Technical Data and Dimensions
SOUND ATTENUATED DRAINAGE

A purpose-designed sound reducing drainage system that offers outstanding sound insulation properties compared with traditional cast iron or lagged single wall plastic drainage systems.

Friaphon is constructed with dual layer technology and offers exceptional sound reduction properties from noises emitted by sanitary installations in buildings.

Lower material costs coupled with speed of installation and no need for lagging, means Friaphon offers significant cost savings over cast iron and single wall plastic drainage systems.

Key Product Information
- Size Range: 110mm and 160mm
- Temperature Rating: 95°C (Short term)

Key Product Features
- Superb sound insulation
- Lower cost alternative to cast iron
- No lagging required
- Lower cost alternative to lagged plastic
- Push fit assembly
- High impact and temperature resistant

Typical Applications
Sound attenuated drainage systems in:
- Luxury apartments
- Hotels
- Libraries
- Hospitals
- Public buildings
- Restaurants
System Overview

Friaphon pipe is manufactured by dual forming two materials of different density. Friaphon Dual Technology guarantees the excellent sound insulation and airborne sound reduction properties of the system.

Sound waves are partially reflected along the boundary layers to be absorbed by the pipe’s mass.

Fittings in the Friaphon range achieve a high sound insulation level due to increased wall thickness and rubber ring joints.

When using Friaphon double couplers as standard connectors, pipes can be connected to each other free of any structure-borne noises by way of a floating bearing of the pipe ends. At the same time this enables expansion to be accommodated.

Installation is by means of rubber lined support and sliding clips. The support clip acts as the normal method of anchoring at individual floor level.
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System Overview

Friaphon is a purpose-designed, sound attenuated drainage system for installation in accordance with BS EN 12056. Friaphon pipe and fittings are subject to quality monitoring by the Plastic Pipe Quality Association (GKR) in Bonn and are officially accredited by a Certificate/Approval: General Building Inspectorate Approval Z-42.1-220 from the German Institute of Building Technology (DIBt) in Berlin. Boss branches and pipes are manufactured in accordance with the dimensional requirements of BS EN 1329/BS4514 and are compatible with MUPVC or ABS waste systems to BS 5255 and polypropylene to BS 5254. The system allows for a simple installation fully complying with the sound protection requirements laid down in standard DIN 4109/VDI 4100. The sound insulation properties are proven by IBP Test Certificate P-BA 354/1998 from the Fraunhofer Institute for Building Physics. Friaphon consists of dual formed plastic pipes and moulded fittings in sizes 110mm and 160mm. The sound-insulating effects of the system result from both its pipes, the production of which is based on the dual forming process, as well as fittings which are connected to each other by way of double couplers and rubber ring joints. The use of high-quality plastics throughout the Friaphon product range ensures corrosion- and encrustation-free components and parts.

Specifications

Material: ABS/ASA/PVC-U styrene copolymer (fittings and inside pipe layer) PVC-U mineral-reinforced (outside pipe layer)
Density: Fittings and inside pipe layer 1.3 g/cm³
Outside pipe layer 1.5 g/cm³
Temperature resistance: 95°C (short term)
90°C (long term)
Thermal expansion coefficient: 0.08 (mm/m x K)
Acidity/alkalinity: pH2 to pH12
Pressure loading capacity: 0.5 bar ring seal (jointed)
Fire characterisation: As per DIN 4102, B2, self-extinguishing, no dropping

Application areas

The Friaphon domestic drainage system is intended for use and installation in accordance with BS EN 12056 and the corresponding national standards. It is generally intended for the removal of waste water in accordance with national standards. The Friaphon domestic drainage system can be used for:
1. Above ground drainage pipework
2. Internal rainwater services.

Friaphon must not be used for:
- piping which carries water containing petrol or benzene
- sanitation piping for dry cleaners.

Temperature resistance

Friaphon will withstand hot water:
- For short periods up to 95°C
- Continuously up to 90°C
Introducing steam into the Friaphon domestic drainage system is not recommended.

Pressure resistance

The Friaphon domestic drainage system is able to withstand pressures of 0.5 bar. Connectors and moulded fittings are tested to 0.5 bar.

Quality assurance

The quality of Friaphon system components is monitored in accordance with recognised quality assurance regulations and standards and in line with the stipulations of the Plastic Pipe Quality Association by means of self-monitoring and third-party monitoring.

Sound Insulation

Overview of the structural requirements for sound insulation

DIN 4109/A1: 2001-01 for residential buildings
A maximum sound pressure level of $L_n \leq 30\text{dB (A)}$ or noises emitted by sanitary installations is permissible in rooms requiring protection, e.g. living rooms and bedrooms.

DIN 4109
Other building installations (non-residential buildings), sound pressure level $L_n \leq 35\text{dB (A)}$.

DIN 4109 – 10 (E)
Additional sound insulation in residential buildings.

DIN 4109 – 10
Specifies the new requirements of additional sound insulation for residential buildings. Accordingly, the sound insulation levels to follow are mandatory:
- standard sound insulation $L_n \leq 30\text{dB (A)}$
- additional sound insulation $L_n \leq 27\text{dB (A)}$
- comfort sound insulation $L_n \leq 24\text{dB (A)}$

Although standard DIN 4109 – 10 has not yet been published, the required sound insulation values should be laid down on a binding basis in current construction contracts now to avoid any subsequent legal disputes as to the observance of sound insulation values.

NB: There is no UK equivalent for acoustic performance standard.

Extracts from the Test Certificate of the Fraunhofer Institute for Construction Physics No. P-BA 354/1998

Friaphon wastewater system: place of measurement: rear section of ground floor

Friaphon wastewater system: place of measurement: rear section of basement I
System Description

Properties
The push-fit Friaphon domestic drainage system is based on pipes made of two layers of plastic. The two layers are inseparably bonded together by a special manufacturing process. The light-coloured inner skin guarantees high resistance to temperature. The dark-coloured outer skin combined with the inner skin provides the sound-deadening effect.

The Friaphon domestic drainage system meets the requirements of BS, DIN, Austrian Standards, SIA Standards, Belgian Standards and Dutch Standards.

Its excellent properties guarantee significant benefits in use such as:
- outstanding sound insulation properties
- low transportation weight
- resistance to hot water
- push-fit assembly
- resistance to corrosion
- excellent resistance to chemicals
- professional installation techniques
- reduced installation cost
- recyclability

Friaphon consists of:
- Two-layer bonded ‘Dual Technology’ pipes with smooth ends
- Friaphon double couplers
- Friaphon support clips with support rings
- Friaphon cushioning sections
- Friaphon fire protection collars
- Friaphon moulded fittings with socket sleeves according to BSEN 1455, DIN 19 561

Friaphon Dual Technology guarantees the excellent sound insulation and airborne sound reduction properties of the entire system.

The sound insulation properties are proven by IBP Test Certificate P-BA 354/1998 from the Fraunhofer Institute for Building Physics. (Copies available on request.)
System Description

Friaphon double coupler
The Friaphon double coupler prevents the transmission of sound along pipes and compensates for thermal expansion. The Friaphon double coupler is used for connecting pipe to moulded fittings and pipe to pipe.

The integral compensation for expansion and the ‘floating mounting’ of the pipe ensure simple installation. The transmission of structure-borne sound (longitudinal transmission of sound) is prevented.

Friaphon fittings
Fittings in the Friaphon range achieve a high sound insulation level resulting from minor sound vibrations.

Friaphon fixings
Installation is by means of sound proofing, rubber lined support and sliding clips. The support clip acts as the normal method of anchoring at individual floor levels.

Sectional representation of Friaphon double coupler.
# System Description

## Product range overview

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
<th>Size d in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Illustration" /></td>
<td>Sound insulated pipe with smooth ends, Dual Technology, length in mm</td>
<td>d = 110 DN 100 110 x 5.3 3000</td>
</tr>
<tr>
<td><img src="image2.png" alt="Illustration" /></td>
<td>Double coupler (normal connection)</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image3.png" alt="Illustration" /></td>
<td>Bend 15°</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image4.png" alt="Illustration" /></td>
<td>Bend 30°</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image5.png" alt="Illustration" /></td>
<td>Bend 45°</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image6.png" alt="Illustration" /></td>
<td>Bend 67°</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image7.png" alt="Illustration" /></td>
<td>Bend 87°</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image8.png" alt="Illustration" /></td>
<td>Short cushioning section for fall up to 10m</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image9.png" alt="Illustration" /></td>
<td>Long cushioning section for fall exceeding 10m, L = 250mm</td>
<td>110 160</td>
</tr>
<tr>
<td><img src="image10.png" alt="Illustration" /></td>
<td>Branch 45°</td>
<td>110/110 160/160</td>
</tr>
<tr>
<td><img src="image11.png" alt="Illustration" /></td>
<td>Single branch 92 1/2°</td>
<td>110/110 160/160 160/110</td>
</tr>
<tr>
<td><img src="image12.png" alt="Illustration" /></td>
<td>Double branch 45°</td>
<td>110/110</td>
</tr>
</tbody>
</table>
## System Description

### Product range overview

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
<th>Size d in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Double branch 92 1/2°" /></td>
<td>Double branch 92 1/2°</td>
<td>110/110</td>
</tr>
<tr>
<td><img src="image" alt="Corner branch 92 1/2°" /></td>
<td>Corner branch 92 1/2°</td>
<td>110/110</td>
</tr>
<tr>
<td><img src="image" alt="Access pipes" /></td>
<td>Access pipes</td>
<td>110</td>
</tr>
<tr>
<td><img src="image" alt="Access boss pipe" /></td>
<td>Access boss pipe</td>
<td>110</td>
</tr>
<tr>
<td><img src="image" alt="Boss pipe" /></td>
<td>Boss pipe</td>
<td>110</td>
</tr>
<tr>
<td><img src="image" alt="Strap-on boss" /></td>
<td>Strap-on boss</td>
<td>110/32, 110/40, 110/50, 160/50</td>
</tr>
<tr>
<td><img src="image" alt="Waste manifold" /></td>
<td>Waste manifold</td>
<td>110</td>
</tr>
<tr>
<td><img src="image" alt="Reducers" /></td>
<td>Reducers</td>
<td>160/110, 110/50</td>
</tr>
</tbody>
</table>

Where:
- d = 110 ≡ DN 100
- d = 160 ≡ DN 150
## System Description

### Product range overview

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
<th>Size d in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sleeve (for repair purposes)</td>
<td>d = 110 ≡ DN 100, d = 160 ≡ DN 150</td>
</tr>
<tr>
<td></td>
<td>Bonding sleeve/Double bonding sleeve</td>
<td>110, 160</td>
</tr>
<tr>
<td></td>
<td>Socket plug</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Screwed access cap</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Boss connector</td>
<td>32, 40, 50</td>
</tr>
<tr>
<td></td>
<td>Boss adaptor (Rubber)</td>
<td>32, 40</td>
</tr>
<tr>
<td></td>
<td>Boss adaptor (Solvent Weld)</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Boss adaptor (Waste Manifold)</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Unicollar fire protection</td>
<td>2250mm strip length</td>
</tr>
</tbody>
</table>
### System Description

**Product range overview**

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
<th>Size d in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Support clip with support ring and wall fixing</td>
<td>110 160</td>
</tr>
<tr>
<td></td>
<td>Intermediate sliding clip</td>
<td>110 160</td>
</tr>
<tr>
<td></td>
<td>Lubricant</td>
<td>125 gram</td>
</tr>
<tr>
<td></td>
<td>Adhesive</td>
<td>500 ml</td>
</tr>
<tr>
<td></td>
<td>Primer</td>
<td>500 ml</td>
</tr>
<tr>
<td></td>
<td>Pipe cutter</td>
<td>50/125</td>
</tr>
<tr>
<td></td>
<td>Chamfering tool</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reamer</td>
<td></td>
</tr>
</tbody>
</table>
**Dimensional Data**

**Sound insulated pipe with smooth ends**

<table>
<thead>
<tr>
<th>d1 mm</th>
<th>s mm</th>
<th>L mm</th>
<th>kg/m</th>
<th>l/m</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>5.3</td>
<td>3000</td>
<td>2.65</td>
<td>7.7</td>
<td>FP 12 12 71</td>
</tr>
<tr>
<td>160</td>
<td>6.3</td>
<td>3000</td>
<td>4.59</td>
<td>17.0</td>
<td>FP 12 12 73</td>
</tr>
</tbody>
</table>

**Double couplers (standard connector)**

<table>
<thead>
<tr>
<th>d1 mm</th>
<th>d2 mm</th>
<th>d3 mm</th>
<th>z1 mm</th>
<th>t1 mm</th>
<th>t2 mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>95.0</td>
<td>132</td>
<td>14</td>
<td>61.5</td>
<td>137</td>
<td>FP 12 22 70</td>
</tr>
<tr>
<td>160</td>
<td>142.0</td>
<td>187</td>
<td>14</td>
<td>78.0</td>
<td>170</td>
<td>FP 12 22 72</td>
</tr>
</tbody>
</table>

**Bends 15°**

<table>
<thead>
<tr>
<th>d1 mm</th>
<th>d2 mm</th>
<th>Z1 mm</th>
<th>t1 mm</th>
<th>t2 mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>132</td>
<td>14</td>
<td>60</td>
<td>72</td>
<td>FP 12 20 19</td>
</tr>
<tr>
<td>160</td>
<td>187</td>
<td>19</td>
<td>71</td>
<td>93</td>
<td>FP 12 20 31</td>
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</table>

**Bends 30°**

<table>
<thead>
<tr>
<th>d1 mm</th>
<th>d2 mm</th>
<th>Z1 mm</th>
<th>t1 mm</th>
<th>t2 mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>132</td>
<td>21</td>
<td>60</td>
<td>80</td>
<td>FP 12 20 20</td>
</tr>
<tr>
<td>160</td>
<td>187</td>
<td>30</td>
<td>71</td>
<td>104</td>
<td>FP 12 20 32</td>
</tr>
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</table>

**Bends 45°**

<table>
<thead>
<tr>
<th>d1 mm</th>
<th>d2 mm</th>
<th>Z1 mm</th>
<th>t1 mm</th>
<th>t2 mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>132</td>
<td>29</td>
<td>60</td>
<td>88</td>
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<td>160</td>
<td>187</td>
<td>42</td>
<td>71</td>
<td>116</td>
<td>FP 12 20 33</td>
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</tbody>
</table>
**Bends 67°**

- **Bends 67°**

**Bends 87°**

- **Bends 87°**

**Short cushioning sections**  height of fall up to 10m

- **Short cushioning sections**  height of fall up to 10m

**Long cushioning sections**  height of fall exceeding 10m

- **Long cushioning sections**  height of fall exceeding 10m
**Branch 45°**

<table>
<thead>
<tr>
<th>d₁ mm</th>
<th>d₂ mm</th>
<th>d₃ mm</th>
<th>d₄ mm</th>
<th>z₁ mm</th>
<th>t₁ mm</th>
<th>t₂ mm</th>
<th>t₃ mm</th>
<th>t₄ mm</th>
<th>L mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>110</td>
<td>132</td>
<td>132</td>
<td>134</td>
<td>60</td>
<td>223</td>
<td>60</td>
<td>134</td>
<td>283</td>
<td>FP 12 22 24</td>
</tr>
<tr>
<td>160</td>
<td>110</td>
<td>132</td>
<td>187</td>
<td>159</td>
<td>71</td>
<td>240</td>
<td>60</td>
<td>168</td>
<td>311</td>
<td>FP 12 22 39</td>
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<tr>
<td>160</td>
<td>160</td>
<td>187</td>
<td>194</td>
<td>71</td>
<td>310</td>
<td>71</td>
<td>194</td>
<td>381</td>
<td>FP 12 22 45</td>
<td></td>
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</tbody>
</table>

**Single branch 92½° five boss**

<table>
<thead>
<tr>
<th>Size mm</th>
<th>L mm</th>
<th>t₁ mm</th>
<th>t₂ mm</th>
<th>Z₁ mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>300</td>
<td>150</td>
<td>60</td>
<td>175</td>
<td>FP 12 26 01</td>
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</tbody>
</table>

**Single branch 92½°**

<table>
<thead>
<tr>
<th>Size mm</th>
<th>L mm</th>
<th>t₁ mm</th>
<th>t₂ mm</th>
<th>Z₁ mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>438</td>
<td>245</td>
<td>96</td>
<td>260</td>
<td>FP 12 27 03</td>
</tr>
</tbody>
</table>

**Single branch 92½° two boss, unequal**

<table>
<thead>
<tr>
<th>Size mm</th>
<th>L mm</th>
<th>t₁ mm</th>
<th>Z₁ mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 x 110</td>
<td>337</td>
<td>175</td>
<td>175</td>
<td>FP 12 28 03</td>
</tr>
</tbody>
</table>
Double branch 45°

Double branch 92½° four boss

Corner branch two boss/access upstands

Access pipes
### Access boss pipe  three boss upstands

![Access boss pipe diagram](image)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>L (mm)</th>
<th>t₁ (mm)</th>
<th>t₂ (mm)</th>
<th>t₃ (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>244</td>
<td>123</td>
<td>70</td>
<td>152</td>
<td>FP 12 32 01</td>
</tr>
</tbody>
</table>

### Boss pipes  four boss upstands, one open

![Boss pipes diagram](image)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>L (mm)</th>
<th>t₁ (mm)</th>
<th>t₂ (mm)</th>
<th>t₃ (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>244</td>
<td>123</td>
<td>70</td>
<td></td>
<td>FP 12 33 01</td>
</tr>
<tr>
<td>160</td>
<td>335</td>
<td>110</td>
<td>96</td>
<td></td>
<td>FP 12 33 03</td>
</tr>
</tbody>
</table>

### Strap-on bosses

![Strap-on bosses diagram](image)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>t₁ (mm)</th>
<th>t₂ (mm)</th>
<th>Hole size</th>
<th>Ref. No.</th>
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</thead>
<tbody>
<tr>
<td>110 x 32</td>
<td>70</td>
<td>55</td>
<td>50</td>
<td>FP 12 35 01</td>
</tr>
<tr>
<td>110 x 40</td>
<td>70</td>
<td>62</td>
<td>50</td>
<td>FP 12 36 01</td>
</tr>
<tr>
<td>110 x 50</td>
<td>86</td>
<td>75</td>
<td>63</td>
<td>FP 12 37 01</td>
</tr>
<tr>
<td>*160 x 50</td>
<td>–</td>
<td>–</td>
<td>63</td>
<td>FP 12 34 03</td>
</tr>
</tbody>
</table>

* *Use with 50mm straight boss adaptor on page 20.*

### Waste manifold  (32, 40, 50mm)

![Waste manifold diagram](image)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>L (mm)</th>
<th>t₁ (mm)</th>
<th>t₂ (mm)</th>
<th>t₅ (mm)</th>
<th>Ref. No.</th>
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</thead>
<tbody>
<tr>
<td>110</td>
<td>208</td>
<td>68</td>
<td>51</td>
<td>110</td>
<td>132</td>
</tr>
</tbody>
</table>

### Reducer

![Reducer diagram](image)

<table>
<thead>
<tr>
<th>d₁ (mm)</th>
<th>d₂ (mm)</th>
<th>d₃ (mm)</th>
<th>t₁ (mm)</th>
<th>t₂ (mm)</th>
<th>z (mm)</th>
<th>L (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>110</td>
<td>132</td>
<td>60</td>
<td>80</td>
<td>4.0</td>
<td>144.0</td>
<td>FP 12 25 10</td>
</tr>
</tbody>
</table>
Sound attenuated drainage

**Reducer** solvent socket, single boss upstand

![Reducer Diagram]

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>L (mm)</th>
<th>t1 (mm)</th>
<th>t2 (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 x 50</td>
<td>48</td>
<td>25</td>
<td>19</td>
<td>FP 12 38 01</td>
</tr>
</tbody>
</table>

**Sleeves**

![Sleeves Diagram]

<table>
<thead>
<tr>
<th>d1 (mm)</th>
<th>d9 (mm)</th>
<th>t (mm)</th>
<th>L (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>132</td>
<td>62.5</td>
<td>125</td>
<td>FP 12 25 30</td>
</tr>
<tr>
<td>160</td>
<td>187</td>
<td>79.0</td>
<td>158</td>
<td>FP 12 25 32</td>
</tr>
</tbody>
</table>

**Bonding sleeves**

![Bonding sleeves Diagram]

<table>
<thead>
<tr>
<th>d1 (mm)</th>
<th>d9 (mm)</th>
<th>t (mm)</th>
<th>t2 (mm)</th>
<th>L (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>132</td>
<td>60</td>
<td>32</td>
<td>95</td>
<td>FP 12 25 44</td>
</tr>
<tr>
<td>160</td>
<td>187</td>
<td>71</td>
<td>42</td>
<td>117</td>
<td>FP 12 25 46</td>
</tr>
</tbody>
</table>

**Double bonding sleeves**

![Double bonding sleeves Diagram]

<table>
<thead>
<tr>
<th>d1 (mm)</th>
<th>d9 (mm)</th>
<th>t (mm)</th>
<th>L (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>115</td>
<td>35</td>
<td>73</td>
<td>FP 12 25 62</td>
</tr>
<tr>
<td>160</td>
<td>167</td>
<td>42</td>
<td>88</td>
<td>FP 12 25 64</td>
</tr>
</tbody>
</table>

**Socket plug**

![Socket plug Diagram]

<table>
<thead>
<tr>
<th>d1 (mm)</th>
<th>d9 (mm)</th>
<th>t (mm)</th>
<th>s (mm)</th>
<th>L (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>120</td>
<td>32.0</td>
<td>5</td>
<td>41.5</td>
<td>FP 12 25 40</td>
</tr>
</tbody>
</table>

**Access cap** solvent socket, screwed

![Access cap Diagram]

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>t1 (mm)</th>
<th>t2 (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>140</td>
<td>30</td>
<td>FP 12 42 01</td>
</tr>
</tbody>
</table>
**Boss connectors**  
ring seal socket/spigot for solvent joint to all boss upstands

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Angle</th>
<th>t₀ (mm)</th>
<th>t₁ (mm)</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>87 ¹/₂°</td>
<td>43</td>
<td>21</td>
<td>FP 12 39 01</td>
</tr>
<tr>
<td>40</td>
<td>87 ¹/₂°</td>
<td>43</td>
<td>21</td>
<td>FP 12 39 02</td>
</tr>
</tbody>
</table>

**Unicollar fire protection**

Unicollar is a unique method of protecting pipes which pass through fire rated walls and floors. The system is supplied in continuous strip form, which is cut to length and attached to the element using ready-made clips. These clips fit into the pre-punched slots on the strip. Unicollar is packed in a box, which contains 2250mm length of collar or 150 segments. The box has installation details on one face. The collar is designed so that it can be cut and snapped in segments of 15mm. One box is the equivalent of 5 x 110mm collars.

For details on fire ratings and installation see pages 37 and 38.
### Support clips with support ring and wall fixing

<table>
<thead>
<tr>
<th>d mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>FP 12 13 01</td>
</tr>
<tr>
<td>160</td>
<td>FP 12 13 03</td>
</tr>
</tbody>
</table>

### Intermediate sliding clips

<table>
<thead>
<tr>
<th>d mm</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>FTPC 1100</td>
</tr>
<tr>
<td>160</td>
<td>FTPC 1601</td>
</tr>
</tbody>
</table>

### Lubricant

<table>
<thead>
<tr>
<th>Contents g</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>FP 12 29 70</td>
</tr>
</tbody>
</table>

### Primer

<table>
<thead>
<tr>
<th>Contents ml</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>FP 12 29 90</td>
</tr>
</tbody>
</table>

### Adhesive

<table>
<thead>
<tr>
<th>Contents ml</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>FP 12 29 80</td>
</tr>
</tbody>
</table>
Tools

Pipe cutter*

<table>
<thead>
<tr>
<th>Size</th>
<th>Ref. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-125 mm</td>
<td>FT 80 00 03</td>
</tr>
</tbody>
</table>

*To cut 160mm pipe we recommend Rothenberg’s Rocut 160 pipe cutter.

Chamfering tool

Ref. No.
FT 55 05 10

Reamer

Ref. No.
FT 80 00 08
Design

Methods of jointing
The principal method of jointing 110 and 160mm Friaphon pipes and fittings is by ring seal. Some components in the range are solvent welded.

Thermal movement
Friaphon double coupler
The coefficient of linear expansion for Friaphon is 0.08mm/m/°C. As a result a 3m length of pipe will increase in length by approximately 4.8mm when subjected to a 20°C temperature variation. Any movement is controlled by means of the Friaphon double coupler. No additional measures are necessary.

Sanitary pipework design
All sanitary pipework systems should be designed in accordance with BS EN 12056: 2000, Parts 1 to 5.
The above is a new European Standard which has British Standard status and supersedes BS 5572: 1994 Code of Practice for Sanitary Pipework which has been withdrawn. The new standard has five sections, parts 1, 2 and 5 deal specifically with sanitary pipework and parts 3 and 4 refer to roof drainage and the design of wastewater lifting plants.
Sound attenuated drainage

Bends at the base of stacks
Bends at the base of vertical stacks should be of long radius and have a minimum centre line radius of 200mm on a 110mm nominal size stack. Two 45° radius bends may also be used as an alternative to provide the change of direction and connection to the building drain. The same design principle should also be adopted where offsets occur in stacks of one or more storey height.

Branches at the base of stacks
For single dwellings up to three storeys high, the distance between the centre line of the lowest branch connection and the invert of the drain should be at least 450mm. For multi-storey systems up to five storeys high, the minimum distance should be 740mm and for systems higher than five floors no connections are permissible at ground floor level. Where this occurs a separate stub stack should be provided to serve the ground floor or individual appliances should have their own separate connection to the building drain.

Offsets in stacks
Offsets in the wet portion of a discharge stack should be avoided wherever possible but where they have to be fitted a large radius or two 45° bends should be used to create each change of direction. Offsets in lightly loaded stacks up to three storeys high do not require offset venting but on multi-storey buildings this may be necessary depending on the loading of the stack and the numbers of floors above the offset. The principles previously described for bends and branches at the base of a stack should also be applied.

Stub stacks
An unventilated stub stack terminated with an access fitting may be used to connect a group of ground floor appliances to the building drain provided the vertical drop to the invert level of the drain does not exceed 1.5m from a WC and 2.5m from a waste appliance. Where one or more stub stacks are connected to the same drain, the head of the run should be ventilated to atmosphere or air admittance valves fitted to each stub stack arrangement.

Stub waste
This technique is often used to connect isolated ground floor waste appliances such as basins, baths, shower trays and sinks to eliminate exposed pipework or low level ducting. The 110mm unventilated drain is terminated at finished floor level with a reducer and boss adaptor to suit the size of waste from the appliance.
**Prevention of cross-flow**

Where small diameter branch waste pipes connect to a discharge stack they must be arranged to eliminate the risk of cross-flow from one branch to the other. A branch creates a no entry zone for opposing waste connections, which varies depending on the stack diameter. No connections should be made within the restricted zone although entry is permissible on the centre line of the boundary directly opposite or at right angles.

<table>
<thead>
<tr>
<th>Stack size</th>
<th>Height of zone ‘H’</th>
</tr>
</thead>
<tbody>
<tr>
<td>110mm</td>
<td>110mm</td>
</tr>
<tr>
<td>160mm</td>
<td>250mm</td>
</tr>
</tbody>
</table>

To prevent cross-flow from a large diameter branch to a smaller waste connection, the latter should be made to the stack at or above the centre line of the larger branch, at right angles or at least 200mm below the restricted zone. Entry is permissible on the boundary centre line directly opposite or at right angles.

‘H’ = 200mm irrespective of stack diameter
**Jointing**

- Special tools are not required
- All tools are standard tools

**Pipe cutting**

- Cut pipe at right angle
- Use saw blades/disc blades for plastics

**Chamfering/deburring**

- Deburr pipe from inside
- Chamfer pipe from outside

**Push-fit jointing**

- Apply lubricant on all lip seals
- Only use lubricants approved for Friaphon products. Any use of inappropriate lubricants may damage or disintegrate the sealing.

- Push part as far as it goes
Bonding

Only use primer and adhesive approved for Friaphon products. Any use of inappropriate primers and adhesives may damage the pipe material and cause leaky connections.

Chamfer pipe

Clean faces to be bonded

Apply adhesive all over faces with brush

Insert pipe to maximum depth

Remove excess adhesive

When using bonding sleeves, provide for compensation of expansion forces.
**Repairs**

- Damaged pipe
- Cut repair part from remnant pipe
- Adjust repair part
- Clean faces to be bonded, apply adhesive, press on repair part
- Fix hose clamp, remove after hardening

**Subsequent installation of branches**

- Cut off pipe length $A = L + 2 \times d$, chamfer remaining pipe ends
- Insert pipe piece into branch at a length of $l = 2 \times d$, fit in sleeves
- Insert branch, provide for connection by way of sleeves
Installation

Boss pipe connections

1. Multiple entry boss pipes
   All have 90° boss upstands moulded on each fitting with one inlet port open. Connection is made using the appropriate size boss connector to suit 32, 40 or 50mm waste pipes.

2. Strap-on-bosses
   Primarily designed to permit 32, 40 and 50mm waste pipe connections to be made to existing 110mm discharge stacks, strap-on-bosses can also be used on new systems to provide flexibility of installation during different stages of construction.

Boss branches

The Friaphon range of five boss branches are designed to allow multiple waste pipe connections to be made to the discharge stack from different directions. Four different side entry combinations are possible together with a rear if required. Staggered waste pipe connections, directly opposite are not permitted as cross-flow could occur.

Compatibility

Boss pipes, boss connectors and strap-on bosses fitted with multi-fit ‘T’ ring seals are suitable for use with MUPVC or abs waste systems to BS 5255, polypropylene to BS 5254 and metric size copper to BS 2871.

Un-perforated boss upstands on boss pipes, branches and reducers may be drilled to accept 32, 40 and 50mm boss connectors using a 51mm diameter hole saw.

Horizontal connections

Boss pipes were developed for use in horizontal situations where it is recommended that connection to the larger diameter pipe is made at 45°. These have solvent weld sockets to receive 50mm diameter MUPVC or abs waste pipes to BS 5255.

Waste manifold (4 port)

Plumbing in the bathroom or WC is made easier by using the waste manifold. Waste pipes may be connected to the manifold above floor level using any one of four inlets to suit site conditions. The four waste inlets will also permit connections of extra pipework at a later date.

The Friaphon waste manifold will accept waste pipes to BS EN 1451 and BS EN 1566, BS 5255.

For 50mm connections, solvent weld the boss adaptor (FP 12 41 01) directly into the socket; for 32mm and 40mm connections use rubber boss adaptors.
Installation
Fixing techniques

Only pipe clips with sound-proofing insert strips, which match the external diameter of the pipe and fully enclose it, should be used for the Friaphon domestic drainage system (insert strips made of soft PVC are not acceptable).

Threaded rods or shanked bolts should be used to attach pipe clips.

<table>
<thead>
<tr>
<th>d DN</th>
<th>Minimum thread size</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-160</td>
<td>100-150</td>
</tr>
</tbody>
</table>

The spacing of the pipe clips must not exceed 2m for vertically installed pipes and 10 times the external diameter of the pipe (10 x d) for horizontally installed pipes. Care must be taken to ensure that pipe clips are fitted as close as possible to the floor and the ceiling.

Pipe attachment for vertical runs.
Top: with a sliding clip.
Bottom: with the Friaphon support clip and support ring.

Pipe with pipe clip.

Pipe clip spacings

<table>
<thead>
<tr>
<th>External diameter d</th>
<th>DN</th>
<th>Horizontal clip spacing 10 x d</th>
<th>Vertical clip spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>100</td>
<td>1100</td>
<td>2000</td>
</tr>
<tr>
<td>160</td>
<td>150</td>
<td>1600</td>
<td>2000</td>
</tr>
</tbody>
</table>
**Installation**

**Friaphon support clip**

Friaphon support clips with support ring and wall attachment allow the pipe to be fixed at any point along its axis. The support clip should preferably be fitted above the bottom branch. The attachment points are selected to suit the best place in the brickwork. The support ring bears the weight of the down pipe above it.

1. Mark, drill and fit the wall attachment.

2. Adjusting the distance from the wall.

3. Adjustment options on the wall fixing.
Installation

Fitting instructions

4. Fit the support clip to the wall attachment and tighten with a 17mm open ended spanner.

5. Open the snap lock of the support clip and insert the Friaphon pipe into the moulded fitting and clip fixer.

6. Assemble the support clip and secure the screws on the snap lock. A spacer prevents overtightening.

7. Fix the support ring onto the Friaphon pipe so that it rests on the support clip.

8. Finished assembly of the complete Friaphon support clip.
Installation of pipes

Distance between pipe clips

Dimensions and design of the wastewater system must be in keeping with BS EN 12056.

Direction change, height of downpipe <10 m

- Sliding clip
- Support clip

Direction change, height of downpipe >10 m, in keeping with standard

- Pipe jacket
- Concrete backfill

Pipe Jacket
To prevent sound vibrations travelling from the pipe to the concrete backfill, wrap 5mm PE foam insulator around the pipe before backfilling.
Installation of pipes

Assembly example of horizontal pipes with sliding clips

If a horizontal pipe has to be secured against being forced apart it must be fitted with support clips.

Assembly example of horizontal pipes with support clips and sliding clips

SC = Sliding clip
Installation of pipes

Assembly example with branch and two down pipes

Wherever there is a change of direction or a branch, the piping must be adequately secured. The distance between pipe clips for horizontal straight pipe runs is a maximum of \(10 \times d\).

The examples below show assemblies which use double couplers. Here the pipe clips fitted must always be of the sliding type.

If a horizontal pipe is fixed to the ceiling as a collector pipe, every change of direction from vertical to horizontal must be made with two 45° bends and one 250mm cushioning section (i.e. a long cushioning bend).

![Diagram of assembly example with branch and two down pipes]

SC = Sliding clip
**Installation of pipes**

**Assembling short runs of pipes**

Even when assembling short horizontal runs of pipe with a length \( \leq 10 \times d \), as shown in the illustration, a sliding clip must be fitted as close as possible to the cushioning section in order to stabilise the position.
Installation of Unicollar® Fire Protection Collar

1 Removing the Casing and Accessories from the Box
The box contains the fixings and accessories required to install the collar. Open the box at the position clearly marked with an arrow. Remove the box of accessories. The end of the collar can now be pulled and the strip will uncoil. Ensure the soft Grafitex faces up. The collar strip has snapping perforations at 15mm centres. Only pull out enough strip for the collar length required.

2 Cutting and Snapping the Strip
Identify the outside diameter of the pipe that is to have the collar applied to. On the box is a table, which gives the number of segments for each size pipe and the length of strip required. Either count the number of (15mm) segments required or measure the strip. Cut through the Grafitex at the appropriate position.

Hold the strip with a finger and thumb on each side of the cut and as close to the cut as possible, and fold in a downward direction as far as possible. Repeat this folding until the steel snaps.

3 Fixing the Collar
The ends of the Grafitex, once cut, will be square. To make it easy to fix, cut these square ends away at a slight angle. Shape the strip to the approximate diameter of the pipe. If the pipe is small (e.g. under 75mm) pay extra attention to the ends of the strip to ensure they have been shaped correctly. Push one of the prongs of a bracket through the notch at one end of the strip. Fold the strip around the pipe and push the other prong through the notch on the other end of the strip. (The bracket can be gently hammered in to position if pushing is difficult). Attach the bracket to the wall or floor as described over and shown on the box drawings. Fix the other bracket(s) as required.

Ensure the correct number of brackets are always used and the two ends of the strip always have a connecting bracket.

Note: To prevent structure-borne sound bridges wrap 5mm PE foam insulator around the pipe before folding the strip around the pipe.
4 Floors

The concrete must be in a condition that will ensure the anchors hold securely. Larger steel fixings may be used if deemed appropriate. Back fill any gap between the pipe and concrete greater than 8mm with mortar or commercial grade mortar mix. Acrylic, intumescent or silicone sealant may be applied around the pipe on the topside of the floor slab if a water seal is required. If there is a possibility of pipe movement occurring that will cause cracks in the seal between the pipe and mortar mix (if used), it may be advisable to seal the pipe with acrylic, intumescent or silicone sealant to prevent cold smoke egress. This however is not required for the fire rating to be achieved. If the gap between the pipe and slab is less than 8mm, apply a bead of acrylic, intumescent or silicone sealant approx. 8mm deep in to the gap at the soffit.

Fire Resistance (BS 476: Part 20)

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>110mm</td>
<td>2 hours</td>
</tr>
<tr>
<td>160mm</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

5 Walls

For framed walls, use the 40mm x 10 laminating screws provided. For masonry walls, use the 20mm x 5mm steel anchors provided. The wall or floor must be in a condition that will ensure the anchors hold securely. Larger steel fixings may be used if deemed appropriate. Ensure the annular gap between the wall and pipe is minimal and seal this gap with a bead of acrylic, intumescent or silicone sealant. Attach a collar to both faces of the wall. Fire tests were conducted with two brackets on pipes 69mm and under. For framed walls, three brackets are recommended if framing studs are not available to screw in to.

Fire Resistance (BS 476: Part 20)

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>110mm</td>
<td>2 hours</td>
</tr>
<tr>
<td>160mm</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

For details of suitability and approvals for use of Unicollar for other pipe materials and sizes contact the technical support department on 01543 272446.
Transition to other Pipe Systems

Overview of outside diameter ‘d’ of other materials in mm

<table>
<thead>
<tr>
<th>DN</th>
<th>Friaphon</th>
<th>Cast iron</th>
<th>PE/PP mineral-reinforced</th>
<th>PVCu</th>
<th>HD PE</th>
<th>Fibre cement</th>
<th>Steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>116</td>
<td>102</td>
</tr>
<tr>
<td>150</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>168</td>
<td>159</td>
</tr>
</tbody>
</table>

Flow direction

- Friaphon pipe
- Friaphon double coupler
- PVCu pipe

- HDPE
- Friaphon double coupler
- Friaphon pipe

- Cast iron pipe
- Flexseal connector
- Friaphon pipe

- Cast iron pipe
- Cast iron pipe coupling
- Friaphon pipe

- Friaphon pipe
- Friaphon double coupler
- Steel pipe

- Vitrified clay
- Connector piece
- Friaphon pipe
Site Work

Inspection and testing
Inspection and testing should be carried out in accordance with BS 12056: 2000 and Building Regulations noting especially the details given in respect of air testing and the fact that smoke testing of plastics pipework should be avoided as the materials can be adversely affected.

Air test
The installation should be capable of withstanding an air test of positive pressure of at least 38mm water gauge for at least three minutes. During this time every trap should maintain a water seal of at least 25mm.

Handling
Friaphon pipes are strong, though lightweight and therefore very easily handled. However, reasonable care should be exercised while handling, particularly in extremely cold conditions. Pipes should preferably be loaded and unloaded by hand but if mechanical handling is used, protected slings are recommended.

Recyclability
All plastic components in the Friaphon domestic drainage system are completely recyclable.

Installation Outdoors
Protect the FRIAPHON® product range against permanent UV radiation.

![Condensate insulation](image)

Condensate insulation
Friaphon pipes do not require insulation against condensation.

Friaphon, being a thicker wall pipe constructed of 2 different layers of pipe has a much lower thermal transfer value than that of, say, cast iron and therefore condensation is less likely to form during periods of cooling.

<table>
<thead>
<tr>
<th>Pipe Material</th>
<th>Thermal Transfer Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friaphon</td>
<td>0.16 W /mk</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>50-60 W /mk</td>
</tr>
</tbody>
</table>
Conformity Certificates

**DEUTSCHES INSTITUT FUR BAUTECHNIK**

**Sound attenuated drainage**

### 1. Soundschallschutzsysteme eines Abwasseranlagens mit Brandabschirmungen

- **Approval number:** Z-42.1-220
- **Subject matter of approval:** Double-layer wastewater pipes and form parts with homogeneous wall structure made of styrene copolymers DN 50 up to DN 150 of building material class B2 – normally combustible as per DIN 4102 for in-house wastewater pipes
- **Currency period expires on:** 30 November 2006

---

### 2. Bestimmung des Geräuschverhaltens eines Wastewater systems mit Feuerabschirmungen

- **Approval number:** Z-19.17-1271
- **Subject matter of approval:** Fire-protective sheathing "Friaphon fire protection collar DE and NE" Fire rating R 120 and R 90 as per DIN 4102-11
- **Currency period expires on:** 30 November 2006

---

### 3. Ermittlung des Geräuschverhaltens einer Abwasserleitung mit Feuerabschirmungen

- **Approval number:** Z-19.17-1271
- **Subject matter of approval:** Fire-protective sheathing "Friaphon fire protection collar DE and NE" Fire rating R 120 and R 90 as per DIN 4102-11
- **Currency period expires on:** 30 November 2006

---

**DEUTSCHES INSTITUT FUR BAUTECHNIK**

**Sound attenuated drainage**
Terms and Conditions

1. DEFINITIONS:
   ‘Seller’ shall mean Glywedd Pipe Systems Limited, registered in England under number 1698059. ‘Buyer’ shall mean any company, organisation or individual to whom a quotation is offered, or whose order is accepted by the Seller.

2. CONDITIONS:
   All offers, quotations, estimates, acceptances and contracts are subject to these Conditions of Business and any terms or conditions which any other person shall seek to impose or make part of any contract shall, so far as is inconsistent with these Conditions of Business, not apply unless expressly agreed by the Seller in writing. The headings in these conditions are for convenience only and shall not affect their interpretation.

3. QUOTATIONS AND PRICE VARIATION:
   a) Any quotation given by the Seller is an invitation to the Buyer to make an offer only and nothing said by the Seller in pursuance of a quotation or in any advertisement shall be binding on the Seller unless and until it is accepted in writing by the Seller.
   b) Unless stated otherwise, all quotations and published price lists are ex works, exclusive of VAT and shall remain valid for 30 days or such a period as may be quoted but nevertheless the Seller may amend or withdraw any quotation by written or oral notice. Quotations may be varied if the Buyer makes variations in his specifications.

4. STATEMENTS OR REPRESENTATIONS TO THE BUYER:
   If any statement or representation has been made to the Buyer upon which the Buyer
   relies other than in the documents enclosed with the Seller’s quotation, the Buyer must set out that statement or representation in a document to be attached to or endorsed on the order in which case the Seller may submit a new quotation.

5. DELIVERY - TIME:
   a) Any period for delivery given at any time and in any manner by the Seller is an estimate only and is not binding on the Seller. Delivery periods are normally calculated from the later of:
      i) acceptance of order; or
      ii) where applicable, the receipt by the Seller of a detailed specification or drawings.
   b) Time shall not be deemed to be of the essence of the contract. Failure by the Seller to
      meet any quoted delivery period for any part or the whole of the order shall not entitle
      the Buyer to rescind the contract or to claim damages of any nature.
   c) The Seller will endeavour to comply with reasonable requests by the Buyer for
      postponement of delivery but shall be under no obligation to do so. Where delivery is
      postponed otherwise than due to default by the Seller the Buyer shall pay all costs and
      expenses including a reasonable charge for occupation and transportation occasioned
      thereby and an extra charge for split delivery if applicable.
   d) The Buyer will receive delivery of any consignment between the hours of 8.00am and
      4.00pm Monday to Friday inclusive, unless otherwise agreed in writing. Cost incurred by
      the Seller arising from the Buyer’s refusal to accept consignments within the agreed hours
      shall be borne by the Buyer.

6. DELIVERY AND RISK:
   a) Where the Buyer provides the transport, delivery shall be made ex the Seller’s works
   b) where the Seller provides the transport, delivery shall be made to the premises of the
      Buyer, or the premises of the Buyer’s customer or works site if the Buyer has requested
      delivery to be so made but where the Buyer has made such a request the Seller will
      make a first delivery to the Buyer’s customer or works site as so much of the goods as
      is available for that delivery but subsequent deliveries will be made to the premises of
      the Buyer.
   c) The Seller may at its discretion make partial delivery of orders and invoice the same.
   d) Risk in the goods shall pass on delivery.
   e) Where goods are sent FOB the Seller’s responsibility shall cease when the goods
      are placed on board ship or aircraft without the need for the Seller to give notice to the
      Buyer and the provisions of Section 32(3) of the Sale of Goods Act 1979 shall not apply.

7. OWNERSHIP OF GOODS:
   a) The goods shall remain the sole and absolute property of the Seller as legal and
      equitable owner until such time as the Buyer shall have paid to the Seller the contract price
      together with the full price of any other goods the subject of any contract between the
      Seller and the Buyer.
   b) The Buyer acknowledges that until such time as the property in the goods passes to
      the Buyer he is in possession of the goods as a bailee and fiduciary agent for the Seller and
      the Purchaser shall store the goods in such a manner that they are clearly identifiable as
      the property of the Seller.
   c) Until payment due under all contracts between the Buyer and the Seller had been made
      in full, in the event of sale of the goods by the Buyer:
      i) the Buyer shall be entitled to trace all proceeds of sale received by the Buyer through
         any bank or other account maintained by the Buyer; and
      ii) the Buyer shall if requested by the Seller in writing to so assign its rights to recover the
         selling price of the goods from the third parties concerned. Such monies to be held
         separately by the Buyer as agent on behalf of the Seller.
   d) The Seller may for the purpose of recovery of its goods enter upon any premises where
      they are stored or where they are reasonably thought to be stored and may reposess the
      same.

8. TERMS OF PAYMENT:
   In the event of default in payment according to the agreed payment terms between the
   Seller and the Buyer – i.e. by the end of the month following the month of despatch of the
   goods the Seller shall be entitled without prejudice to any other right or remedy to suspend
   all further deliveries and to charge interest on any amount outstanding at the rate of 2% per
   month until payment in full is made (as a part of a month being treated as a full month for
   the purpose of calculating interest).

9. SHORTAGES AND DEFECTS APPARENT ON DELIVERY:
   a) It shall be the responsibility of the Buyer to inspect or arrange for an inspection of the
      goods on delivery whether the goods are delivered to the Buyer’s premises or to the
      premises of the Buyer’s customer or to a works site. If no such inspection is made the
      Buyer shall be deemed to have accepted the goods.
   b) The Buyer shall have no claim for shortages or defects apparent on inspection unless:
      i) a written complaint is made to the Seller within three days of receipt of the goods
         specifying the shortage or defect; and
      ii) the Seller is within seven days of receipt of the complaint given an opportunity to
         inspect the goods and investigate the complaint before any use is made of the goods.
   c) If a complaint is not made to the Seller as herein provided then in respect of such
      shortages or defects the goods shall be deemed to be in all respects in accordance with
      the contract and the Buyer shall be bound to pay for the same accordingly.

10. CLAIMS FOR DEFECTS NOT APPARENT ON INSPECTION:
    a) The Buyer shall have no claim for defects not apparent on inspection unless the Seller
       is notified of defective workmanship or materials within twelve months from delivery of
       the goods. Provided that the goods have been installed and applied in accordance with any
       relevant recommendations made by the Seller, the Seller will at its option replace the
       goods or refund the net invoiced price in respect of the goods which have been shown to
       be defective. If the Seller does not at its option replace the goods or refund the net invoiced
       price it shall be bound to accept such substituted goods in full satisfaction of the obligations of the Seller under the contract.
    b) The Buyer shall in any event have no claim or set-off in respect of defects unless a
       written complaint is sent to the Seller as soon as the defect is noticed and no use is made
       of the goods thereafter or alteration made thereto by the Buyer before the Seller is given
       an opportunity to inspect the goods.
    c) The Buyer is responsible for ensuring that the goods are fit for any particular purpose,
       and no warranty or condition of fitness for any particular purpose is to be implied into the
       contract.

11. LIABILITY:
    a) Save as stated in Conditions 9 and 10 (and save in respect of death or personal injury
       resulting from the negligence of the Seller its servants or agents) the Seller shall not be
       liable for any claim or claims for direct or indirect consequential or incidental injury loss or
       damage made by the Buyer against the Seller whether in contract or in tort (including
       negligence on the part of the Seller its servants or agents) arising out of or in connection
       with any defect in the goods or their fitness or otherwise for any particular purpose or any
       act omission neglect or default of the Seller or its servants or agents in the performance of
       the contract.

12. FORCE MAJEURE:
    a) Notwithstanding anything herein contained neither the Buyer nor the Seller to be held
       liable for any delay or failure to carry out the contract due wholly or in part to an act of God
       by any Government whether British or foreign civil war strikes and/or lockouts whenever occurring the fire, theft, epidemics, flood or other unfortunates or becoming unavailability or irreparable (whether at all or at commercially acceptable prices) or any other circumstances beyond the control of the Seller.

13. SUB-CONTRACTING:
    The Seller reserves the right to sub-contract the fulfilment of any order or any part thereof.

14. INSOLVENCY AND BREACH OF CONTRACT:
    In the event that:
    a) the Buyer commits any breach of the contract and fails to remedy such breach
       (if capable of remedy) within a period of thirty days from receipt of a notice in writing from
       the Seller requesting such remedy; or
    b) any distress or execution is levied upon any of the goods or property of the Buyer; or
    c) if the Buyer offers to make any arrangements with or for the benefit of its creditors or
       (if an individual) becomes subject to a petition for a bankruptcy order or (being a limited
       company) has a receiver appointed of the whole or any part of its undertaking property or
      assets; or
    d) an order is made or a resolution is passed or analogous proceedings are taken for the
       winding up of the Buyer (save for the purpose of reconstruction or amalgamation with
       insolvent and previously approved in writing by the Seller) the Seller shall thereupon be
       entitled without prejudice to its other rights hereunder forthwith to suspend all further
       deliveries until the default has been made good or to determine the contract and any
       unfilled part thereof at the Seller’s option to make partial deliveries. Notwithstanding any
       such termination the Buyer shall pay to the Seller at the contract rate for all the goods
       delivered up to and including the date of termination.

15. INDUSTRIAL PROPERTY RIGHTS:
    If goods supplied by the Seller to the Buyer’s design or specifications infringe or are
    alleged to infringe any patent or registered design right or copyright the Buyer will
    indemnify the Seller against all damages, costs and expenses incurred by the Seller as a
    result of the infringement or allegation. The Buyer will give the Seller all possible help in
    meeting any infringement claim brought against the Seller.

16. BUYER’S ERROR IN ORDERING:
    In the event the Buyer orders incorrectly the Seller will be under no obligation to the Buyer
    to rectify or assist in rectifying the error.

17. LAW AND JURISDICITION:
    The contract shall be subject in all respects to English Law and to the jurisdiction of the
    English Courts.
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