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DVS – DEUTSCHER VERBAND FÜR SCHWEISSEN UND VERWANDTE VERFAHREN E.V.

Adhesive bonding of pipes and fittings made of thermoplastics – Chlorinated polyvinyl chloride (PVC-C)

Technical Code DVS 2204-5

Replaces November 2003 issue as well as Supplement 1 and Supplement 2 from December 2003

Contents:

1 Scope

This guideline applies to the bonding of pipes and pipeline components made from chlorinated polyvinyl chloride (PVC-C) in accordance with the standards DIN 8079, DIN 8080, DIN 16832 et seq., DIN EN 1566-1, DIN EN ISO 15493 and DIN EN ISO 15877.

2 Material

The material is chlorinated polyvinyl chloride (homopolymer) that is free from plasticisers and impact-resistant compounds. The compounds are characterised by a high impact strength. The material is used as a semi-finished product in the form of pipes, moulded parts, fittings, sheets and profile sections. PVC-C has a heat resistance of 80°C in pressurised pipeline systems. The adhesion properties can be checked by means of a visual inspection of the components' bonding surfaces in accordance with Guideline DVS® 2221 (Section 4.3.3 et seq. – Visual inspection).

3 Adhesives

Due to the good solubility characteristics of the material, polyvinyl chloride is generally bonded using solvent adhesives. The solvents diffuse into the joint surfaces, trigger molecular movements and, after their escape, result in solid and durable connections between the joining parts.

Although it is possible to use other bonding systems, e.g. reactive adhesives, this guideline concerns itself with the use of adhesives containing solvents that are based on high performance solvents.

Adhesives containing solvents for the specified materials are solutions of PVC-C in organic solvents based on tetrahydrofuran, cyclohexanone, methyl ethyl ketone and other strong solvents. By selecting the appropriate solvents, optimal partial solution of the bonding surfaces, defined open time and a setting rate that is suited to processing can be achieved. In order to obtain certain characteristics, additives such as stabilisers, thickening agents, agents to modify impact strength and coloured pigments are incorporated. In the event of incorrect use of solvent adhesives, for example application of too much adhesive, the structure of the plastics may suffer serious damage in certain cases. In particular, significant changes to the strength properties can result in bonds to parts subject to high mechanical stresses, and stress cracks may form. High residual stresses, for example those on injection-moulded or heat-moulded parts, promote these processes to a particularly great extent.

Particular attention should be paid to the fact that only adhesives that the manufacturer intended for bonding pipes and fittings made from chlorinated polyvinyl chloride and declared accordingly may be used. Adhesives that are used in the field of PVC-C pressurised pipes must comply with DIN EN 14814.

When using solvent adhesives, bonding must take place "wet-in-wet", i.e. the joining parts must be joined immediately after applying the adhesive, during the open time (processing period).

Key features of these bonding systems: short waiting time, rapid setting. The hardened adhesive-bonded joint (see manufacturer's specifications) have similar mechanical and thermal stability and similar chemical resistance, to the materials themselves.

When choosing the adhesive, the following points must be considered:

– Dimensions and tolerances
– Mechanical and thermal loads
– Impact of media

4 Requirements on adhesives

The adhesives must make it possible to create connections of PVC-C pipes and fittings in line with the requirements arising from the intended use of the pipeline. These requirements include, among other things, storage duration, strength behaviour, temperature resistance, resistance to chemicals and the necessary hygiene characteristics for use in contact with foodstuffs/drinking water. These requirements are defined in the various guidelines and directives. Enquiries must be made to the adhesive manufacturer and/or semi-finished product manufacturer to determine the chemical resistance of adhesive-bonded joints, i.e. when using concentrated inorganic acids. During processing, adhesives may not cause any damage to health, in compliance with the Occupational Exposure Limit.

DVS, Technical Committee, Working Group "Joining of Plastics"

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5 Labelling of adhesive containers

In addition to the information required by law, the adhesive containers must be labelled with the following information as a minimum:

- Name of the adhesive
- Name of the manufacturer or supplier
- Reference to the relevant adhesive standard
- Field of application
- List of standards applicable to thermoplastic pipeline systems for which the adhesive is suitable
- CE label with information on the pressure class in line with the standards, e.g. DIN EN 14814
- Instructions for usage and storage
- Safety precautions regarding use and storage
- Batch number
- Date of manufacture or expiry, stating the minimum shelf life of at least 12 months.

6 Shelf life of adhesives

The shelf life of an adhesive is understood as the time period during which the adhesive, in as yet unopened containers, following storage in line with the specified storage conditions (manufacturer's instructions), can be worked without problems.

The adhesives must have sufficient shelf life when stored normally (at least 12 months). The shelf life is not only dependent on the composition of the adhesive, but also on the type of packaging and other external influences, above all the storage temperature. The adhesive manufacturer guarantees a minimum shelf life in its technical documentation.

Irrespective of this, the person carrying out the processing must always check the workability of the adhesive.

7 Bonding instructions

All adhesives and adhesive systems have specific working conditions. As a result, it is only possible to provide information that is generally applicable here.

The adhesives and corresponding cleaning agents are supplied by the manufacturers or pipe system providers in ready-to-use condition. Usage quantities can be found in the technical leaflets or requested from the manufacturer. Thinning and other changes are not permitted. This also applies to the cleaning agents. As a matter of principle, the bonding instructions supplied by the adhesive or pipe system manufacturer must be observed. The pipes and fittings must be dry, and free from grease and contamination. The adhesive must be examined to ensure it is workable. After stirring, it must run off a bar held at an angle in an even manner, without any lumps.

Bonding should only take place at working temperatures between 5°C and 40°C. In the event of deviations, these working temperatures must be created by additional suitable measures. At higher temperatures and/or lower thicknesses of adhesive film, the open time of the adhesives is reduced. The open time is the period between application of the adhesive and joining the parts.

In general, the following procedure is used to attain the optimal adhesive-bonded joint:

- The dimensional accuracy of pipes and fittings must be checked.
- The pipes to be bonded are cut to the required length.
- The pipes are cut at a right angle to the pipe axis.
- The pipe ends are chamfered on the outside using an angle of approximately 15° (see Figure 1 and Table 1), and deburred on the inside.

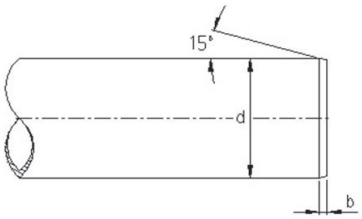

Figure 1. PVC-C pipe-fitting measurement b.

Table 1. PVC-C pipe-fittings – Stipulations for measurement b.

Pipe outside diameter [mm]	Approx. measurement for b [mm]
up to 16	1 to 2
20 to 50	2 to 3
63 to 225	3 to 6

The insertion depth of the sleeve is marked on the pipe end, so that the required application of adhesive and complete insertion of the pipe in the sleeve can be checked.

The bonding surfaces on the pipe end and in the sleeve of the fittings are cleaned thoroughly. For this, clean, unused, absorbent, lint-free and non-staining paper is used, together with the cleaning agent prescribed by the manufacturer of the adhesive or pipe system. The paper must be replaced after each cleaning operation.

The cleaned bonding surfaces must be dried prior to the application of adhesive, and must not be touched again.

Prior to use of the adhesive, it must be examined to ensure it is workable. The adhesive is applied evenly over the whole surface in the joint area within the sleeve and on the pipe, using a suitably-sized brush (see manufacturer's specifications and recommendations).

Immediately after application of the adhesive, the pipe is inserted into the sleeve, without twisting or tilting, as far as the marking. It is aligned if necessary and fixed in place there for a few seconds. An even excess of adhesive on the outside and a small complete ring of adhesive within the pipe indicate that bonding has taken place over the whole surface.

Excess adhesive is immediately removed with paper so that a small fillet forms on the outside of the pipe.

The bond location must not be mechanically loaded during the waiting time until further processing takes place. The duration of the waiting time depends on the bonding system, the pipe diameter and the working temperature. It must be taken from the adhesive manufacturer's information. The same applies for the setting time, leading up to the pressure test. During the drying phase the lines must not be sealed. Accumulations of adhesive in the joint area are to be avoided.

With larger dimensions, from d200/d225 upwards, the special instructions of the adhesive and component suppliers must be observed.

8 Testing of adhesives

The following section provides an overview of the test procedures that exist for adhesives. The tests are carried out by the adhesive manufacturers.