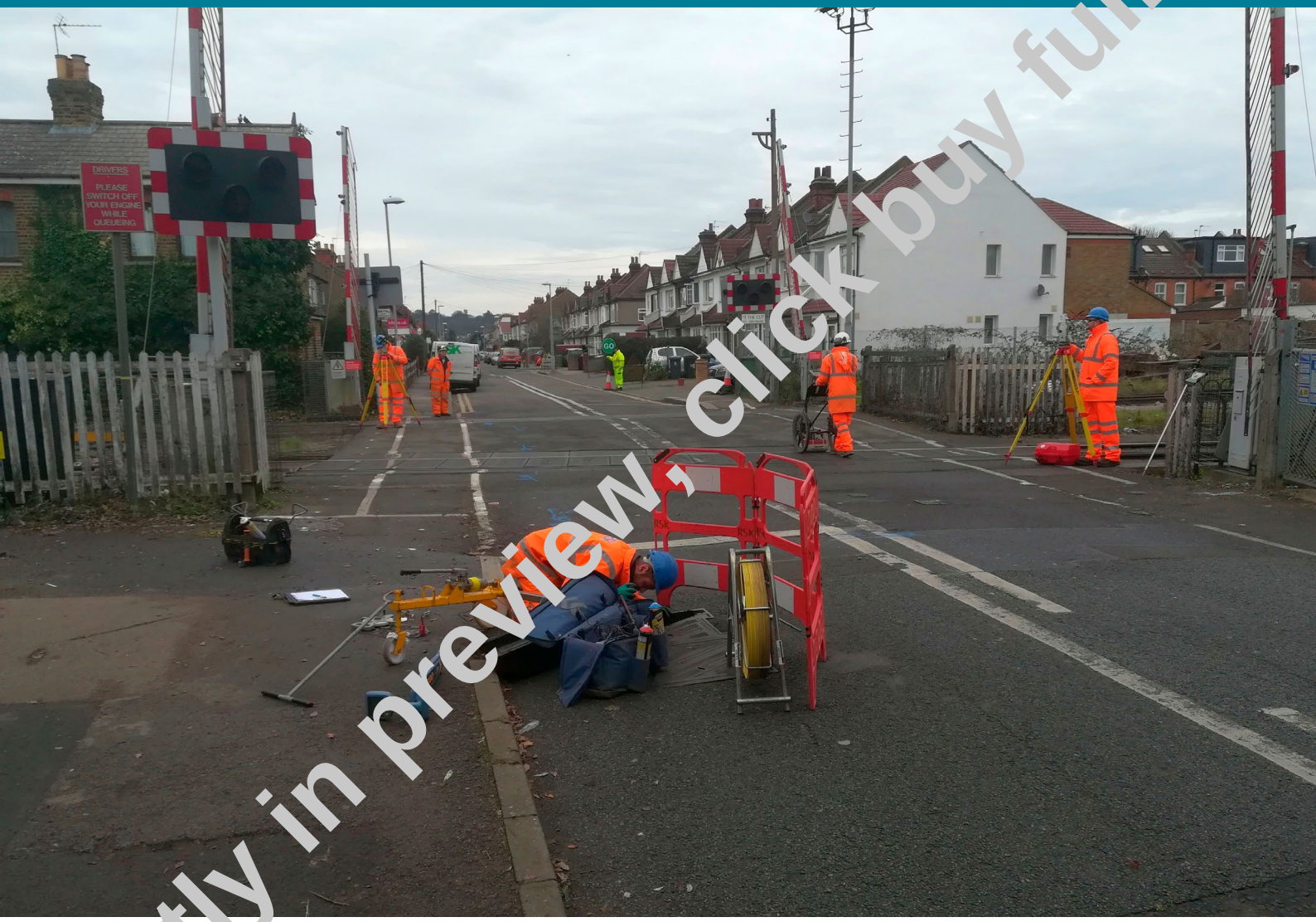
PAS 128:2022

Underground utility detection, verification and location – Specification



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Foreword

This PAS was sponsored by the Institution of Civil Engineers (ICE). Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 30 April 2022.

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- EuroGPR
- Ordnance Survey
- The Geological Society
- The Survey Association
- Transport for London
- University of Birmingham
- Co-opted members

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Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

Supersession

This PAS supersedes PAS 128:2014, which is withdrawn.

Information about this document

This is a full revision of the PAS, and introduces the following principal changes:

- addition of guidance on training and qualifications of practitioners (Clause **4**);
- updates to the application of post-processing in detection surveys (Table 2);
- new specification for buried utility detection and avoidance to support on-site permit to break ground (Annex A);
- new guidance on the accuracy of detection methods (Annex C); and
- new guidance on the technical factors that dictate the effort required for a detection survey (Annex D).

Acknowledgement is given to the following who were involved in the development of the previous edition of this PAS: Ian Bush (Black & Veatch, ICE, ICES) as the technical lead and Peter Barker (SUMO Services Ltd, The Survey Association), John Robinson (Subscan Technology Ltd) and Nick Zembillas (Subsurface Utility Engineering LLC) as the drafting panel.

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Hazard warnings

WARNING 1. This PAS calls for the use of procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

WARNING 2. For all excavations, assume that underground utilities are present and act accordingly. To avoid buried services effectively it is necessary to positively identify and locate the services that are present.

Attention is drawn to laws, rules and regulations applicable to vacuum excavating or hand digging near or atop dangerous utilities such as electric, gas, fuel or petroleum.

Attention is drawn to HSE's publication, *Avoiding danger from underground services* (HSG47) [1].

Annex A sets out the application of this specification to the detection, location and avoidance of buried services in support of excavation and intrusive ground investigation.

WARNING 3. This PAS refers to physical entry into confined spaces, which is not to be attempted without suitably trained operatives and safety equipment.

Attention is drawn to HSE's publication, *Confined spaces – A brief guide to working safely* (INDG258) [2].

Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Requirements in this PAS are drafted in accordance with *Rules for the structure and drafting of UK standards:2017,* subclause **G.1.1**, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall …'". This means that only those products that are capable of passing the specified test will be deemed to conform to this PAS.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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0 Introduction

0.1 Background

As the demand on the nation's infrastructure continues to grow due to new developments, and the need to replace and/or maintain existing utilities increases, it is essential to have accurate information on the existence and location of underground utilities.

The accurate detection, identification, verification and location of utility assets have always been difficult tasks, subject to interpretation and inaccuracies. Not having sufficient or reliable information leads to:

- risk to the safety of workers and to the public;
- abortive and unnecessary work;
- damage to third party assets;
- inefficient design solutions; and
- potentially compromising the resilience of the existing network.

Accurate utility data could also afford the opportunity for as yet unrealized benefits, such as the use of remote robotic techniques to maintain asset networks in busy highways in future to reduce the need for intrusive maintenance practices (road excavations). Similarly, accurate mapping of utility networks could improve asset modelling capabilities with more determined outcomes.

***NOTE** Given the wide use and varying connotations associated with the word "survey", the word "location" has been used throughout this PAS to define the act of geospatially referencing utility assets or topographical features.*

The purpose of this PAS is to set out clear and unambiguous provisions for those engaged in the detection, verification and location of active, abandoned, redundant or unknown utilities.

This PAS aims to provide:

- clarity in the service provided and methods employed;
- consistency in the approach to data capture;
- classification of the results and the confidence that can be associated with them;
- an indication of the effort required to be confident that the survey is capable in principle of achieving higher accuracy levels in different settings;
- standardization of the format of deliverables; and
- accountability for the work undertaken.

It is expected that time, education and experience in the application of this PAS will lead to more effective planning and safer execution of street works, civil works, ground works and utility-based activities.

In creating this PAS, the development of other similar work, such as guidelines and standards undertaken in the USA, Canada and Australia, have been taken into account.

Different survey types and methods provide different levels of accuracy and certainty around results. For example, verification provides more accurate results than a desktop utility records search. It is recognized that an increase in accuracy and certainty inevitably means an increase in effort, cost and time to deliver those results.

0.2 The survey type

This PAS takes a hierarchical approach to the survey types used in recognition that different clients at different stages of an asset life cycle require different levels of accuracy and confidence in the data provided. This PAS defines four types of survey:

a) desktop utility records search (survey type D) – where underground utilities are identified through the collation and analysis of existing paper/online utility records;

b) site reconnaissance (survey type C) – where existing records are supported and validated by the visual inspection of physical evidence observed or recorded during a site visit;

c) detection (survey type B) – where underground utilities are detected and located by geophysical techniques and geospatially located; and

d) verification (survey type A) – where underground utilities are observed within and located at a manhole or inspection chamber or are excavated and exposed.

These represent the different levels of survey required for obtaining information on the location of utilities, whereby the desktop utility records search usually requires the least effort and verification the most.

A survey type D is a prerequisite for survey types C, B and A. Survey type C is also a prerequisite for a survey type B but can be carried out as an independent site reconnaissance visit by the person writing the type B survey scope or as an integral part of a type B survey. Survey types A and C are independent of each other. For example, a verification survey can conform to this PAS without the need to conduct a survey type C or B, although carrying out each stage in order further reduces project risk.

More information on the different survey types is contained in Annex B.

0.3 Detection methods

This PAS defines a hierarchy of methods to be used to detect underground utilities in terms of the minimum equipment types to be used, the minimum techniques to be applied and the survey search resolution, and relates this to the maximum quality levels achievable that can be attained using a particular detection method (see Table 2 and Annex C).

The detection methods are usually selected taking into account density of services of the survey area and whether post-processing is undertaken or not. In a PAS 128 survey, both electromagnetic locators (EML) and ground penetrating radar (GPR) are deployed as a minimum in conjunction with each other for each segment of a utility within the survey area. In addition to EML and GPR, other detection methods can be applied to the survey area.

***NOTE** A multiple antenna array GPR only survey can be used to increase confidence in type D information so that a more targeted type B survey can be carried out.*

By requiring the practitioner to indicate in their method statement the methodologies they intend to use and thus the level of work their price is based on, the client can assess and compare tenders on an equal basis. More importantly, this PAS defines for the practitioner the minimum standard expected for detection associated with each typical application.

0.4 Quality levels

The quality level is a classification applied to each segment of utility surveyed based on survey type undertaken (D, C, B or A), location accuracy achieved (B and A survey type), whether post-processing was undertaken and level of supporting data obtained in determining the quality level (see Table 1). It reflects the method the practitioner has used and the confidence in the accuracy at which they state they have determined the location of the service.

0.5 Absolute geospatial location of underground utilities

To improve accuracies and how data are exchanged and integrated, this PAS encourages the absolute geospatial location of utilities referenced to three dimensions using a national coordinate grid system and datum. In Great Britain this is the Ordnance Survey's National Grid (OSGB36) and Ordnance Datum Newlyn (ODN) coordinates. In Northern Ireland this is the Irish Grid (IG) as used by Ordnance Survey Northern Ireland.

***NOTE** The coordinate system for Ireland is the Irish Transverse Mercator (ITM).*

1 Scope

This PAS specifies requirements for the detection, verification and location of existing and new underground utilities.

It applies to the detection, verification and location of active, abandoned, redundant or unknown underground utilities and the location of their associated surface features (e.g. manhole covers and utility markers). It applies regardless of where these utilities are located (e.g. in urban or rural areas, in the street, or on private sites such as hospitals or airfields).

This PAS sets out the accuracy to which the data are captured, the quality expected of these data and a means by which to assess and indicate the confidence that can be placed in such data.

More specifically it covers:

a) project planning and the scoping process;
b) the classification system for quality levels based on survey type, location accuracy, inclusion of post-processing and level of supporting data;
c) desktop utility records search;
d) detection;
e) verification;
f) location; and
g) deliverables.

It does not cover the detection, verification or location of the following:

1) emergency utility works (as defined by the New Roads and Streets Works Act 1991 (NRSWA) [3]) or where there is imminent risk to life, limb or environment;
2) underground basements, underground tunnels (including railway, road tunnels and underground pedestrian walkways), plant rooms and non-utility based features (although clients are made aware if such a structure is detected although not surveyed); or
3) above surface utility infrastructure (such as overhead power or telecommunication lines).

This PAS is for use by practitioners (usually a surveyor, geophysicist or subsurface utility engineer). The PAS might also be of interest to clients (such as engineers, constructors, project managers and utility owners) who are responsible for recording information about underground utilities. Annex B and Annex D are aimed specifically at the client and explain how to use this PAS and some of the limitations associated with the two main utility detection techniques specified. Annex E sets out an example project workflow which, if adopted, and if appropriate for the scope and nature of the project, can maximize the benefit to both client and practitioner of this PAS.

Where ground investigation borehole, trial pit works and other construction works are proposed, a current utility mapping survey conforming to this PAS can be used as an indicator of the presence or absence of underground utilities before conducting further ground investigation prior to breaking ground.

It is good practice to undertake a full detection survey prior to the development of a site, so this information can support and inform the safety and progress of the project from before the initial ground investigation through to design and construction phases. If a full detection survey is not available prior to a ground investigation, then this specification can be used to support the detection, location and avoidance of buried services as part of a permit to break ground safe system of work, as set out in Annex A.