EADIPS® FGR®

European Association for Ductile Iron Pipe Systems

Fachgemeinschaft Guss-Rohrsysteme

EADIPS®/FGR® STANDARD 2017-02

Ductile iron pipes

Push-in joints for ductile iron pipe systems – Root resistance – Requirements and test methods

EADIPS®/FGR® 76

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1. Foreword

The undesired penetration of tree roots into push-in joints

- causes obstacles to flow with the resulting risks of blockages and backing-up,
- causes leakage in sewage systems with the hazards to the soil and groundwater which this entails,
- leads to high, recurring costs for root removal,
- makes the replacement or renovation of the section of sewage or drainage system affected necessary.

In this case, even after replacement or renovation, the cause often remains in effect – namely the close proximity of the tree with the route of the drainage and sewage system. Therefore root-resistant pipe systems should be used when laying new drainage and sewage systems and replacing existing ones.

2. Scope

The present EADIPS/FGR standard 76 is applicable for diffusion-tight pipes, accessories and fittings in ductile cast iron to EN 598. In the context of the tests described here, a standardised test method for plastic pipes is adjusted to the characteristics of push-in joints for ductile iron pipe systems.

3. Normative references

DIN 4060: Pipe joints of sewage and drainage systems with elastomer seals – Requirements and testing for pipe joints containing elastomer seals. 2016-07

DIN 28603: Ductile iron pipes and fittings – Push-in joints - Survey, sockets and gaskets, 2002-05

EN 14741: Thermoplastic piping and ducting systems – Joints for buried, non-pressure applications – Test method for the long-term sealing performance of joints with elastomer seals by estimating the sealing pressure; 2006-05

DVGW GW 125: DVGW data sheet GW 125 Trees, underground pipelines and sewers (same text as DWA-M 162 and FGSV no. 939) 2013-02

EN 598: Ductile iron pipes, fittings, accessories and their joints for sewerage applications – Requirements and test methods; English version EN 598:2007+A1:2009-10

4. Requirement for the level of contact pressure of the gasket in push-in joints according to DIN 28603

The level of the contact pressure of the gasket between the sealing surfaces of socket and spigot end is determined on the non-loaded side of a aligned mounted push-in joint loaded with a shear force of 3 x DN [N]. When this is extrapolated over 100 years, the contact pressure should be at least 7 bars.

5. Test method

The test method simulates the penetration of a root tip into the sealing gap which is sealed to be pressure-tight with a compressed rubber gasket.
The compressed gasket clamps four PTFE tubes (PTFE - polytetrafluorethylene) to the sealing surface so that this assembly is gas-tight. PTFE tubes which meet the following points are used (see EN 14741, Section 5.5):

- they are suitable for sustaining at least 10 bars;
- the overall thickness of the flattened PTFE tube, measured in the centre of the specimen at two different points vertical to each other, must be between 0.16 mm and 0.24 mm;
- the overall width of the flattened tube must be between 6 mm and 10 mm.

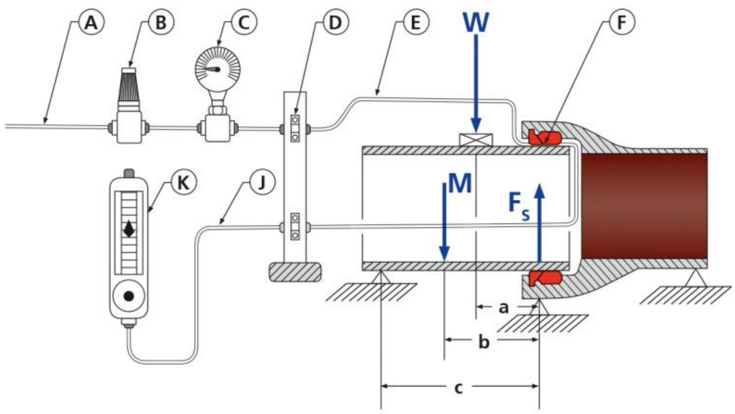
The gas pressure in the PTFE tubes is raised after increasingly long periods of time until a passage of air of 120 ml/min is reached in one of the tubes.

5.1 Preparation of the specimen

The tests are carried out on a representative basis for the DN groups of push-in joints described in EN 598: DN 200, DN 400 and DN 800. The push-in joints to be tested, each consisting of a section of pipe or fitting with a spigot end and a section of pipe or fitting with a socket, are to be selected in such a way that, in the installed condition, they offer the maximum joint annulus according to EN 598. The maximum dimension of the socket and the minimum dimension of the spigot end can be found in DIN 28603. Hence components with minimal spigot end external diameters and components with maximal socket internal diameters are to be selected for testing. In order to compensate for the effect of the thickness of the means of measurement (PTFE tube), the diameter of the spigot end is to be reduced by the thickness of the means of measurement before the test.

5.2 Performing the test

Four PTFE tubes are positioned on the non-loaded side of a aligned mounted joint loaded with a shear force between the gasket and the surface of the spigot end (Figure 1) at 0°, 45° and 90°, 300° (see Figure 2).



Key:

A Source of N_2 or air (purified)
B Pressure regulator
C Manometer
D Joint
E PTFE tube
F Position of the PTFE tube in the joint
J Connection tube
K Flow meter

M Total pipe weight [N]
W Shear load [N]
F_S Shear force [N] = 3 x DN [N]

Figure 1: Test equipment with specimen

The joint to be tested is mounted with its axis lying horizontally. The shear force F is applied vertically to the joint (see Figure 1) and is dependent on the nominal diameter. It is calculated according to the formula 3 x DN [N]. So that the shear force is applied at the height of 3 x DN in the joint, the test equipment shown in Figure 1 is loaded with a shear load W. The level of shear load W is calculated using the formula shown below from the shear force F and the mass M of the pipe and the testing geometry of the test equipment:

$$W = \frac{F \times c - M(c - b)}{c - a}$$

Shear load W is introduced into the joint system via a V-shaped support with an opening angle of 120° (± 10°). The distance between the central point of application of the shear load W and the front of the socket is about 0.5 x DN in millimetres or 200 mm (the higher value is to be selected).

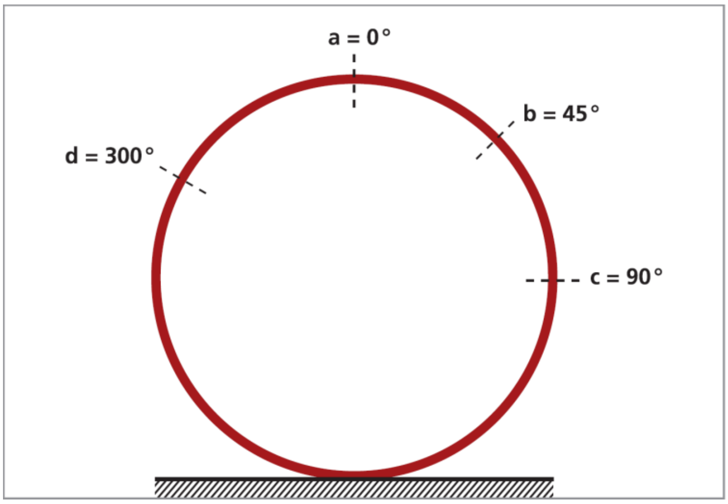


Figure 2: Arrangement of PTFE test tubes

The pressure p of nitrogen or air required for a gas flow rate of 120 ml/min is measured and held at the specified time intervals.

The measurement values read off for the opening pressure p_t are documented after 24 hrs,168 hrs, 336 hrs, 504 hrs, 600 hrs, 696 hrs, 862 hrs, 1008 hrs, 1392 hrs and 2000 hrs. The entire test equipment is to be kept at a constant room temperature of 23 °C ± 2 °C.

5.3 Evaluation and representation of test results

Using the extrapolated regression curve of p_t, the opening pressure after 100 years can be determined. The gradient of the straight line is represented with a logarithmic timeline and determined by means of linear regression. The opening pressure for a time of 100 years is to be stated.

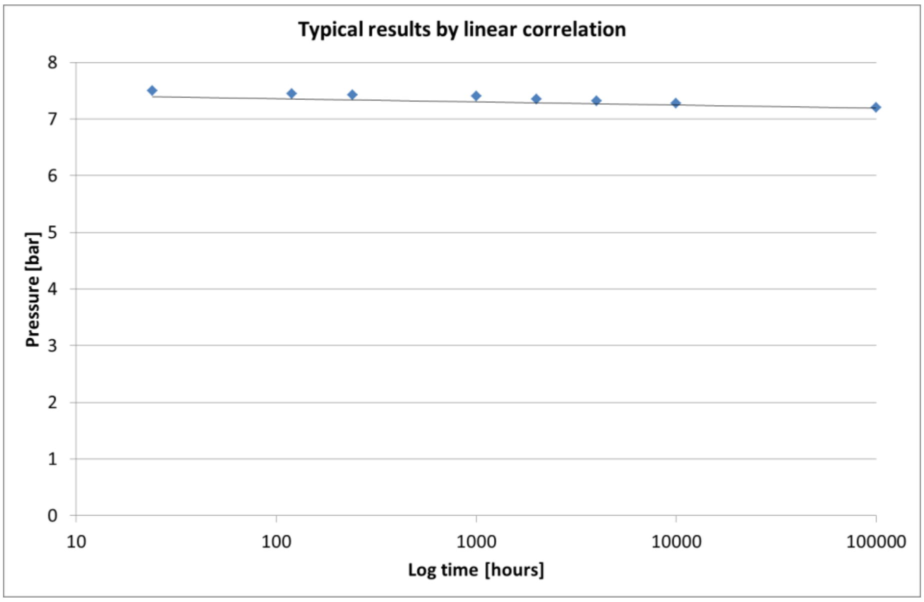


Fig. 2 – Extrapolation of measurement values for the opening pressure (example)

Root resistance is said to have been achieved if the requirements in Chapter 4 are met.

Annex

Influences on the root resistance of connected pipe joints

Evidence of the root resistance of push-in joints has long been a requirement in standards for pipe systems for wastewater transport. Here it was assumed in the past that small leakages induced the roots to grow in the direction of the water in the pipeline (hydrotropism). It is only more recent investigations that have shown that roots can also penetrate into joints which are tight according to standard (DIN 4060) and the growth characteristics of roots in the area of pipelines need to be taken into account when establishing root resistance.
This was first described in the set of rules produced jointly by DWA (M 162), DVGW (GW 125) and FGSV (no. 939) as follows:

Roots can grow not only into leaky pipes and pipe joints, but also into tight pipe joints which do not offer sufficient resistance to the roots.

The “sufficient resistance” of the pipe joint is not described any further in these identical texts and no limit values are defined for those parameters which influence the sufficient resistance.
Relevant influencing factors are the supply of oxygen to the roots along the pipe and in the area of the pipe joints and the contact pressure and width of the sealing surface between elastomer seal and pipe material.
Pipes and pipe joints to EN 598 are demonstrably diffusion-tight. This means that a supply of oxygen to the roots through the pipe system can be excluded. Therefore, sufficient resistance to root penetration for ductile iron pipe systems can be described as follows:

If the contact pressure between the elastomer seal and the spigot end of a push-in joint is greater than the average growth pressure of the root tip and if the width of the sealing surface is large enough to cut the root tip off from the oxygen available in the pore space of the soil, then sufficient resistance against root penetration is substantiated and the push-in joint is described as being root-resistant.

This viewpoint is supported by many years of practical experience on the part of network operators who use e.g. ductile iron pipe systems for the replacement of pipelines damaged by roots as well as by independent scientific investigations and tests on push-in joints. In tests[1] evidence was able to be provided of e.g. contact pressures of more than 20 bars (TYTON®).

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[1] Stützel, Th. et. al.: Wurzeleinwuchs in Abwasserleitungen und Kanäle “Ergänzungsvorhaben”; final research report June 2007, sponsored by the Ministry for the Environment and Conservation, Agriculture and Consumer Protection of North Rhine Westphalia; download: https://www.lanuv.nrw.de/landesamt/forschungsvorhaben/details/?tx_mmkresearchprojects_pi1%5Buid%5D=141