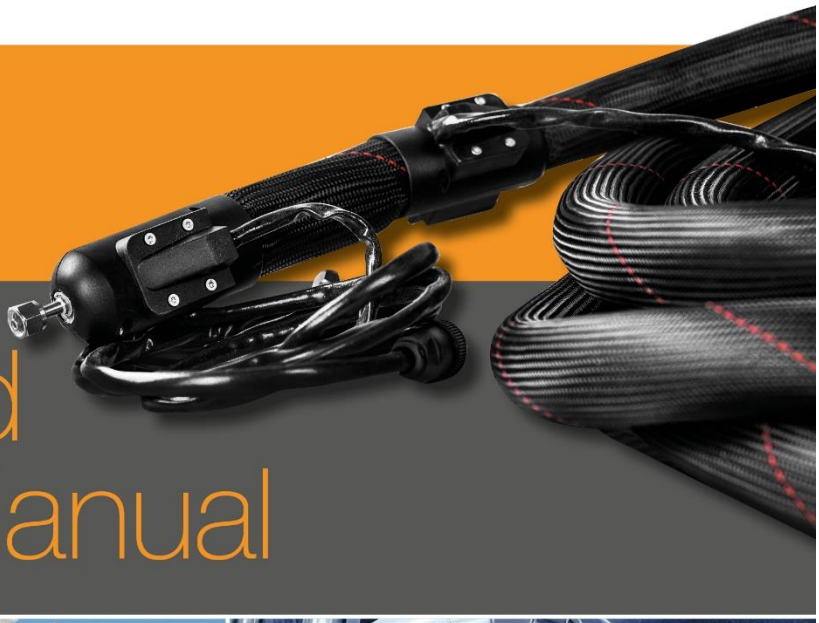
Protea

technology leadership
in measurement solutions



Heated Line Manual

www.protea.ltd.uk

Protea Heated Line Manual
– for Use With Protea Gas Analyser Systems

The information contained in this manual is subject to change without notice due to changes in the hardware and software design, specifications and operational procedures of use of Protea analysers and heated sampling lines.

Last Revision 06/17

WARNING

The gas sampling system parts contain parts that are hot under normal operation. Care should be taken when handling any heated sampling system parts.

Telephone: +44 (0)1270 872000
Email: mail@protea.ltd.uk
Website: www.protea.ltd.uk

Protea Limited
10 Prosperity Court, Middlewich,
Cheshire, CW10 0GD UK

Table of Contents

Telephone: +44 (0)1270 872000
Email: mail@protea.ltd.uk
Website: www.protea.ltd.uk

Protea Limited
10 Prosperity Court, Middlewich,
Cheshire, CW10 0GD UK

1. Construction

As a rule, the heating hose consists of a high-quality PTFE or PFA inner hose through which the liquid or gaseous medium flows. The inner hoses are resistant to high temperatures up to 250°C, high operating pressures and aggressive substances to cover a wide range of applications. Selection of the type of pressure hose can be accomplished on the basis of the operating pressure required.

The appropriate fitting can be press-fitted to the basic hose. Please note that the inner diameter of the fitting is not identical with the nominal width of the hose and therefore restricts the hose passage.

The heating conductor is laid out according to VDE guidelines, is protected against moisture and the protective conductor is protected by a braided jacket. A temperature sensor is installed to control the operating temperature of the heated hose – as a standard feature; the sensor is located approximately 300 mm from the electrical connection. If additional control lines or single-wire conductors are required, they can also be incorporate into the heating hose.

The thermal insulation can be selected according to the operating temperature or by outer environmental effects and is protected against mechanical damage by an outside protective braid. On both ends, silicone caps or polyamide hard caps are mounted.

Usually a standard 5-pin or 7-pin plug for connection to Protea's temperature controllers is fitted with the leads for heating and temperature sensing. Separate power, control and signal lines are marked appropriately and fitted with suitable connectors,if provided.

Before using the heating hose, carefully read and observe the safety and installation instructions.

Safety level: Thermal safety

Level 0: No safety equipment only controlled operation – an overheating because of design feature is excluded (Regulator)

Level 1: With temperature regulator

Level 2: With adjustable temperature regulator or –temperature regulator and delimiter combination

2. Safety Instructions

When planning, installing; testing and operating as well as for repair, always observe:

- Operating instructions
- DIN EN 60519-1 "Safety in Electrical heating systems"
  Part 1 : General requirements (= IEC 519-1 = VDE 0721, Part 911)
- Applicable part of VDE 100
- Other standards and regulations applicable for such applications
- All recognized rules of technology such as EN standards, VDE0100, Low-Voltage Guidelines
  EN 60204, Part 1, Machine Guidelines EN 292 and the Accident Prevention Regulations according to BGV A2

Ensure that protection against dangerous body currents are provided as specified in VDE 0100, Part 410 and Part 540 (Grounding and System Grounding) as well as the specifications and the standards listed above.

Ensure that the heating hose is installed only outside of explosion-hazard areas. It is not permissible to heat explosive mediums or mediums which release explosive gases when heated!

Proper and safe operation of the heating hose assumes that the hose has been carefully transported, stored and properly installed.

Ensure that heating hoses are installed and put into operation only by qualified personnel.

Observe these operating instructions and operation of the device, particularly instructions and notes on routing, the applicable safety precautions for installation and operation of electrical equipment.

3. Heated Line Label

Your heated line will have a nameplate and label that contains the following information:

- Model type
- Serial number (Fabr. Nr.)
- Material Number
- Length, L in metres
- Operating Voltage
- Total Power and Freq
- Maximum operating temperature
- Expected operating pressure, in barg

4. Installation Instructions

Please read these installation instructions carefully and observe all points listed when installing the equipment. Failure to observe these installation instructions can result in malfunctions or, under certain conditions, the required EMC Guidelines may not be fulfilled.

4.1 Electrical Installation

Before connection and use of the heating hose, ensure that the operating voltage and the required operating voltage conditions for the heating hose conform with the local conditions (see type plate and technical data).

Ensure that the load voltage is switched off on site and secure against being switched back on while installing the heating hose. Complete electrical connections in conformance with the connection diagram and applicable, electric-technical regulations. Route the supply lines to the heating hose so that they are free of tension under all conditions and cannot be pinched or sheared off under any circumstances. If possible, use shielded cable for the sensor lines and signal lines and shielded compensation lines for the thermocouples. The heating hose load circuit should be suitably protected against over current (e.g. MCB or fuse). In addition, an RCD protected supply is recommended.

This protection is built into the Protea integrated systems, such as the atmosFIR CEM cabinet.

atmosFIR CEM Cabinet system as RCB and MCB protection for heated line supply provided

4.1 Pneumatic Connections

The heated line will have been supplied with the inner sample tube dimensions as ordered, or as required for connection to your Protea gas analyser. If purchased with a Protea gas analyser, then suitable compression fittings will have been provided and attached to the sample line.

- Connect the heated line to your gas analyser and/or sample probe using the provided compression fittings. Do not over tighten the fittngs.
- Ensure that are no exposed sections of either PTFE inner core or stainless steel end caps. These “cold spots” can cause sample condensing and loss of sample for reactive or “sticky” gases
- If there are exposed sections of heated sample line, insulate with silicone foam insulation

4.2 Commissioning

Before putting the heating hose into operation, observe the following:

- Specifications on type plate must coincide with your order data
- Protea recommends the use of Protea-brand temperature controllers, to ensure compatibility with the type of sensor in the heating hose.
- Ensure that the line voltage coincides with the voltage specified on the type plate.
- Ensure that the nominal power for the heating hose does not exceed the maximum power output of the connected temperature control or power output from the equipment (resistive load).
- Never operate the heating hose without temperature sensor (connected to temperature control), because otherwise it heats up without control and exceeds the maximum operating temperature which can lead to damage to the heating hose and your equipment.
- Provide for a protective system to protect the line against excessive temperature in the event of overload.
  Line protection according to VDE 0721, Part 1, Section 19, must ensure that the nominal value of the fuse is matched to the specific load and must be connected in series in front of the heating hose (including control).
  However, the max. fuse rating must not exceed 16A.
  We recommend using a conductor with a cross section of at least 1.5mm²
- If the heating hose is suspended or fastened with clamps, ensure that the outer diameter of the heating hose is not reduced by more than 10%.
- Ensure that connection fittings are not under tension, under any circumstances.
- It is necessary for the heating hose to reach its operating temperature before it is subjected to the operating pressure, because the medium could still be rigid at the fittings.

- The time required to heat up the heating hose to operating temperature is approx. 15-30 minutes, as a rule. As soon as the hose reaches his operating temperature the fittings have to be tightening again.

- When starting up the system for the first time or restarting; ensure that the medium in the heating hose has reached its processing temperature to avoid damage to the inner hose.

- **Observe minimum bending radii (see Section 4.3).**

- Kinks and high torsion loads lead to destruction of the heating hose.

- The resistance of the flexible heating hoses to pressure changes at various operating temperatures.

  In the range up to 250°C, the pressure resistance can be specified, however, this decreases down to 0 bars at temperatures above 250°C. The maximum operating pressure should be calculated with a corresponding correction factor, depending on the maximum operating temperature.

- Observe pressure surges. These can be very high and are not indicated by normal pressure gauges.

- Never exceed the operating pressure.

- Hoses and PTFE tubing up to NW 8 have been tested for their suitability for use with vacuum down to 8 mbar at temperatures up to 250°C.

- Ensure there are no “cold spots” and insulate any exposed join as much as possible.

- Cut PTFE sample line shorter if it is widely exposed from the end of the heated hose

- For sampling of reactive or “sticky” gases, the heated hose will require conditioning with the sample to ensure good responses. This can take 24-48 hours of continuous sampling, depending on the length of the heated line and the sample being tested

- Silicone sealant is used in the fabrication of heated sample lines. During testing at Protea, all lines are heated and purge for at least 24 hours. There may still be some residual levels of VOCs produced in the heated hose and a bake-in period of 24-48 hours may still be required on-site prior to commissioning and measurement system.

4.3 Pressure Ratings and Bend Radii

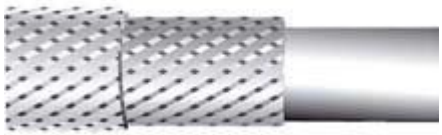
T1

Smooth PTFE hose
with one woven layer of stainless steel wire (DIN 1.4301)
nominal temperature 250°C

Nominal diameter DN	4	6	8	10	12
Working pressure in bar	275	240	200	175	150
Burst pressure in bar	1100	920	800	700	600
min. bending radius in mm	50	75	100	120	135

T2

Smooth PTFE hose
with two woven layers of stainless steel wire (DIN 1.4301)
nominal temperature 250°C



Nominal diameter DN	6	8	10	12
Working pressure in bar	275	250	225	200
Burst pressure in bar	1100	1000	900	800
min. bending radius in mm	75	100	120	135

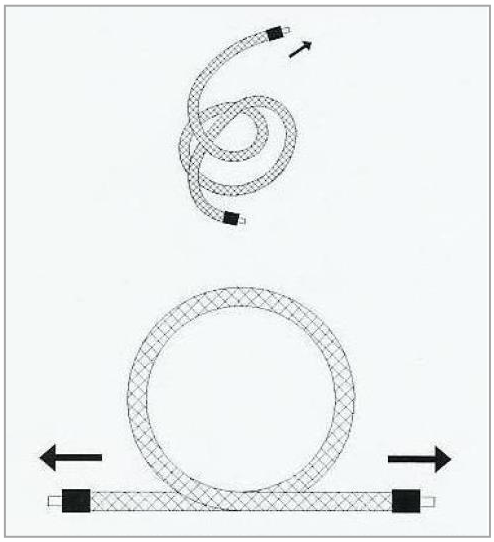
T3

Smooth PTFE hose
with two layers of high tensile steel wires and one braided steel wire
nominal temperature 250°C

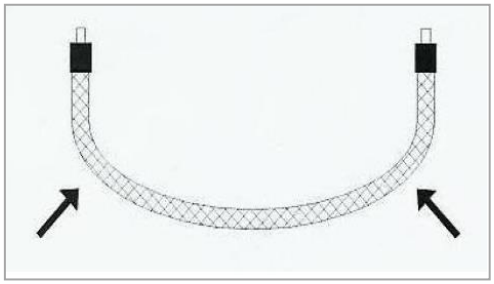
Nominal diameter DN	6	8	10	12
Working pressure in bar	500	475	450	400
Burst pressure in bar	2000	1900	1800	1600
min. bending radius in mm	75	100	120	135

4.4 Handling and Laying Heated Lines

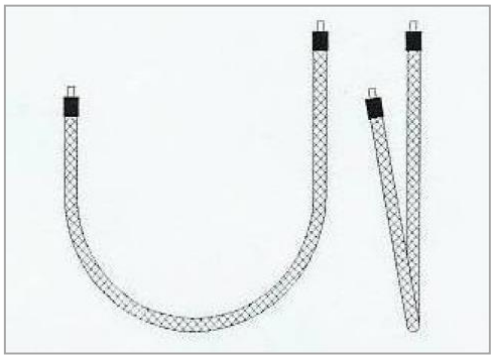
WRONG



Dragging at the ends of the rolled-up heated hoses causes torsional stress, as well as too narrow a minimum bending radius.

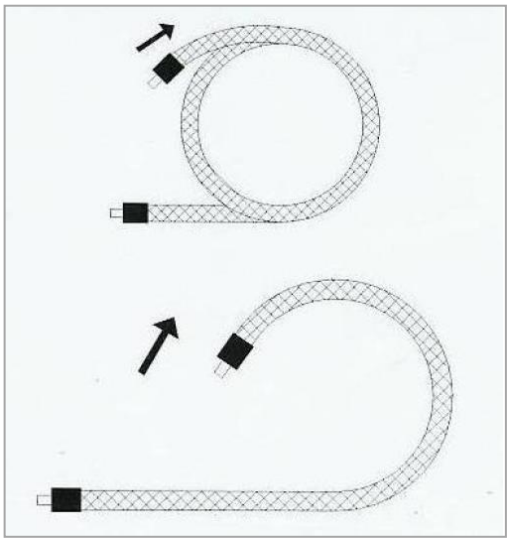


If heated hoses are too short, the heated hose will be kinked at the connections.

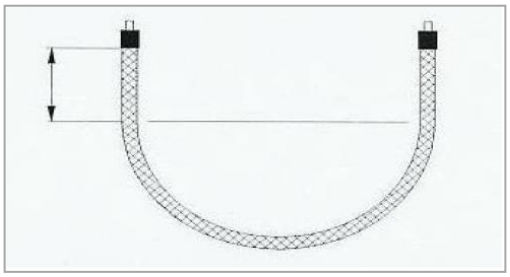


The heated hoses are often destroyed by torsional motions caused by improper installation.

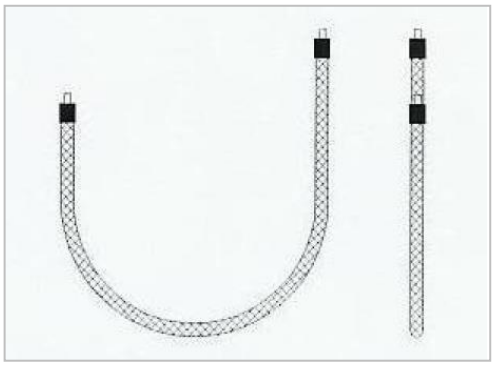
CORRECT



Unwind the roll instead of pulling the heated hose.

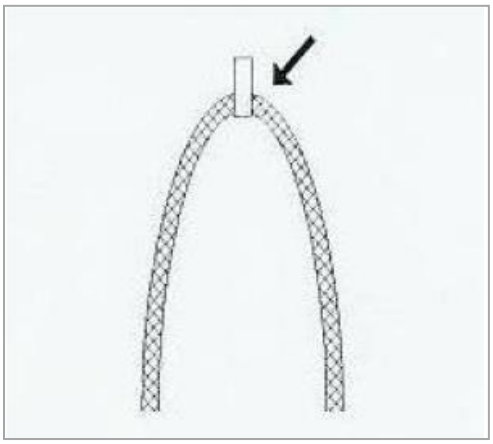
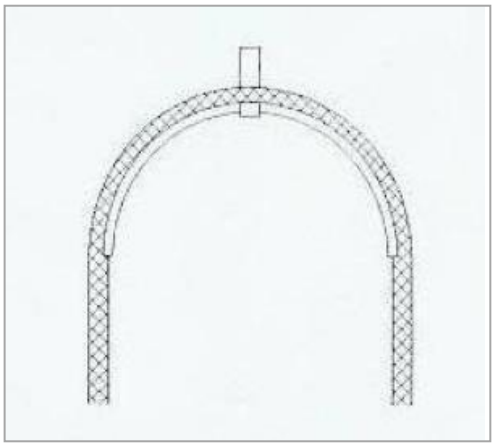
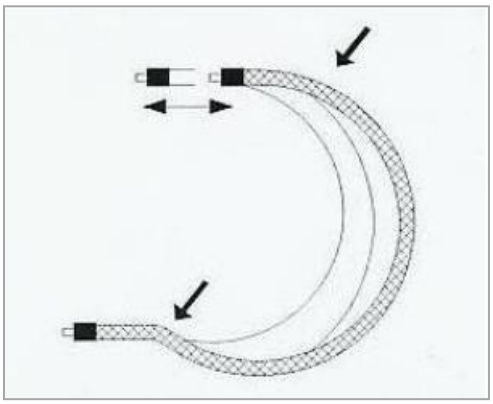
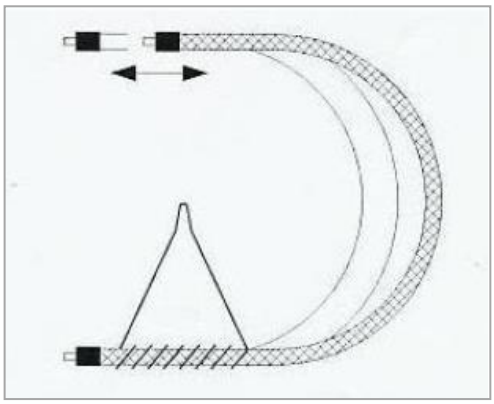
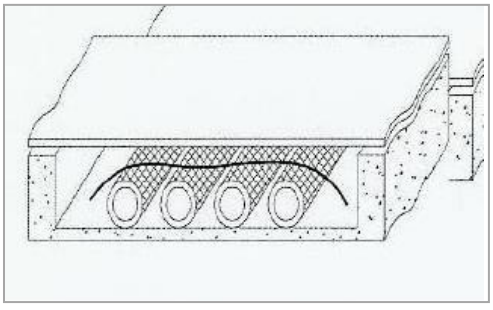
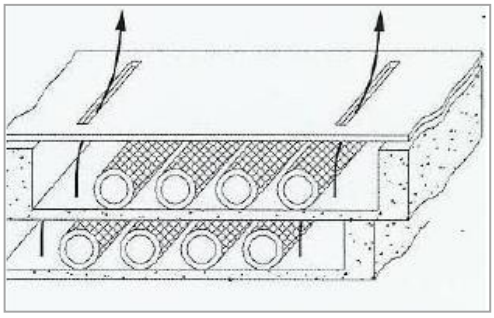


Plan in a straight piece of heated hose (about 5 x hose diameter) at the connections. A wide bending radius ensures a longer durability.



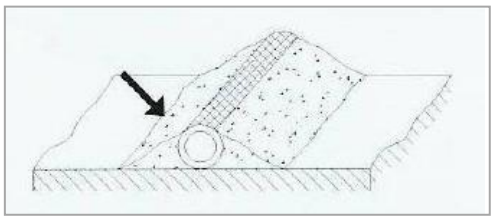
Make sure the axes of the heated hose run parallel and the motions are always on one and the same level.

4.5 Hanging and Suspending

WRONG	CORRECT
	
Avoid diversions, for they may cause kinking and bending stress.	Use a saddle-shaped device or a roll, each with the appropriate diameter.
	
Any inappropriate installation makes the heated hose sag.	Use a spiral heated hose suspension.
	
Heated hoses mounted within a closed channel or shaft will cause heat built-up.	Heated hoses must not touch each other. Sufficient ventilation is to be provided.

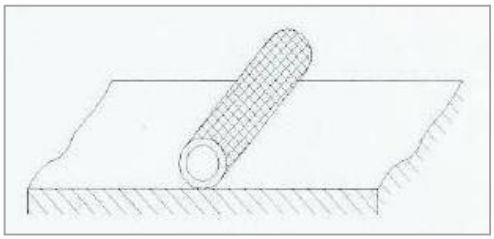
4.6 Elimination of Overheating

WRONG

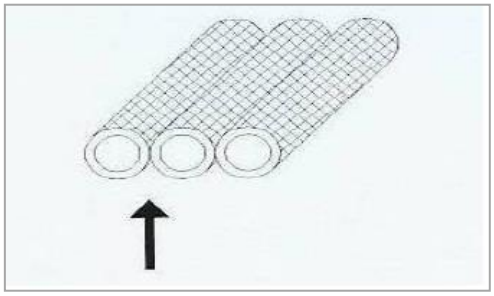


If e.g. powdery substances, adhesives, or other thermo-insulating materials are spilled on heated hoses, those parts will overheat.

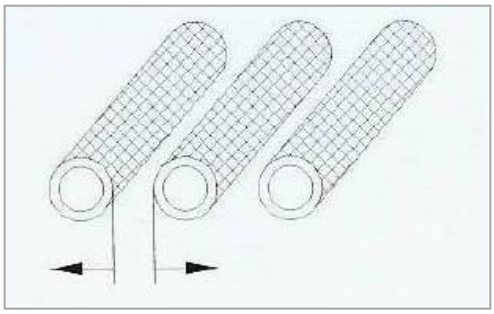
CORRECT



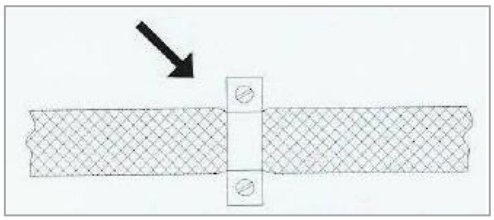
Constant cleaning and elimination of cause.

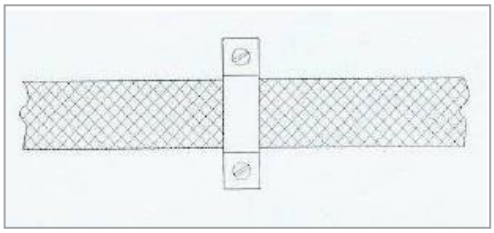


Heated hoses bundling or embedding with contact will cause overheating of contact areas.

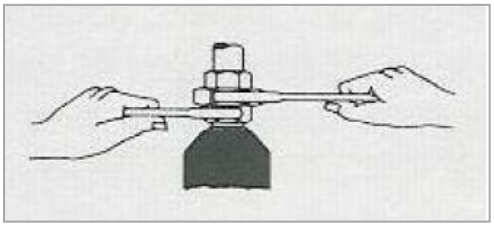


Install heated hoses with sufficient spacing.





With the mounting brackets, please do not squeeze the outer heat insulation onto the heating conductor during installation. This can cause damage of the protective layer, and may destroy the heated hose or damage the medium.



Use a counter-wrench when installing to avoid twisting the heated hose!

5. Maintenance and Repair

Perform maintenance and repair according to the standards and conditions specified under the point "Safety precautions" observing all applicable regulations of the employer's liability insurance association and other conditions applicable for the type of application.

The heating equipment and control should be checked for proper function at least once a year and testing intervals observed according to BGV A2.

6. Technical data and Tolerances

See type plate on the heating hose

Electrical tolerance of performance	+ 5 % / - 10 %
Length tolerance	+ / - 2 %

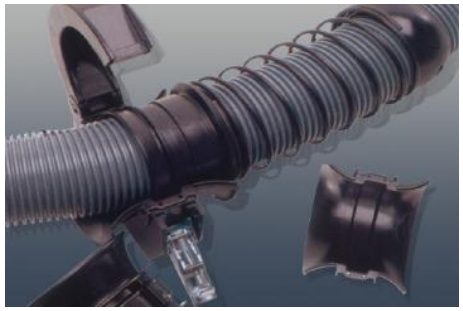
7. Accessories

For connecting, placing and guiding of heated lines Protea offers the corresponding accessories.

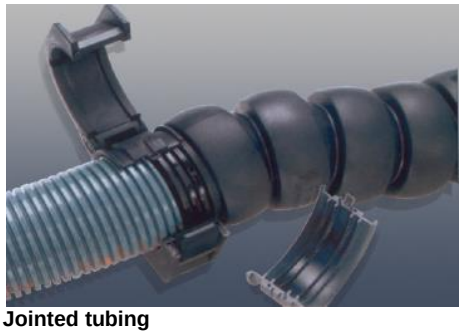
Coil ring with holding device

Also suitable for heated hoses with polyamide braid.*

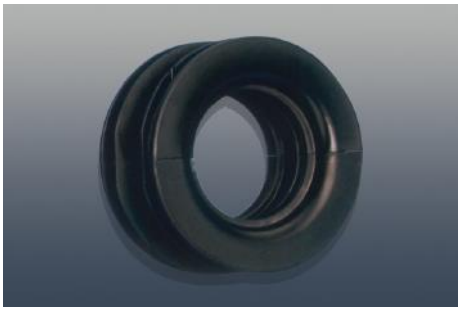
Gripping clamps



Trumpet



Jointed tubing



Middle-and end jaws

Conduit protector

8. Temperature Controllers

For operating the heated line at the required temperature, Protea offers a range of controllers for running heated lines.

All of our electronic, micro-processor controlled temperature regulators have the following features:

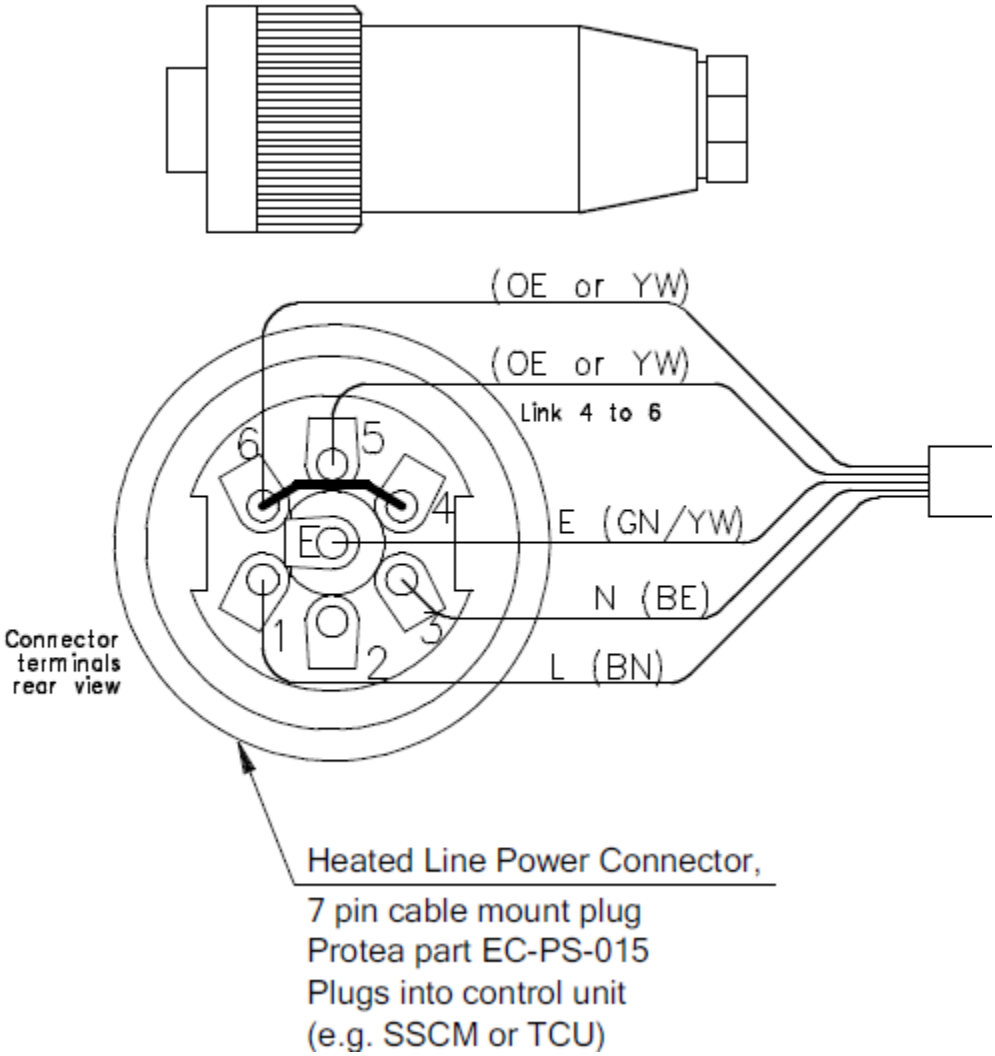
- Control and limiter system ready to plug in
- Two displays for indication of nominal and actual value
- Simple operation with function buttons
- Adjustment at parameter level
- Sensor input : Pt-100 or thermocouple
- PID auto optimization
- Freely adjustable temperature range 0-1200°C
- Switching capacities up to 8 A possible through standard 7-pin connector

TCU
Wall mounted controllers for fixed or portable operation (13A max)

SSCM Module
Dedicated control module to be used alongside Protea's range of gas analysers

Temperature regulator and delimiter combination for EX installations

Appendix A Standard Plug Wiring



NOTE: Pin wiring could be different or a non-standard connector could be issued for high current or EX heated lines.

END OF MANUAL