
Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use

Systèmes de canalisation en matières plastiques — Tubes et raccords plastiques thermodurcissables renforcés de verre (PRV) — Méthodes pour une analyse de régression et leurs utilisations



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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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 procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

This third edition cancels and replaces the second edition (ISO 10928:2009), which has been technically revised and includes the following changes. It also incorporates the Amendment ISO 10928:2009/Amd 1:2013:

- [Annex A](#) (GRP pressure pipe design procedure) has been removed from the document;
- several bibliographical references have been removed.

Introduction

This document describes the procedures intended for analysing the regression of test data, usually with respect to time and the use of the results in design and assessment of conformity with performance requirements. Its applicability is limited to use with data obtained from tests carried out on samples. The referring standards require estimates to be made of the long-term properties of the pipe for such parameters as circumferential tensile strength, long-term ring deflection, strain corrosion and creep or relaxation stiffness.

A range of statistical techniques that could be used to analyse the test data produced by destructive tests was investigated. Many of these simple techniques require the logarithms of the data to

- a) be normally distributed,
- b) produce a regression line having a negative slope, and
- c) have a sufficiently high regression correlation (see [Table 1](#)).

While the last two conditions can be satisfied, analysis shows that there is a skew to the distribution and hence this primary condition is not satisfied. Further investigation into techniques that can handle skewed distributions resulted in the adoption of the covariance method of analysis of such data for this document.

However, the results from non-destructive tests, such as long-term creep or relaxation stiffness, often satisfy all three conditions and hence a simpler procedure, using time as the independent variable, can also be used in accordance with this document.

These data analysis procedures are limited to analysis methods specified in ISO product standards or test methods. However, other analysis procedures can be useful for the extrapolation and prediction of long-term behaviour of some properties of glass-reinforced thermosetting plastics (GRP) piping products. For example, a second-order polynomial analysis is sometimes useful in the extrapolation of creep and relaxation data. This is particularly the case for analysing shorter term data, where the shape of the creep or relaxation curve can deviate considerably from linear. A second-order polynomial analysis is included in [Annex A](#). In [Annex B](#), there is an alternative non-linear analysis method. These non-linear methods are provided only for information and the possible use in investigating the behaviour of a particular piping product or material therefore they might not be generally applicable to other piping products.

Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use

1 Scope

This document specifies procedures suitable for the analysis of data which, when converted into logarithms of the values, have either a normal or a skewed distribution. It is intended for use with the test methods and referring standards for glass-reinforced thermosetting plastics (GRP) pipes or fittings for the analysis of properties as a function of time. However, it can be used for the analysis of other data.

Depending upon the nature of the data, two methods are specified. The extrapolation using these techniques typically extends the trend from data gathered over a period of approximately 10 000 h to a prediction of the property at 50 years, which is the typical maximum extrapolation time.

This document only addresses the analysis of data. The test procedures to collect the data, the number of samples required and the time period over which data are collected are covered by the referring standards and/or test methods. [Clause 6](#) discusses how the data analysis methods are applied to product testing and design.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Principle

Data are analysed for regression using methods based on least squares analysis which can accommodate the incidence of a skew and/or a normal distribution. The two methods of analysis used are the following:

- method A: covariance using a first-order relationship;
- method B: least squares, with time as the independent variable using a first-order relationship.

The methods include statistical tests for the correlation of the data and the suitability for extrapolation.