Class 1 – Public

Size Selection & Installation of AP-2000 Heat Shrink Tubing

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1. SCOPE

The following guide details the selection and installation procedures which should be considered when using Raychem AP-2000 heat shrinkable tubing from TE Connectivity for the protection of pipework, primarily for applications in the automotive market, e.g., brake pipe protection.

Other TE Connectivity heat shrinkable tubing may in certain circumstances be specified for brake pipe protection. However, the use of alternatives needs careful selection and control, and guidance should be sought from the appropriate TE Connectivity representative.

The equipment required to install the heat shrinkable tubing will depend upon the production capacity and the pipe lengths being protected. Generally, hot air ovens with conveyor belt feeds or infra-red heater beds are the most widely used.

2. REVISION HISTORY / REASON FOR CHANGE / RELATED DOCUMENTS

As PIP006:

Rev No	Date	Revised by	Details of Revision
1	April 1994	K Acott	K Acott
2	January 1997	K Acott	K Acott

As 114-120021:

Rev	Date	Prepared By	Approved By	Remarks
A	Mar 2023	Kamalasaravanan	Richard Kewell	New document

2.1. Customer Assistance

Reference Product Base Part Number and Product Code are representative. Use of these numbers will identify the product line and help you to obtain product and tooling information when visiting www.te.com or calling the number at the bottom of page 1.

2.2. Drawings

Customer drawings for product part numbers are available from www.te.com. The information contained in Customer Drawings takes priority if there is a conflict with this specification.

2.3. Specifications

Latest revision of Product Specification RW-1001 available from www.te.com provides product performance and test results.

2.4. Shelf Life

Refer document Global Dimensional Life for Heat Shrink Tubing Standard Size Products 408-32191 for details regarding the shelf life.

2.5. Safety

Appropriate Personal Protective Equipment (PPE) should be worn, and installation should take place with fume extraction or in a well-ventilated area. Adhere to local Codes and Regulations relating to Safe Working Practices.

3. TUBING SIZE SELECTION AND INSTALLATION GUIDELINES

3.1. Tube Size Selection

There are four standard sizes of AP-2000 designed for installation onto specific pipe diameters.

AP-2000 Standard Sizes	Pipe Outside Diameter (OD) (mm)
AP-2000-6-0	4.8
AP-2000-8-0	6.4
AP-2000-10-0	8.0
AP-2000-15-0	10.0

The AP-2000 tubing are intended for installation onto straight pipe lengths prior to the pipe bending operation.

Other pipe diameters can be protected using AP-2000. However, the heat shrink tubing size must not be selected without suitable guidance from TE Connectivity.

The standard AP-2000 sizes for specific pipe diameters have been deliberately designed to minimise the difference between the expanded cut length and the installed (after heating) recovered length of the tubing, commonly known as the longitudinal shrinkage.

Where installed length tolerances of the AP-2000 are critical, a knowledge of the longitudinal shrinkage becomes very important and initial trials may be required to select the appropriate cut length.

3.2. Cutting Procedures

It is of paramount importance to have suitable cutting equipment capable of producing a clean-cut tubing edge which ultimately reduces the risk of the tube splitting during installation.

Recommendations on suitable equipment can be provided by TE Connectivity.

To minimize problems with cut length, installed length tolerance and tube splitting, the cut angle should not exceed 5°. Ideally a straight edge, i.e., angle 0°, should be the aim.

The ancillary equipment required to feed the AP-2000 into the cutting blade must be capable of pulling the AP-2000 from the standard 36" diameter reels on which it is supplied, without stretching the tubing and without slippage. The AP-2000 must be introduced to the cutter blade as flat and straight as possible, i.e., not curved, to obtain the ideal cut edge and angle.

A belt conveyor may also be necessary to transport the cut product away from the cutting unit, especially if production throughput is high.

3.3. Installation Equipment

There are no standard installation heat and time conditions for the AP-2000 products as the type of heating equipment can vary from one end user to another. Recommendations on suitable equipment can be provided by TE Connectivity.

As with all heat shrink tubing, temperature and time are the critical conditions. Generally, AP-2000 can be installed using conveyor belt type ovens where the heaters are mounted above and below a mesh belt. However, the following general recommendations can be made for installers of AP-2000 onto pipes.

- The heater area should be at least 2 meters in length for production use and each heater should have its own temperature control.

- The heaters should be capable of achieving a pipe internal bore temperature of approximately 150°C -160°C. It is recommended that these temperature checks are performed prior to production to enable the temperature and time conditions to be accurately set.
- Care must be taken not to overheat the pipe end fittings as this could result in destruction of the plating (if any) on the fitting.
- A loading area for the belt ahead of the heater should be provided for ease of processing.
- A cooling process after installation of the heat shrink tubing should be provided.
- The belt speed should be variable
- Wire mesh belts should be coated with PTFE to minimize surface indentation on the installed product.
- When the production line has been organized and the installation conditions set, allow the equipment time to reach steady temperature (as recommended by equipment supplier)

3.4. Installation Procedure

The pre-production trials required when establishing the ideal heat and time conditions for the AP-2000 should be aimed at achieving full recovery of the product along its entire length.

It would also be useful at this stage to identify the upper and lower limits of temperature and time control required to achieve a quality installation.

For the temperature measurements a thermocouple probe can be placed inside of the pipe ensuring its contact with the pipe wall followed by installation of the AP-2000 onto the outside diameter of the pipe. This technique gives a good indication of the adhesive bondline temperature (ideally 150°C - 160°C).

During the heating process the following principles should be applied.

- The AP-2000 tubing must be recovered onto the pipe starting at one end and moving along the pipe length. Failure to gradually install the AP-2000 in this way can cause air entrapment and uneven shrinkage.
- The AP-2000 should ideally be heated from opposing sides of the pipe.
- The pipe ends should be deburred prior to positioning of the AP-2000, and pipe surfaces must be thoroughly cleaned from oil, grease, water, and other contaminants. This is important to minimise damage to the AP-2000 and poor adhesion to the pipe.
- The pipes should be supported at both ends such that the AP-2000 recovers in free space and is not in contact with the conveyor belt meshing. This may cause surface imperfections.

3.5. Quality Procedures - Visual

As a routine check the AP-2000 tubing should be visually analysed for full recovery onto the pipe along its entire length, ensuring the installed AP-2000 is free from surface imperfections, i.e., blisters, indentations, scratch marks, unrecovered areas.