

SVENSK STANDARD

SS-ISO 19973-1:2015



Fastställt/Approved: 2015-09-18
Publicerad/Published: 2015-09-30
Utgåva/Edition: 2
Språk/Language: engelska/English
ICS: 23.100.01

Pneumatik – Bedömning av komponenters tillförlitlighet genom provning –

Del 1: Allmänna metoder (ISO 19973-1:2015, IDT)

Pneumatic fluid power – Assessment of component reliability by testing –

Part 1: General procedures (ISO 19973-1:2015, IDT)

This preview is downloaded from www.sis.se. Buy the entire standard via <https://www.sis.se/std-8016191>

Standarder får världen att fungera

SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.

Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.



Standards make the world go round

SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.

Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00



Den internationella standarden ISO 19973-1:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 19973-1:2015.

Denna standard ersätter SS-ISO 19973-1:2007, utgåva 1.

The International Standard ISO 19973-1:2015 has the status of a Swedish Standard. This document contains the official English version of ISO 19973-1:2015.

This standard supersedes the Swedish Standard SS-ISO 19973-1:2007, edition 1.

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige. Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för Hydraulik och pneumatik, SIS/TK 106.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Symbols and units of measurement.....	3
5 Concept of reliability.....	3
6 Strategies for conducting testing.....	4
6.1 Assumptions.....	4
6.2 Test stand and measurement of parameters.....	4
6.3 Test planning.....	4
7 Statistical analysis.....	4
8 Test conditions.....	4
9 Sample size and selection criteria.....	5
10 End of test.....	6
10.1 Minimum number of failures required.....	6
10.2 Termination time of a test unit.....	6
10.3 Termination life.....	6
10.4 Suspended test unit.....	6
10.5 Censored test.....	6
11 Evaluation of reliability characteristics from the test data.....	6
12 Test report.....	8
13 Identification statement (reference to this part of ISO 19973).....	9
Annex A (normative) Determination of the termination life.....	10
Annex B (informative) Determination of threshold values for leakage rates.....	14
Annex C (informative) Calculation procedures for censored data without suspensions.....	21
Annex D (informative) Calculation procedures for censored data with suspensions.....	24
Annex E (informative) Verification of minimum life at a specified reliability and one-sided confidence level.....	28
Annex F (informative) Dealing with outliers in test data.....	33
Annex G (informative) Examples of test results.....	39
Bibliography.....	44

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 131, *Fluid power systems*.

This second edition cancels and replaces the first edition (ISO 19973-1:2007) which has been technically revised.

ISO 19973 consists of the following parts, under the general title *Pneumatic fluid power — Assessment of component reliability by testing*:

- *Part 1: General procedures*
- *Part 2: Directional control valves*
- *Part 3: Cylinders with piston rod*
- *Part 4: Pressure regulators*
- *Part 5: Non-return valves, shuttle valves, dual pressure valves (AND function), one-way adjustable flow control valves, quick-exhaust valves*

Introduction

In pneumatic fluid power systems, power is transmitted and controlled through a gas under pressure within a circuit. Pneumatic fluid power systems are composed of components and are an integral part of various types of machines and equipment. Efficient and economical production requires highly reliable machines and equipment.

It is necessary that machine producers know the reliability of the components that make up their machine's pneumatic fluid power system. Knowing the reliability characteristic of the component, which can be determined from laboratory testing, the producers can model the system and make decisions on service intervals, spare parts inventory and areas for future improvements.

There are three primary levels in the determination of component reliability:

- a) preliminary design analysis: finite element analysis (FEA), failure mode and effect analysis (FMEA);
- b) laboratory testing and reliability modelling: physics of failure, reliability prediction, pre-production evaluation;
- c) collection of field data: maintenance reports, warranty analysis.

Each level has its application during the life of a component. A preliminary design analysis is useful to identify possible failure modes and eliminate them or reduce their effect on reliability. When prototypes are available, in-house laboratory reliability tests are run and initial reliability can be determined. Reliability testing is often continued into the initial production run and throughout the production lifetime as a continuing evaluation of the component. Collection of field data is possible when products are operating and data on their failures are available.

Specific component test procedures and exclusions are provided in ISO 19973-2, ISO 19973-3, ISO 19973-4 and ISO 19973-5.

Pneumatic fluid power — Assessment of component reliability by testing —

Part 1: General procedures

1 Scope

This part of ISO 19973 provides general procedures, the calculation method for assessing the reliability of pneumatic fluid power components and the methods of reporting. These procedures are independent of the kinds of components and of their design.

This part of ISO 19973 also provides general test conditions and a method for data evaluation.

NOTE Because the service life of any component is subject to variations, a statistical evaluation assists the interpretation of the test results.

The methods specified in this part of ISO 19973 apply to the first failure without repairs (see IEC 60300-3-5), but exclude outliers; however, because outliers can be highly significant, information about how to deal with them is given in [Annex F](#).

2 Normative references

The following referenced 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.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 6358 (all parts), *Pneumatic fluid power — Determination of flow-rate characteristics of components using compressible fluids*

ISO 10099, *Pneumatic fluid power — Cylinders — Final examination and acceptance criteria*

ISO 19973-3, *Pneumatic fluid power — Assessment of component reliability by testing — Part 3: Cylinders with piston*

ISO 80000-1, *Quantities and units — Part 1: General*

IEC 60050-191, *International Electrotechnical Vocabulary, chapter 191: Dependability and quality of service*

IEC 61649, *Goodness-of-fit tests, confidence intervals and lower confidence limits for Weibull distributed data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534-1, ISO 5598 and IEC 60050-191 and the following apply.

3.1

catastrophic failure

failure of an item that results in its complete inability to perform all required functions

3.2
confidence coefficient
confidence level

value $(1 - \alpha)$ of the probability associated with a confidence interval or a statistical coverage interval

Note 1 to entry: See also [3.6](#).

Note 2 to entry: See ISO 3534-1 for notes related to this term and definition.

3.3
confidence limit

either of the limits, T_1 or T_2 , of the two-sided confidence interval, or the limit, T , of the one-sided confidence interval

Note 1 to entry: See ISO 3534-1 for notes related to this term and definition.

3.4
failure

termination of the ability of an item to perform a required function

Note 1 to entry: In the ISO 19973 (all parts), the reaching of a threshold level for statistical calculation is also considered a statistical failure (see [Annex A](#)).

[SOURCE: IEC 60050-191]

3.5
one-sided confidence interval

T
interval estimator for a parameter, θ , comprised of the interval from the smallest possible value of the parameter, θ , up to T or the interval from T up to the largest possible value of θ , where the probability $p(T \geq \theta)$ or $p(T \leq \theta)$ is at least equal to $(1 - \alpha)$, where $(1 - \alpha)$ is a fixed number, positive and less than 1

Note 1 to entry: See ISO 3534-1 for notes related to this term and definition.

3.6
relevant failure

failure that should be included in interpreting test or operational results or in calculating the value of a reliability performance measure

[SOURCE: IEC 60050-191]

3.7
reliability

probability that an item can perform a required function under given conditions for a given time interval

[SOURCE: IEC 60050-191]

3.8
sample

one or more test units taken from a population and intended to provide information on the population

Note 1 to entry: A sample can serve as a basis for a decision on the population or on the process that produced it.

3.9
sample size

number of test units in the sample

Note 1 to entry: In a multi-stage sample, the sample size is the total number of test units at the conclusion of the final stage of sampling.

3.10 three-point moving average 3PMA

arithmetic average of three consecutive measured component's test data

3.11 threshold level

value of a performance characteristic (for example, leakage, shifting pressure, stroke time, etc.) against which the component's test data is compared

Note 1 to entry: This is an arbitrary value defined by the experts as the critical value for performance comparisons, but is not necessarily indicative of a component failure.

4 Symbols and units of measurement

4.1 The symbols used in this part of ISO 19973 are given in [Table 1](#).

Table 1 — Symbol list

Symbol ^a	Definition
B_{10}	Expected time at which 10 % of the population is predicted to fail (10 % of the lifetime distribution)
$(B_{10})_{95\%}$	B_{10} life at the one-sided 95 % confidence level
η	Scale parameter (characteristic life) of the Weibull distribution
$F(t)$	Probability of failure, expressed in percent
β	Shape parameter (slope) of the Weibull distribution
$R(t)$	Reliability of a component at time t ; $1-F(t)$
t	Life time expressed in time, cycles, or distance
^a Other symbols can be used in other documents and software.	

4.2 Units of measurement are in accordance with ISO 80000-1.

5 Concept of reliability

For the purposes of this part of ISO 19973, reliability is the probability that a component does not have a relevant failure for a specified interval of time, number of cycles or distance when it operates under stated conditions.

A relevant failure occurs when

- component data, determined using the three-points moving average (3PMA), exceeds a threshold level for the first time (see [10.2](#)), or
- a component experiences a catastrophic failure (burst, fatigue or functional failure, etc.).

Threshold levels of the components covered by ISO 19973 (all parts) are specified in the component-specific parts of this International Standard.

This probability can be determined by analysing the results of a series of tests and describing the population failure by statistical methods. There are many different statistical distributions that describe the population of failures that result from testing.

It is also possible to verify the minimum life of a component by the one-sided confidence estimation at a specified reliability level. Examples are given in [Annex E](#).