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**Underground installation of flexible  
glass-reinforced thermosetting resin (GRP)  
pipes —**

**Part 1:**  
Installation procedures

*Installation enterrée de canalisations flexibles en plastique renforcé de  
fibres de verre/résine thermodurcissable (PRV) —*

*Partie 1: Procédures d'installation*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 10465-1, which is a Technical Report of type 2, was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Sub-Committee SC 6, *Reinforced plastics pipes and fittings for all applications*.

This document is being issued in the type 2 Technical Report series of publications (according to subclause G 6.2.2 of part 1 of the IEC/ISO Directives) as a "prospective standard for provisional application" in the field of underground use of GRP pipe because there is an urgent need for guidance on how standards in this field should be used to meet an ident-

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ified need. The reasons which led to the decision to publish this document in the form of a type 2 Technical Report are explained in the introduction.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this type 2 Technical Report will be carried out not later than two years after its publication with the options of: extension for another two years; conversion into an International Standard; or withdrawal.

ISO/TR 10465 consists of the following parts, under the general title *Underground installation of flexible glass-reinforced thermosetting resin (GRP) pipes*:

- *Part 1: Installation procedures*
- *Part 2: Static calculation methods*
- *Part 3: Parameters and application limits*

Annex A forms an integral part of this part of ISO/TR 10465. Annex B is for information only.

## Introduction

### 0.1 Historical background

Work within ISO/TC 5/SC 6 (now ISO/TC 138) on writing standards for the use of glass-reinforced plastics (GRP) pipes and fittings was approved at the subcommittee meeting in Oslo in 1979. An ad hoc group was established and the responsibility for drafting various standards was later given to a Task Group (now ISO/TC 138/SC 6).

At the SC 6 meeting in London in 1980, Sweden proposed that a working group be formed for establishing documents regarding a code of practice for GRP pipes. This was approved by SC 6, and Working Group 4 (WG 4) was formed for this purpose. Since 1982, eleven WG 4 meetings have been held and various Task Groups have been formed, with research being carried out in the following areas:

- procedures for underground installation of GRP pipes;
- pipe/soil interaction with pipes having different stiffness values;
- minimum design features;
- overview of various static calculation methods.

During the work of WG 4 it became evident that no unanimous proposal could be reached within the WG upon specific methods to be employed and therefore WG 4 agreed that, pending further development and experience, all prepared descriptions with minimum acceptance levels should be compiled into a Technical Report (Type 2). This is to be prepared in three Parts, of which the present document is Part 1.

In Part 2, a survey will be given of different methods for static calculation of underground GRP pipe installations which are used on an international basis (e.g. ATV 127, December 1988 and AWWA C-950-88). Also, recommendations will be given for the choice of important parameters for those calculations, such as soil modulus, bedding angles, time lag factor and strain (shape) factors.

In Part 3, advice will be given, based on pipe installations according to Part 1 and static calculations according to Part 2, on such items as:

- a) allowable depth of cover for different pipe stiffnesses in different native soils;
- b) minimum pipe stiffness, depth of cover, and compactions for GRP pipes installed under traffic surfaces;
- c) minimum pipe stiffness in relation to embedment conditions for GRP pipes which need to sustain negative pressures;

- d) rating of pressure pipes which are used under conditions, such as depth of cover, other than those for which the standard pipe has been designed;
- e) influence of sheeting on allowable depth of cover.

## 0.2 Basic technical concepts

Glass-reinforced thermosetting resin (GRP) pipes are classed as flexible pipes that may be expected to deflect under external load with no structural damage. The performance of GRP pipe is affected by the amount of strain induced in the pipe wall by external loads and/or internal pressure. Allowable strain levels vary with the type of resin, lamination, manufacturing process and other variables. It is necessary to control the deflection and distortion of the pipe to ensure that the manufacturer's allowable strain level is not exceeded.

In an underground installation, the soil and traffic loads above a buried flexible pipe cause a decrease in the vertical diameter and an increase in the horizontal diameter of the pipe. The horizontal movement of the pipe walls into the soil material at the sides of the pipe develops a passive resistance that helps the pipe support the external load. The resistance of the soil is affected by the type of soil, its density, depth of overburden and the presence of groundwater. The higher the soil resistance, the less the pipe will deflect. Proper installation techniques are essential to develop the passive soil resistance required to prevent excessive pipe deflections and/or distortions.

The deflection of a buried flexible pipe depends on the soil and on the pipe. It is a function of the depth of burial, the stiffness of the pipe, the passive resistance of the soil at the sides of the pipe, the time-consolidation characteristics (time lag factor) of the soil and pipes and the degree of support given to the bottom of the pipe (bedding constant). Several procedures exist that can be used to obtain the mathematical relationship of these parameters and the deflection that will occur in a particular installation.

The methods of calculating the pertinent parameters will be covered in ISO/TR 10465-2.

It is important to recognize the effects of handling and installation on GRP pipes during initial pipe embedment. Care in soil placement and compaction will minimize deflection and distortion that is attributable to certain treatment during this phase of construction.

# Underground installation of flexible glass-reinforced thermosetting resin (GRP) pipes —

## Part 1: Installation procedures

### 1 Scope

This part of ISO/TR 10465 describes the procedures for underground installation of glass-reinforced thermosetting resin (GRP) pipes. The report refers generally to GRP pipes in particular stiffness classes for which performance requirements have been specified in at least one product standard, but it can also be used as a guide for the installation of pipes of other stiffness classes.

### 2 Terminology

Because pipeline installation terminology varies throughout the world, figure 1 has been prepared to illustrate the meaning and limits of the terms used in this part of ISO/TR 10465.

### 3 Soil conditions

The soil conditions that relate to trench construction and pipe installation should be determined prior to construction. If this information has not previously been established to the satisfaction of the engineer, a site exploration investigation programme should be conducted. The results of this programme should not only indicate the proper backfill and compaction procedures (see figure 2) to be followed, but should also indicate the areas of suitable materials so that importation of material may be minimized. Fine-grained soils with medium to high plasticity and organic soils with Group 4 classification (see annex A)

are generally considered unsuitable for primary pipe zone backfill (see figure 1) material, unless the pipe has been specifically designed for this condition.

An important part of the site investigation is also to classify the native soil. Such a classification should be made in accordance with annex A, because this will facilitate the choice of suitable pipe stiffnesses in accordance with clause 4.

### 4 Selection of pipe stiffness (SN)

**4.1** For general installations, the selection of SN from those classified in the relevant product standard is mainly dependent upon the native soil.

For other installations, such as installations under traffic surfaces or where considerable negative pressure can occur, other parameters also influencing the selection of SN will be dealt with in Part 3 of ISO/TR 10465.

**4.2** In order to facilitate the selection of SN, the native soil can be classified in one of the four main groups described in annex A.

Based on this native soil classification, the minimum SN is then primarily chosen in accordance with figure 2, with due regard to the applicable installation system detailed in clause 7 and without consideration of traffic loads. Specific recommendations based upon the depth of cover should be made only after calculations based upon Part 3 of ISO/TR 10465.