SVENSK STANDARD
SS-ISO 21940-1:2021

Vibration och stöt – Balansering av rotorer – Del 1: Introduktion (ISO 21940-1:2019, IDT)

Mechanical vibration – Rotor balancing – Part 1: Introduction (ISO 21940-1:2019, IDT)

Svenska Institutet för Standarder

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Standarden är framtagen av kommittén för Maskiners påverkan av vibrationer, SIS/TK 111/AG 02.

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.

Fastställd: 2021-04-25
ICS: 01.040.21; 21.120.40

Svenska Institutet för Standarder

Den internationella standarden ISO 21940-1:2019 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 21940-1:2019.

Denna standard ersätter SS-ISO 19499:2007, utgåva 1

The International Standard ISO 21940-1:2019 has the status of a Swedish Standard. This document contains the official English version of ISO 21940-1:2019.

This standard supersedes the SS-ISO 19499:2007, edition 1

LÄSANVISNINGAR FÖR STANDARDER

I dessa anvisningar behandlas huvudprinciperna för hur regler och yttre begränsningar anges i standardiseringsprodukter.

Krav

Ett krav är ett uttryck i ett dokuments innehåll som anger objektivt verifierbara kriterier som ska uppfyllas och från vilka ingen avvikelse tillåts om efterlevnad av dokumentet ska kunna åberopas. Krav uttrycks med hjälpverbet ska (eller ska inte för förbud).

Rekommendation

En rekommendation är ett uttryck i ett dokuments innehåll som anger en valmöjlighet eller ett tillvägagångssätt som bedöms vara särskilt lämpligt utan att nödvändigtvis nämna eller utesluta andra. Rekommendationer uttrycks med hjälpverbet bör (eller bör inte för avrådanden).

Instruktion

Instruktioner anges i imperativ form och används för att ange hur något görs eller utförs. De kan underordnas en annan regel, såsom ett krav eller en rekommendation. De kan även användas självständigt, och är då att betrakta som krav.

Förklaring

En förklaring är ett uttryck i ett dokuments innehåll som förmedlar information. En förklaring kan uttrycka tillåtelse, möjlighet eller förmåga. Tillåtelse uttrycks med hjälpverbet får (eller motsatsen behöver inte). Möjlighet och förmåga uttrycks med hjälpverbet kan (eller motsatsen kan inte).

READING INSTRUCTIONS FOR STANDARDS

These instructions cover the main principles for the use of provisions and external constraints in standardization deliverables.

Requirement

A requirement is an expression, in the content of a document, that conveys objectively verifiable criteria to be fulfilled, and from which no deviation is permitted if conformance with the document is to be claimed. Requirements are expressed by the auxiliary shall (or shall not for prohibition).

Recommendation

A recommendation is an expression, in the content of a document, that conveys a suggested possible choice or course of action deemed to be particularly suitable, without necessarily mentioning or excluding others. Recommendations are expressed by the auxiliary should (or should not for dissuasion).

Instruction

An instruction is expressed in the imperative mood and is used in order to convey an action to be performed. It can be subordinated to another provision, such as a requirement or a recommendation. It can also be used independently and is then to be regarded as a requirement.

Statement

A statement is an expression, in the content of a document, that conveys information. A statement can express permission, possibility or capability. Permission is expressed by the auxiliary may (its opposite being need not). Possibility and capability are expressed by the auxiliary can (its opposite being cannot).

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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).

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 voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

This first edition of ISO 21940-1 cancels and replaces ISO 19499:2007, which has been technically revised. The main changes are as follows:

— reference made to all International Standards in the ISO 21940 series;

— deletion of former Table 2 "Guidelines for balancing procedures";

— deletion of former Annex C "How to determine rotor flexibility based on an estimation from its geometric design".

A list of all parts in the ISO 21940 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Vibration caused by rotor unbalance is one of the most critical issues in the design and maintenance of rotating machines. It gives rise to dynamic forces which adversely affect both machine and human health and well-being. The purpose of this document is to give guidance on the usage of the other parts of the ISO 21940 series.

Balancing is explained in a general manner, using the specific terms and definitions, to help readers to select the appropriate balancing approach for their application.

Mechanical vibration — Rotor balancing —

Part 1:
Introduction

1 Scope

This document provides a general background to balancing technology, as used in the ISO 21940 series, and directs the reader to the appropriate parts of the series that include vocabulary, balancing procedures and tolerances, balancing machines and machine design for balancing.

Individual procedures are not included here as these can be found in the appropriate parts of ISO 21940.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 21940-2, *Mechanical vibration — Rotor balancing — Part 2: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041 and ISO 21940-2 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at http://www.electropedia.org/

4 Fundamentals of balancing

4.1 General

Balancing is a procedure by which the mass distribution of a rotor (or part of a rotor or module) is measured and adjusted to ensure that unbalance tolerances are met.

Many factors can cause rotor unbalance, e.g. non-homogenous material, manufacture, assembly, wear during operation, debris or an operational event. It is important to understand that every rotor, even in series production, has a unique individual unbalance distribution.

New rotors are commonly balanced by the manufacturer in balancing machines before installation into their operational environment. Following rework or repair, rotors can be rebalanced in a balancing machine or, if appropriate facilities are not available, the rotor can be balanced *in situ* (for details, see ISO 21940-13). For *in-situ* balancing, the rotor is held in its service bearings and support structure and rotated within its operational drive train.

When rotated, unbalance generates forces that can be directly measured by force gauges mounted on the structures supporting the bearings or indirectly by measuring either the motion of the bearing or the shaft. The unbalance vector can be calculated from these measurements and balancing achieved by adding, removing or moving correction masses on the rotor. Depending on the balancing task, the mass corrections are performed in one, two or more correction planes.

Inertia forces due to unbalances or correction masses added during the balancing process induce an excitation of the rotor and support system, which is observed as once-per-revolution vibration. Once-per-revolution vibration and vibration at other frequencies can also be excited by other effects, e.g. asymmetric stiffness, magnetic or fluid forces, but it is only the once-per-revolution effects that can be compensated for by balancing. Non-linear systems can also cause frequencies other than at once per revolution to be generated but these are usually a second order effect.

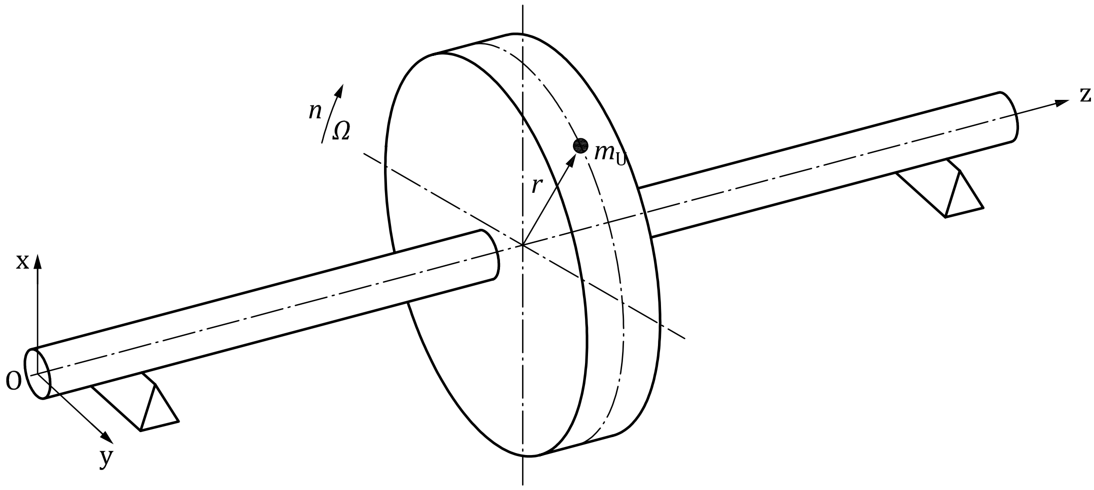
The theory of balancing is widely described in the literature (see e.g. References [11], [12]), and therefore only the basics are presented here to aid the understanding of the terms used in balancing standards and to direct the user towards the appropriate parts of ISO 21940.

4.2 Unbalance of a single disc

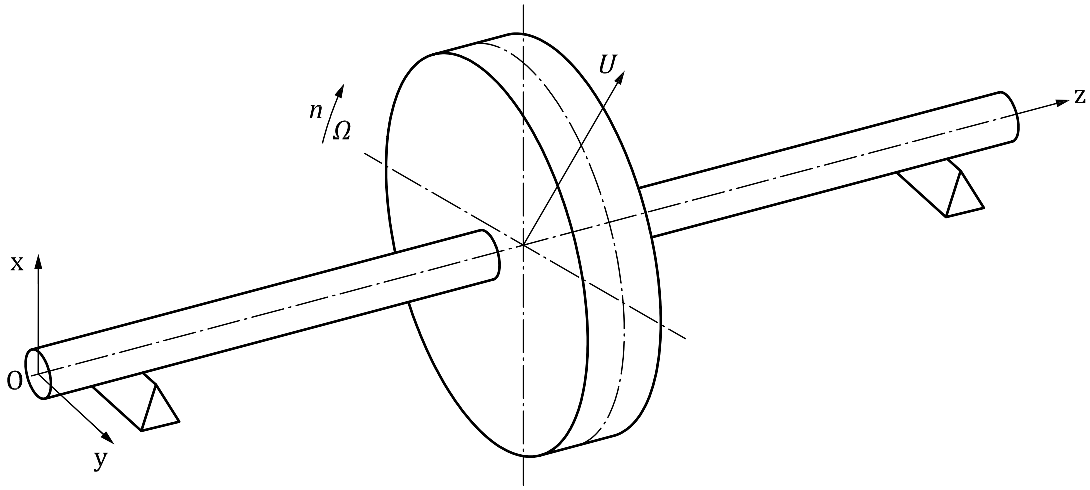
The simplest mechanical model of a rotor consists of a single disc supported on two bearings by a massless shaft as shown in Figure 1. An unbalance mass, m_U, on the disc with a radial distance from the shaft axis, $\boldsymbol{r}$, generates the unbalance vector, $\boldsymbol{U}$, whereby $\boldsymbol{U} = m_U \boldsymbol{r}$. The unbalance vector $\boldsymbol{U}$ is expressed in the unit of mass times length, usually kg·m, but for practical reasons, smaller units are generally used, e.g. kg mm, g mm or, for very small unbalances, mg mm.

NOTE Bold font indicates vector quantities.

At a rotational speed n (angular velocity Ω), the unbalance causes a centrifugal force $\boldsymbol{F} = \boldsymbol{U}\,\Omega^2$. When expressing the unbalance, $\boldsymbol{U}$, in kg·m, and the angular velocity, Ω, in rad/s, $\boldsymbol{F}$ is expressed in newtons, N.



a) Unbalance of a disc as unbalance mass m_U at radius *r*



b) Unbalance of a disc as unbalance vector *U*

Figure 1 — Unbalance of a disc

The unbalance, ***U***, can be expressed as the eccentricity, ***e***, of the disc mass, *M*, from the shaft axis, given by the expression ***U*** = *M* ***e***. See Figure 2.