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Industrial piping made of thermoplastics Design and execution Above-ground pipe systems Recommendations for the internal pressure and leak tests

DVS
Technical Code
DVS 2210-1
Supplement 2

Contents:

1 Scope of application

The DVS 2210-1 technical code includes fundamentals for the design, calculation, prefabrication and assembly of industrial piping made of thermoplastics and laid above ground.

Section 7 of the technical code deals with tests, inspections and acceptances, including the **internal pressure test** on the completed pipe system. For reasons explained in greater detail in **Section 2** below, it has been decided to refer to the internal pressure testing of thermoplastic pipe systems in a separate supplement. The whole scope of Section 7.5 of the DVS 2210-1 technical code is being replaced with the publication of the DVS 2210-1 technical code, Supplement 2.

The scope of application of the internal pressure test recommendations given in Supplement 2 can also be transferred to those areas of application and materials that are not expressly listed in Section 1.1 or 1.2 of DVS 2210-1.

Buried piping that is made of thermoplastics and whose joints can be inspected visually during the test can be included in the scope of application. If the testing of buried piping is subject to other rules or regulations, exclusively these must be applied (e.g. DIN 1988-2).

If the scope of application is extended, the user must ensure that the recommendations made in the DVS 2210-1 technical code and in Supplement 2 are taken into appropriate consideration. The recommendations for carrying out an internal pressure test according to Supplement 2 do not exclude the application of other technical codes, guidelines, standards and similar documents or any modified testing conditions.

2 Explanations

With the introduction of the SDR classification for thermoplastic pipes, which is intended to replace the nominal pressure ratings [PN], a reference variable that is different from the reference variable specified in DVS 2210-1, Table 7 must be chosen for determining the test pressure.

Another reason for modifying the former approach is the fact that pipes made of thermoplastics with restricted temperature resistance may be subjected to excessive stresses for a short time, which may even lead to a reduction of the service life if the pipe wall temperature $T_R = 20°C$ is exceeded by more than 5°C during the internal pressure test, depending on the nominal pressure.

DVS Working Group AG W 4.3a proposes the stipulation of a test pressure which is regulated according to SDR and depends on the pipe wall temperature and the strength parameter $\sigma_{V(T)}$ at 100 h. As the pipe wall temperature increases, the test pressure must also be reduced in such a way that a constant safety margin to the creep strength $\sigma_{V(T,100h)}$ is maintained.

Since not all thermoplastic pipes have an SDR classification, the value of d_a/s (≈ SDR ratio) is chosen as the reference variable for determining the test pressure.

During the execution of a temperature-influenced internal pressure test, as well as the internal pressures determined for the maximum temperature, variable internal pressures can be used.

For pipes that are laid outside buildings, either above ground or not buried, the internal pressure test may be carried out at an early or late time of the day in order to reduce the influence of temperature.

When determining the permissible testing pressure, attention must be paid not only to the influence of temperature but also to the load-bearing capacity of fittings, valves or measuring components.

Piping that contains components with a load-bearing capacity lower than that of the pipe may only be subjected to loads up to the level of the internal pressure specified by the manufacturer. If necessary, the components with a lower load-bearing capacity must be removed during the internal pressure test.

3 Details about the internal pressure test

The internal pressure test forms the conclusion to the pipe laying work and requires a ready-to-operate pipe system or ready-to-operate sections for testing. The stresses resulting from the test pressure should constitute the experimental proof of the operational safety of the system. In this respect, emphasis should not be placed on the calculated operating overpressure but instead on the internal pressure capacity originating from the pipe wall thickness.

The recommendations for carrying out the internal pressure test are according to DVS 2210 ff. Table 1 includes a summary which is intended to provide the essential key data of the test. The specified test durations are based on empirical values, which take account of both the practical requirements and the efficiency of the test.

3.1 Preliminary test

The preliminary test serves to prepare the piping system for the actual test (main test). A stress-strain equilibrium, generated by the internal pressure loads, arises during the preliminary test. This leads to a material-dependent pressure drop that requires the repeated addition of water (repumping) in order to restore the test pressure as well as the frequent retightening of the flanged joint screws.

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Table 1. Recommendations for carrying out an internal pressure test.

Subject with explanations		Preliminary test	Main test	Short-term test
Test pressure p_P (see Section 7)	Depending on the pipe wall temperature or the permissible testing pressure of the installed parts	$\leq p_{P(zul)}$	$\leq 0.85 \cdot p_{P(zul)}$	$\leq 1.1 \cdot p_{P(zul)}$
Test duration (see also Section 7.5)	Piping **with** or **without** branches and a total length, ges L ≤ 100 m *1)*	≥ 3 h	≥ 3 h	≥ 1 h
	Piping **with** or **without** branches and a total length 100 m < ges L ≤ 500 m	≥ 6 h	≥ 6 h	≥ 3 h
	Piping **with** or **without** branches and a total length, ges L > 500 m	The pipe system must be checked section by section. In this respect, it is necessary to comply with the test length $L_{Prüf} \leq 500$ m *1)*		
		≥ 6 h	≥ 6 h	≥ 3 h
Inspections during the test (see also Section 7.4)	The inspection results, as well as the pressure and temperature changes during the test, must be documented in a test report	≥ 3 inspections carried out over the test duration **with** restoration of the test pressure	≥ 2 inspections carried out over the test duration **without** restoration of the test pressure	≥ 1 inspection **while** keeping the test pressure constant
Material-specific pressure drop	Reference values, depending on the elastic modulus of the plastic concerned	PE: ≤ 1.0 bar/h	PE: ≤ 0.5 bar/h	No values for the pressure drop are available for short term loads
		PP *2)*	PP *2)*	
		PVC *2)*	PVC *2)*	
		PVDF *2)*	PVDF *2)*	
Remarks: *1) If ges L exceeds the stipulated limiting length by no more than 10 %, the specified testing conditions may be retained.* *For further remarks, see the footnote on Page 8.* *2) See the explanations in the footnotes on Page 8.*		**Normal case** (In relation to the specified duration of the preliminary and main tests)		**Special case** (Consent of the customer or operator required)

3.2 Main test

The main test immediately follows the preliminary test. During the main test, a substantially lower pressure drop may be expected at an approximately constant pipe wall temperature.

In most cases, this makes it unnecessary to add any water to restore the test pressure. The inspections may essentially concentrate on the leak-tightness of the flanged joints and on any conspicuous features in the pipe system (e.g. major position changes).

3.3 Short-term test

The short-term test represents a special case since, according to general experience, no stress-strain equilibrium can arise in the available time. In certain circumstances, imperfections at the joints may not be detected due to the short-term loads, which contradicts the point of the test. The short-term test should therefore only be used for pipe systems that do not have a hazard potential.

3.4 Preparation of the internal pressure test

A prerequisite for the internal pressure test on plastic piping is the elimination of any air bubbles (residual air volume) in the system before the preliminary test. To accomplish this, venting points, which must be open during the rinsing or filling of the line, must be provided, if at all possible, at all the high points of the pipe system. The rinsing speed should be at least 1.0 m/s.

3.4.1 Filling of the line

The pipe system is filled from the geodetically lowest point. The filling rate must be set such that the air emerging at the high points has time to escape. Reference values for the filling rate are given in the following table.

Table 2. Reference values for filling the line

DN	V [l/s]	DN	V [l/s]
≤ 80	0.15	250	2.0
100	0.3	300	3.0
150	0.7	400	6.0
200	1.2	500	9.0

If a pipe system has several low points it may be necessary, in certain circumstances, to fill it section by section from each individual low point.

Between filling and testing the pipe system, enough time must be left for the air in the system to escape via the venting points (guide time: ≥ 6 min, depending on the nominal pipe diameter.

In the case of piping laid with less than DN 150 which does not have any definite high points and is laid with only a slight inclination, it may be necessary to use a pig to eliminate any air bubbles remaining inside the pipe.

3.4.2 Application of the test pressure

When applying the test pressure up to its maximum value, it must be ensured that the chosen pressure rise rate does not cause any damage in the pipe system to be tested. Guide values for this are given in Fig. 1.

4 Facilities for, and remarks about, the execution of the internal pressure test

It is advisable to use motor-driven pumps for carrying out the internal pressure test. The use of small manually-actuated pumps (e.g. piston pump) must be restricted to short pipe sections with nominal diameters up to DN 50.