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**Bore head radar for horizontal directional drilling (HDD-radar) –
Environment, conditions and limitations of use**

Bohrkopfradar für das Horizontal-Spülbohrverfahren (HDD-Radar) –
Umfeld, Bedingungen und Grenzen des Einsatzes

Radar de tête de forage pour le forage dirigé horizontal (radar FDH) –
Environnement, conditions et limitations de mise en service

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Dieses Dokument wurde durch die im Vorwort genannten Verfasser erarbeitet und verabschiedet.

Contents

	Page
Forword.....	3
Introduction	4
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
4 Process Description	10
4.1 General.....	10
4.2 Pilot drilling and obstacle avoidance	10
5 Equipment Requirements	11
5.1 General.....	11
5.2 Location	12
5.3 Accuracy of bore head location	12
5.4 Control	13
5.5 Buried obstructions to be detected	13
5.6 Size of objects to be detected	13
5.6.1 Linearly Shaped Objects	13
5.6.2 Amorphously Shaped Objects	13
5.6.3 Multiple Objects	13
5.7 Detection direction and distance	13
5.7.1 Distance	13
5.7.2 Direction	13
5.8 Data processing speed	13
5.9 Durability and compatibility requirements.....	13
5.10 Drill Rod Connectivity	14
6 Pre-Planning.....	14
6.1 General.....	14
6.2 Limitations depending on soil types and saturation	14
6.3 Utilities under Ground	14
6.4 Bore path planning	14
7 Installation	15
7.1 General.....	15
7.2 Practitioner training requirements.....	15
7.3 Installation records.....	15
7.3.1 As-Built records	15
7.3.2 Enhanced information on detected objects	15
Annex A (informative) Factors affecting HDD-radar performance	16
A.1 General.....	16
A.2 Energy absorption	16
A.3 Energy spreading.....	16
A.4 Energy scattering.....	16
Annex B (informative) Methods to determine the position of the bore head	17
A.5 General.....	17
A.6 Walkover technique	17
A.7 Wire-Cable techniques	17
Bibliography	19

Forword

This DIN SPEC has been developed according to the PAS procedure. The development of a DIN SPEC according to the PAS procedure is carried out in workshops and does not require the participation of all stakeholders.

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At present, there are no standards covering this topic.

DIN SPECs are not part of the body of German Standards.

A draft of this DIN SPEC has been published.

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Introduction

Utility services such as water, sewer, electric, gas, telephone, cable and other services to industry, business and homes are vital to the quality of life and the economic potential of society. There are over 2 million km of underground utility services in the UK alone; and each year across the world 483 000 km of underground utilities are installed at a cost of over 35 billion \$. All these buried assets will need repair or replacement over time and this activity causes disruption.

The existing methods of installing, managing and repairing underground infrastructure are costly, very disruptive to the communities that they serve, have a negative impact on the environment and are poorly integrated. These problems are further compounded by a combination of lack of knowledge of what is already installed underground in a given area, difficulty in determining the precise position of such installed utilities and plant and, therefore, very real potential for damage to existing systems and a potential danger to those working in the street or living nearby.

In Germany it has been determined that the cost of damage to buried assets caused by construction work is, at least, 200 million € per year. This damage was caused despite 93 % of the projects obtaining the best information possible prior to the commencement of the work. The majority of the damages were caused by excavation equipment and operator negligence.

Trenchless techniques, such as horizontal directional drilling (HDD), are currently used for less than 5 % of street works (with considerable variability from region to region), could, with greater use, deliver significant advantages in terms of cost and reductions in disruption.

The level of activity in underground excavation is already significant; a conservative estimate suggests that at the end of 2011, there were approximately 40 000 HDD rigs (of all sizes) in existence across the globe.

The advantages of the conventional HDD technique include:

- reduces soil disturbance and collateral damage (and rework) for roads/trees/buildings/urban and green spaces caused by the removal/replacement of spoil from excavations;
- enables a single access area to be used to install different pipes and services;
- reduces the fractures to existing rock formations;
- protects the ecosystem and adjacent areas;
- reduces emissions and air pollution due to traffic congestion/accidents;
- reduces use of non-renewable materials (e.g. sand and gravel);
- reduces the excavation and shoring costs and consequential costs due to poor installation and reinstatement;
- enhances operational safety compared to open cut techniques;
- continues to operate in different weather conditions;
- reduces traffic and landscape disruption as less space is taken by the equipment;
- ideal for sites sensitive to surface disruption such as railways, Tramways, Metro lines, heavy roadways, airport runways, golf courses, etc.;
- can drill beneath surface obstructions or ongoing site operation.

It is in relation to these problems and trends that trenchless technologies, such as horizontal directional drilling (HDD) using obstacle detection equipment will have an increasing impact. It provides a solution that is reliable, cost effective, environmentally attractive and is non-disruptive. Use of HDD technology combined with GPR (subsequently referred to as HDD-radar) offers significant benefits over conventional HDD in that it allows early detection of obstructions in the path of the drill whilst the drilling is taking place. This enables the operator to stop drilling and to plan an alternative drill path so reducing the risk of damage to other buried facilities by early identification of obstacles along the line of the drill path. The drill operator is thereby in a better position to avoid such obstacles and minimise disturbance or damage to such obstacles, be they natural (i.e. rock formations) or manmade (such as archaeological remains or utilities).

The main applications of HDD-radar include:

- Installation of telecom cables (mainly fibre-optic), water mains and sewers, gas networks, district heating schemes, surface water and highway drains;
- River, street and railway crossings, and crossing of other natural or artificial obstacles;
- Installation of horizontal filter wells, of drainages or other geotechnical applications;
- Power cable laying and cable replacement;
- In subsequent text all these services are jointly referred to as “utilities”.

The continuous development of HDD equipment, including the incorporation of radar within the bore head, has led both to improvements in the detection of buried obstacles and to the development of this standard. To ensure a consistent quality standard in the use of HDD-radar, this document sets out the requirements, quality assurance, and testing methods and summarises the requirements according to today's technical standards. To meet accepted best practice, it is necessary to implement these standards when applying HDD-radar drilling methods. This document provides the basis for specifications for the procurement of these services.

1 Scope

This DIN SPEC covers Horizontal Directional Drilling-Radar (HDD-radar) procedures based on the HDD using fluids as the drilling agent.

HDD methods are used for the trenchless installation of pipelines, ducts and cables, sewers and drains, geotechnical elements and other applications (collectively referred to in this DIN SPEC as “utilities”). To ensure a consistent quality standard during the process, this document sets out the requirements, quality assurance and testing for HDD-radar. It applies to installation and replacement of existing and new underground utilities and associated surface features necessary for the operation of underground utility infrastructure.

This DIN SPEC is for use by practitioners, such as engineers, constructors, project managers and utility owners, who are responsible for the installation or replacement underground utilities. This DIN SPEC is intended for use by those who procure trenchless technology services for the installation of utilities. This DIN SPEC will also be of interest to those involved in the specification of Trenchless Technology (TT) techniques and those choosing between TT and conventional techniques.

Utilisation of HDD methods generally consists of the following 3 steps:

- 1) Pilot drilling and obstacle avoidance;
- 2) Bore enlargement by reaming;
- 3) Insertion by pull back.

All three steps are explained in detail in the DVGW document GW 321 *“Horizontal directional drilling for gas- and water pipelines – requirements, quality assurance and inspection/ survey/audit”*. This DIN SPEC sets out the requirements for HDD-radar.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

BSI PAS 128, *Specification for underground utility detection, verification and location*

DVGW GW 315, *Hints for measures for the protection of supply plants in case of construction work*

DVGW GW 329, *Fachaufsicht und Fachpersonal für steuerbare horizontale Spülbohrverfahren — Lehr- und Prüfplan*

DVGW W 400-3, *Technische Regeln Wasserverteilungsanlagen (TRVV) — Teil 3: Betrieb und Instandhaltung*

EN 16228-3, *Drilling and foundation equipment — Safety — Part 3: Horizontal directional drilling equipment (HDD)*

EN ISO 6529, *Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

bore head

drill tip

tool that creates the bore hole and facilitates steering at the face of the bore

3.2

bore path

drilled path according to the grade and alignment tolerances specified in the bore plan

3.3

client

person or organization who has commissioned the use of HDD-radar by the practitioner

3.4

designation

act of determining the properties of buried utilities, by research, measurement or calculation

3.5

detection

use of geophysical techniques and methods to establish the presence of an underground utility and to mark its horizontal position on the ground surface

3.6

drilling fluid

mixture of water and additives, such as bentonite, polymers, designed to block the pore space on a bore wall, reduce friction in the bore, and to suspend and carry cuttings to the surface

3.7

drill rig

trenchless machine that installs pipes and cables by drilling a pilot bore to establish the location of the underground utility before enlarging the hole if needed and pulling back the product

3.8

drill rod

drill pipe, drill stem

hollow steel pipes joined to form a string used to transmit rotational torque and thrust, and to transport drilling fluid from the drill rig to the down hole tools

3.9

drill string

entire span of drill rods connected together between the drilling rig and the bore head

3.10

employer

person or organization who has commissioned the use of HDD-radar by the practitioner

3.11

employer's information requirements

EIR

pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process

[SOURCE: BSI PAS 1192-2:2013, 3.21]

3.12

geospatial

relating to or denoting data that is associated with a particular location on the earth's surface