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DWA
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DWA Set of Rules

Standard DWA-A 161E

Static Calculation of Jacking Pipes

March 2014, corrected version October 2017

Statische Berechnung von Vortriebsrohren
März 2014, korrigierte Fassung Oktober 2017

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The content of the Standard DWA-A 161 and the DVGW code of practice GW 312 is identical.

The German Association for Water, Wastewater and Waste (DWA) is strongly committed to the development of secure and sustainable water and waste management. As a politically and economically independent organisation it is professionally active in the field of water management, wastewater, waste and soil protection.

In Europe DWA is the association with the largest number of members within this field. Therefore, it takes on a unique position in connection with professional competence regarding standardisation, professional training and information. The approximately 14,000 members represent specialists and executives from municipalities, universities, engineering offices, authorities and companies.

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Foreword

With the second edition of this Standard, the Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (German Association for Water, Wastewater and Waste, or DWA for short) and the Deutsche Verein des Gas- und Wasserfaches e. V. (German Association of Gas and Water, or DVGW for short) provide recommendations for devising the structural calculation of jacking pipes. For pipes installed using an open-cut method of construction, the relevant standards and regulations are referred to (e.g. Standard ATV-DVWK-A 127).

The soil mechanics model concepts used in practice up until now have been assessed and adapted to the current state of knowledge. This has resulted in new load models and their effects on jacking pipe calculations. However, not all possible special cases could be recorded that might necessitate further or restricting actions.

Since the appearance of the first edition from January 1990, significant progress has been documented in the trenchless installation of pipes, which is reflected in the revised version of the DWA-A 125/DVGW GW 304 code of practice in tandem with DIN EN 12889. The steerable and non-steerable jacking methods defined there require a differentiated approach to the structural calculation of pipes, made from different types of materials, which also touches on issues of soil mechanics.

Furthermore, the parameters of this Standard have been obtained over the course of several years based on standards and other sources which have now been updated or replaced in some way. This must be considered if the bases of the specific values and calculation methods are to be investigated. It is the user's responsibility to take appropriate account of the particular circumstances of specific cases, important changes to standards and technology and newer discoveries.

Changes

In particular, the following changes have been made from Standard ATV-A 161:1990-01 and advisory leaflet DVGW GW 312:1990-01:

a) Plastics have also been included as piping materials.

b) Authoritative load conditions (influences) have been specified in detail for the steerable and non-steerable processes mentioned in Standard DWA-A 125/DVGW GW 304.

c) The determining of soil characteristics for loose and solid rock has been revised. For adjusting the soil characteristics of a geotechnical report to a particular jacking situation, factors are specified as reference values. Soil characteristics and soil mechanics characteristics, with which soil load continues to be determined according to the silo model, are specified as reference values based on the density and consistency of the soil.

d) To describe the load scenarios, Standard ATV-DVWK-A 127 has been adapted.

e) The minimum cutting force measurement for considering driving forces (previously only controlled for straight-line jacking) has been expanded for curving.

f) Additionally, minimum values for wall thickness/radius ratios have been specified.

g) For the permitted axial forces during jacking, equations were also developed for bending routes, which take account of steering movements and permitted tolerances for the perpendicularity of the pipes' abutting faces.

h) For the pressure transfer rings, recommendations for determining compressive stress/compression behaviour under cyclical loads and typical values for the elasticity moduli of the pressure transfer rings have been specified.

i) For jacking pipes in the solid rock and transition area (loose rock / solid rock), information has been provided for loads transverse to the pipe's axis and the abutment of the pipe.

j) Point loads can occur depending on the type of soil or method of installation. No specific assumptions, mechanical models or influences were specified for point loads. Special considerations should be employed for these as required.

k) For fluid-filled pressure transfer rings the requisite verifications have been compiled.

l) The stability verifications for pipes in a transverse direction have been adapted to the specifications in Standard ATV-DVWK-A 127 with simplifications and supplemented with the verification in an axial direction.

m) The verification of equivalent stress has been expanded for anisotropic materials with different tensile and compressive strengths.

n) The measuring tables for steel pipes have not been kept.

o) The verification against fatigue under loads that are not predominantly static has been revised.

p) Compressive and tensile force-locking connections have been included.

q) The Standard has been adapted to meet the partial safety concept.

r) The horizontal part has been considered for traffic loads.

s) DIN technical report 101 has been taken as a basis for road traffic loads. The previous road traffic loads SLW60, SLW30 and LKW12 do not apply.

t) Dynamic impact coefficients have been specified for rail transport loads (LM 71) in accordance with DIN technical report 101.

u) For the fatigue verification under loads that are not predominantly static, the dynamic stress component may be calculated taking account of the horizontal soil pressure from traffic. The permitted fluctuation range $2\sigma_A$ must be determined for each material using S-N curves. For rail transport loads, the permitted range of fluctuation $2\sigma_A$ must be determined for 1×10^8 load cycles and for 2×10^6 load cycles for other transport loads.

The DWA working group ES-5.5 'Structural Analysis of Drainage Systems – Open Construction Methods' is currently devising a separate standard, DWA-A 127-10, in which the parameters of piping materials for the structural analysis of drains and sewers are defined. Until this Standard appears, Appendix A of this Standard continues to apply. Until Standard DWA-A 127-10 is released, users of this Standard must check whether the stated material parameters are appropriate in each case.

Note

The user is provided with sample calculations for download free of charge on the DWA website in a secure user area ('DWAdirect') at: <http://www.dwa.de/dwadirekt>. You can reach the secure user area by entering your username and password. If you are not yet registered, you can request your authorisation code using the specified link, which will then be sent to you via email.

Earlier editions

Standard ATV-A 161:1990-01 and Advisory Leaflet DVGW GW 312:1990-01

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User Notes

This Standard has been produced by a group of technical, scientific and economic experts, working in an honorary capacity and applying the rules and procedures of the DWA and the Standard DWA-A 400. Based on judicial precedent, there exists an actual presumption that this document is textually and technically correct and also generally recognised.

Any party is free to make use of this Standard. However, the application of its contents may also be made an obligation under the terms of legal or administrative regulations, or of a contract, or for some other legal reason.

This Standard is an important, but not the sole, source of information for solutions to technical problems. Applying information given here does not relieve the user of responsibility for his own actions or for correctly applying this information in specific cases. This holds true in particular when it comes to respecting the margins laid down in this Standard.

1 Scope

This Standard applies to the structural calculation of pipes with a circular cross-section which are installed according to the pipe jacking method in a straight or bending direction in non-cohesive or cohesive soils (loose soils as per DIN 18319) with static force in accordance with Standard DWA-A 125/DVGW GW 304. It also applies to jacking that is done wholly or partially in solid rock, whereby special considerations shall be made.

This Standard can be applied analogously to pipes that are driven with dynamic energy. Unless otherwise mentioned in this standard, it also applies to pipe jacking using related methods with the appropriate adjustments. For pipes installed within a jacking path in an open-cut method of construction in shafts or connecting paths, Standard ATV-DVWK-A 127 applies.

2 Normative References

The following documents cited are required for using this document. With dated references, only the edition referred to applies. However, users of this section of the DWA/DVGW Set of Rules are asked to use the latest editions of the normative documents specified below in each case. For undated references, the last edition of the document referred to applies (including all changes). Listed DIN standards may be a component of the DWA/DVGW Set of Rules.[1)]

DIN CEN/TS 15223: Plastics piping systems – Valid calculation parameters of buried thermoplastic piping systems

DIN EN ISO 9967: Thermoplastic pipes – Determining deformation behaviour

DIN EN ISO 12162: Thermoplastic materials for pipes and fittings for applications under pressure – Classification, material labelling and overall service (calculation) coefficient

DIN EN 295-1: Vitrified clay pipe systems for drains and sewers – Part 1: Requirements for pipes, fittings and joints

DIN EN 295-3: Vitrified clay pipe systems for drains and sewers – Part 3: Test methods

DIN EN 295-7: Vitrified clay pipe systems for drains and sewers – Part 7: Requirements for pipes and joints for pipe jacking

DIN EN 300: Plates from long, flat, oriented strand boards (OSB) – Definitions, classifications and requirements

DIN EN 312: Particleboards – requirements

1) Dates have generally been omitted (see foreword).