of important recommendations, set out below.

The use of COPRAX and COPRAX + Aluminium in the stated operating conditions creates absolutely no problems for the material.

However, exceeding the stated conditions may impair the product’s resistance. All precautions must therefore be taken to ensure that this does not occur. If any problems should arise, our technical service is always at your disposal.

*Note: COPRAX + Aluminium cannot be installed or stored where it is subject to direct ultraviolet rays (sunlight or neon lights). Ultraviolet rays cause ageing in the material, leading to loss of its initial chemical-physical characteristics.*

- COPRAX must never be installed or stored where it is subject to direct ultraviolet rays.
- COPRAX + Aluminium can be installed on the outside of walls, but on the inside of the building, while installations with direct exposure to U.V. radiation are not recommended, since the effects gradually break down first the external PP-R film, then the aluminium sheet and finally the pipe itself.

In the event of any doubts or queries, please contact our technical service department in writing, telephone or fax.
During handling, storage and use on site, bundles of pipes or individual lengths must be protected against excessive external stresses, such as shaking, knocks, hammer blows, etc. This is even more important as the ambient temperature falls, since at low temperatures the material is more rigid and has a less elastic response to outside stresses. When water passes from the liquid to the solid state (ice), its volume increases to an extent which may generate stresses inside the installation which the material is unable to withstand. The appropriate measures must be taken to ensure that this does not occur, draining the system completely after testing if there is the risk of freezing.

Any contact with sharp edged bodies (such as brick shards) causes cuts on the outside of the pipe which might lead to breakages later. Care must be taken to ensure that this does not occur during storage and installation, and any scratched or scored pipes must not be used.

**HANDLING PIPES**

![Diagram of pipes]

**BENDING**

![Diagram of bending pipes]

When bending Coprax system pipes, proceed as follows:

- For very wide radius curves, the pipe may be bent cold.
- For radii close to, but not below, 8 times the diameter of the pipe, the pipe should be bent while cold.
- For wide radius curves, the pipe may be bent hot.

When using Coprax system fittings with threaded female metal insert:

- For very wide radius curves, the pipe may be bent cold.
- For radii close to, but not below, 8 times the diameter of the pipe, the pipe should be bent while cold.
- For wide radius curves, the pipe may be bent hot.

**FITTINGS WITH METAL INSERT**

![Diagram of fittings with metal insert]

When using Coprax system fittings with threaded female metal insert:

- To bend Coprax system pipes, proceed as follows:
  - For very wide radius curves, the pipe may be bent cold.
  - For radii close to, but not below, 8 times the diameter of the pipe, the pipe should be bent while cold.
  - For wide radius curves, the pipe may be bent hot.

**HANDLING PIPES**

![Diagram of handling pipes]

- For very wide radius curves, the pipe may be bent cold.
- For radii close to, but not below, 8 times the diameter of the pipe, the pipe should be bent while cold.
- For wide radius curves, the pipe may be bent hot.
PRECAUTIONS

Use tools capable of making a burr-free cut, perpendicular to the pipe's axis.

CUTTING PIPES

The parts for welding must be thoroughly clean and the welding machine's thermostat must indicate that it has reached the operating temperature. No twisting forces must be applied to the connected parts during or after welding. See page 30, "Welding with the welding machine."

After welding, check the weld. See page 30, "Welding with the welding machine."

The parts for welding must be thoroughly clean and the welding machine's thermostat must indicate that it has reached the operating temperature. No twisting forces must be applied to the connected parts during or after welding. See page 30, "Welding with the welding machine."

TESTING THE INSTALLATION

Testing plays a fundamental role in ensuring that the installation operates correctly. Testing allows the installation technician to check that the system is not leaking at any point, for any reason.

The operations required are:

- Visual check on the pipes and fittings
  This ensures that the pipes and fittings have been installed correctly and that no sharp-edged bodies have been accidentally damaged by sharp-edged bodies.
- Tightness test
  This is carried out with the system still directly accessible. It is filled with water of ambient temperature, allowing care to be taken of the preset.
  The system is then under pressure for 24 h with the water of ambient temperature, allowing care to be taken of the preset.
  The pressure rate is called off the system if a leak is found or if a preset.
- Visual check on the pipes and fittings
  The operations required are:
  The system is not leaky or any point, for any reason.
  After welding, check the weld. See page 30, "Welding with the welding machine."

WELDING

After welding, check the weld. See page 30, "Welding with the welding machine."

The parts for welding must be thoroughly clean and the welding machine's thermostat must indicate that it has reached the operating temperature. No twisting forces must be applied to the connected parts during or after welding. See page 30, "Welding with the welding machine."