International Organization for Standardization
Organisation internationale de normalisation
Международная организация по стандартизации

STRATEGIC BUSINESS PLAN – ISO/TC 4

Executive summary

Scope of ISO/TC 4

Standardization of all types and all sizes of bearing elements based on the principle of rolling motion, including their lubrication, accessories, application and identification and standardization of spherical plain bearings, i.e., plain bearings with spherical contact surface.

- **The main field and the overall size of the markets addressed by the committee**

Rolling bearings are mechanical components used in all kinds of stationary and mobile equipment. Rotating rolling bearings transmit loads from rotating to stationary machine elements with high precision and extremely low energy loss. Linear motion rolling bearings serve the same purpose in the transmission of linear movements. Spherical plain bearings are internally self-aligning and are used to accommodate slow or partial rotation with relatively low friction.
The size of the market in 2019 is estimated at a value of 40 billion euros (45 billion US $).

Note: European Central Bank average exchange rate 2019: 1 euro = 1.1195 US $.

- **The benefits already realized and/or expected through the availability of the standards**

Assistance to the users in the selection, specification and application of appropriate rolling bearing products as well as ensuring interchangeability, irrespective of origin by:

— standardization of boundary dimensions and tolerances, thereby ensuring dimensional interchangeability,

— standardization of measuring principles, including Geometrical Product Specification (GPS) implementation,

— Implement Geometrical Product Specification (ISO GPS)

— definition of performance criteria, thereby facilitating the consistent prediction of service performance, and impartial rational comparison of products.

— standardization of vocabulary and designations required to define the product.

- **The main objectives and the priorities in the work of the committee**

The objectives of ISO/TC 4 are to Standardization of all types and all sizes of bearing elements based on the principle of rolling motion, including their lubrication, accessories, application and identification and standardization of spherical plain bearings, i.e. plain bearings with spherical contact surface.

standardize all types and all sizes of standard bearings and bearing elements based on the principle of rolling motion, their accessories, application, identification, characteristics and performance criteria. Similarly, the objective is also to standardize spherical plain bearings, i.e. plain bearings with spherical contact surfaces.

The main objectives of the committee are:

— to continue the standardization of the boundary dimensions, tolerances and measuring principles for products not yet standardized and new products,

— to implement GPS, where applicable

— to standardize the methods for calculating, testing and validating bearing performance factors, e.g., load ratings, life prediction, limits for speed, misalignment axial displacement etc., friction, cleanliness, noise and vibration, remaining useful life and likelihood of functional failure.

— to standardize vocabularies.

1 Introduction

1.1 ISO technical committees and business planning

The extension of formal business planning to ISO Technical Committees (ISO/TCs) is an important measure which forms part of a major review of business. The aim is to align the ISO work programme with expressed business environment needs and trends and to allow ISO/TCs to prioritize among different projects, to identify the benefits expected from the availability of International Standards, and to ensure adequate resources for projects throughout their development.

1.2 International standardization and the role of ISO

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade.

Three bodies are responsible for the planning, development and adoption of International Standards: ISO (International Organization for Standardization) is responsible for all sectors excluding Electrotechnical, which is the responsibility of IEC (International Electrotechnical Committee), and most of the Telecommunications Technologies, which are largely the responsibility of ITU (International Telecommunication Union).

ISO is a legal association, the members of which are the National Standards Bodies (NSBs) of some 164 countries (organizations representing social and economic interests at the international level), supported by a Central Secretariat based in Geneva, Switzerland.

The principal deliverable of ISO is the International Standard.

An International Standard embodies the essential principles of global openness and transparency, consensus and technical coherence. These are safeguarded through its development in an ISO Technical Committee (ISO/TC), representative of all interested parties, supported by a public comment phase (the ISO Technical Enquiry). ISO and its Technical Committees are also able to offer the ISO Technical Specification (ISO/TS), the ISO Public Available Specification (ISO/PAS) and the ISO Technical Report (ISO/TR) as solutions to market needs. These ISO products represent lower levels of consensus and have therefore not the same status as an International Standard.

ISO offers also the International Workshop Agreement (IWA) as a deliverable which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by ISO and its national members. An important distinction is that the IWA is developed by ISO workshops and fora, comprising only participants with direct interest, and so it is not accorded the status of an International Standard.

2 Business Environment of ISO/TC 4

This section establishes a sequential development of thoughts regarding the market for which ISO/TC 4 aims to fulfil the needs. Details in relation to the market analysis are given in the Guidance document on ISO Business Planning. The sequence of thoughts starts from a description of the current market situation relevant to the product or product grouping under consideration by ISO/TC 4, continues on to an analysis of the different factors motivating/influencing the activities of ISO/TC 4, to come to clear description of objectives and expected benefits resulting from the work of ISO/TC 4, together with an accompanying strategy how to reach those objectives. Finally, a general 'risk analysis' is included highlighting issues that may delay or stop the ISO/TC 4 achieving its set objectives.

2.1 Description of the Business Environment

The following political, economic, technical, regulatory, legal and social dynamics describe the business environment of the industry sector, products, materials, disciplines or practices related to the scope of this ISO/TC, and they may significantly influence how the relevant standards development processes are conducted and the content of the resulting standards:

2.1.1 Use of ISO/TC 4 standards

More than 90 % of the rolling bearing production is to ISO/TC 4 Standards for dimensions, tolerances or other parameters. Bearings to inch sizes and special bearings for particular applications make up the rest.
Rolling bearings are produced in billions per year and bearings are one of the most essential products for industry and an important factor for the industrial development until today and in the future. To manufacture the billions of bearings without dimensional standards and provide interchangeability of replacement bearings from different manufacturers would be impossible.

When safety aspects are involved references to ISO/TC 4 Standards are often specified, e.g. in the CEN Standard EN 12080:2017 for railway axlebox rolling bearings.
As rolling bearings are used everywhere in industrial machinery and in consumer products, the ISO/TC 4 Standards for dimensions, tolerances, etc. have an influence on a very large number of products, and the standards are often cited as normative references in standards outside the remit of ISO/TC 4 for other products and machinery etc. that interface with rolling bearings.

2.2 Quantitative Indicators of the Business Environment

The following list of quantitative indicators describes the business environment in order to provide adequate information to support actions of the ISO/TC:

2.2.1 Bearing demand of complete bearings

All larger bearing companies have production & sales other than bearings, e.g. lubrication, power transmission components and seals, but also products without connection to bearings. The published figures do not always allow to extract the real bearing part. Hence only estimates can be given.
Estimated global demand by region in 2019 for complete rolling bearings is shown in Table 1.

Table 1 – Bearing demand of complete bearings

Year	Total bearing demand	Europe[a)]	North America[b)]	Asia[c)]	Other
2019	40 billion euros (45 billion US $)	22 %	22 %	50 %	6 %

a) In Europe, Germany accounts for around 7 % of global demand
b) In North America, USA accounts for around 20 % of global demand
c) In Asia, China accounts for around 30 %, and Japan for 10 % of global demand.

Note: European Central Bank average exchange rate 2019: 1 euro = 1.1195 US $

2.2.2 Employment

Hard competition, limited market growth, automation and digitalization has led to rationalization and reduction of employees amongst bearing manufacturers. Many companies are also reviewing their manufacturing footprint to adapt localization to regional demand.
A very rough estimate of number of employees in the bearing sector with regards to the six largest bearing companies in 2019 is shown in Table 2. People that are not directly involved in the bearing business are not considered.

Table 2 – Employment

Number of employees 2019	Rolling bearing companies
> 30 000	SKF, Schaeffler
> 20 000	NSK
> 10 000	Timken, NTN, JTEKT

2.3 Description of the market structure and the major market players

2.3.1 Structure of the market: Suppliers/Manufacturers (descriptive and quantitative)

2.3.2 Major product categories, tendencies, and their relative market shares

Roughly estimated, the share of ball bearings, of various designs, account for more than half of the world market, while different roller bearings make the balance. This share has been stable for a number of years.

The most popular of the ball bearing types is the deep groove ball bearing, which accounts for about 28 % of the total world bearing market. Other ball bearings are angular contact, self-aligning and thrust ball bearings, and hub bearing units for automotive applications, such as wheels and suspension assemblies.

The roller bearings are cylindrical, spherical, tapered or needle roller bearings. The most common of the roller bearing types is the tapered roller bearing, representing around 16 % of the total world bearing market.
Spherical, cylindrical and needle roller bearings represent an aggregated share of the world market share slightly over 20 %.

The share of large size bearings is increasing due to new applications, e.g. for renewable energy applications such as wind turbines and tunnel boring machines.

2.3.3 Major global bearing manufacturers

The six largest world bearing companies can be found in Table 3. It is estimated that these top 6 represent about 60% of the global rolling bearing market.

Table 3 – Six largest world bearing companies

Main rolling bearing companies
SKF
Schaeffler Group
NSK
Timken
NTN
JTEKT

In addition to the large, global, bearing manufacturers, there are manufacturers that are strong within a certain region/country and/or strong in a certain industry segment. Examples of such manufacturers are ILJIN, MinebeaMitsumi (NMB), NACHI, RBC Bearings and Thyssen Krupp (Rothe Erde). The large Chinese bearing market is fragmented, with the main international bearing companies accounting for a significant part of the market while the remaining part of the market consists of a host of local manufacturers. Some of the largest Chinese suppliers are: C&U, Wanxiang Qianchao, ZWZ, Luoyang(LYC), and Tianma (TMB).

2.3.4 Structure of the market: Customers (descriptive and quantitative)

Rolling bearings are components in industrial machinery equipment and consumer products. The main customers can be found in manufacturing industry.

Among the end markets, the automotive segment represents around 30 % (o/w car segment is the largest) of the world bearing market. The industrial market segment represents around 40 % of the world bearing market. Around 30 % of the global market is aftermarket, or demand sold via distribution. Here, industrial distribution represents around 23% and automotive aftermarket around 8% of global demand.

2.4 Major factors which may have an impact on the development of the markets

2.4.1 Bearing Industry

The rolling bearing market has a large customer base and is, therefore, dependent upon the world economy.

2.4.2 Technological trends

During the last 60 years, the production of rolling bearings has been driven by industrial development; however, this development pattern is changing and has changed importantly during recent years.
One important point is digitalization. It influences manufacturing, purchasing, maintenance, operation etc. It means shorter lead-times and smaller inventories to reduce costs.
The performance requirements have also changed. In many applications trouble-free operation of the bearings for the entire life of the equipment is required e.g. motor vehicles. In other applications the requirement is for maximum reliability and long periods between service e.g. railway goods wagons and locomotives, power plants, windmill operations. In machine tool spindles and electric motors, high precision, high speed and low vibration levels are of paramount importance. Very special demands for high precision and safe operation at extreme temperatures are the primary concern for bearings in aircraft jet engine main shafts. Higher speeds are required for new generation products used in existing applications, e.g. vacuum cleaners, alternators. There is also a trend for having more capacity in less space; a typical example is automotive

gearbox bearings. This is often referred to as increased power density, a common trend in electrification where a speed increase makes it possible to reduce the footprint of an electrical drive maintaining the same power. Extended range for electrical vehicles is a driver for reduced friction losses in rolling bearings and their application. An increased use of hybrid bearings, especially in cases of electrification is another noticeable trend.

To respond to these demands, the rolling bearing industry is continuously improving products in many respects, including design, material composition and cleanliness, heat treatment and the entire manufacturing process.

The cleanliness of the bearing material is of particular importance and together with other improvements, a modern bearing running under very clean operating conditions, can be expected to obtain a very long service life – under certain load and operating conditions an almost infinite life.

For the predictable future, it is expected that the use of rolling bearings will follow industrial development to a large extent. Active magnetic bearings are making some progress when it comes to cost reduction but the cost versus performance gap is still significant. Rolling bearings will therefore continue to maintain their relevance in the industrial society, even if distribution and use of electric energy, production machines, rail, road and air transport, etc. may change in the future, not the least by the influence of information technology (IT), Internet and other new technologies.

One important aspect that has come up over the recent years is how to get the best performance out of a bearing – cost wise but also from the environment point of view. This is particularly true for large size bearings and for a number of specific applications such as railway and continuous casters. Bearings are core components of plant assets, and they can take a lot of punishment. Usually, bearings are either replaced during planned maintenance when nearing the end of their operational life or after unplanned breakdowns. Depending on the bearing type, replacement can be expensive and may involve long lead times. In addition, scrapping of “end of life” bearings may have a negative impact on a company’s sustainability – an aspect that is becoming increasingly important to investors and customers. Remanufacturing can increase the service life of bearings in order to decrease downtime, reduce cost and scrap.

Plain bearings have an obvious use but can only marginally compete in the classical bearing field. Hydrostatic, air and magnetic bearings will find their use in very specialized areas.
There has been a slow change in the use of the classical bearing types over the years. The tendency is an increased market share for ball bearings and a reduction for tapered roller bearings. In the automotive sector ball bearing hub units and tapered roller bearing hub units for wheels are being extensively used instead of conventional designs with tapered roller bearings.

A hub bearing unit can combine the elements of bearing, housing and shaft. It represents a confirmed tendency in the bearing industry to supply complete sub-units, where the bearing is part of the equipment with added properties. Mechatronics is another example, where a bearing unit combines its bearing function with the sensor for an ABS braking system. A further example of the development of a new bearing in the field of mechatronics is the integration of an electronic cell inside the bearing which can measure speed, acceleration, sense of rotation and/or angular position with a better degree of precision than systems used at present. These bearings are mainly used in electric motors for speed control or in forklift trucks for position control (replacement of the mechanical steering). New applications can also be found in railway bearing units and large size bearings in heavy industry, mainly windmill applications.

2.4.3 Technical barriers and other regulatory issues

The need for standardization was recognized by the manufacturers of rolling bearings in the 1920s. Basic dimensional standards were established by ISA in the 1930s. Work was resumed in 1945 and ISO established ISO/TC 4 – Rolling bearings in 1947.

The standardization work has mainly engaged the bearing manufacturers, but in the different national standardization bodies, the customers have also expressed opinions. For example, the standardization of load ratings and life calculations were initiated by the American military organization, as there had been purchasing problems, during the Second World War, when comparing the expected performance of replacement bearings from different suppliers.

The standardization work has been free from restrictions. From the beginning, the need for interchangeable replacement bearings and high-volume production initiated dimensional standards followed by the customers need for a common system for calculation of load ratings, lives, etc.

2.4.4 Environmental issues

Environmental care is becoming increasingly important. With proper measures, the bearing industry can contribute to a more sustainable future. Steel production accounts for a large share of the CO_2 emissions globally and the bearing industry can contribute to reducing emissions by keeping a high focus sustainability.

Recycling of residual products is common. Chips can be recycled 100 %. A high percentage of used oils, paper, carton and grinding swarf can be recycled.

Cleaning liquids, such as trichloroethylene, can for example be replaced by water-based cleaning liquids. There are large bearing factories where no trichloroethylene is used.
Certification to the environmental management system standard ISO 14001 is of course important and many bearing companies have been certified.

However, one aspect that needs to be considered here is re-manufacturing. There is not only potential cost savings of between 50% to 80% of the cost of a new bearing. Remanufacturing of used bearings can reduce CO_2 emissions. Remanufacturing 100 kg of used bearings can lead to a reduction of about 350 kg CO_2.

2.5 Acceptance of the ISO/TC 4 Standards

For manufacturing and selling rolling bearings the standards worked out by ISO/TC 4 are of utmost importance. These standards are widely accepted, and all common bearing types are produced according to the standards. However, bearings with specific dimensions are also produced. One example is bearings with inch dimensions. Although externally not conforming to standard dimension series, these special bearings typically adopt appropriate ISO/TC4 standards for internal features.

3 Benefits expected from the work of the ISO/TC

It has already been explained above that rolling bearings have been essential for the manufacturing of industrial products and in the development of new products. As bearings are produced in extremely large numbers and with many thousands of variants, the ISO/TC 4 Standards have been, and remain, indispensable for bearing manufacturers and users.
This is valid for all stages in the process from bearing manufacturing, storage, sales and distribution. The end user needs the standardized products when selecting and purchasing bearings and when designing his product in order to obtain good performance and easy mounting and replacement of bearings.

4 Representation and participation in the ISO/TC

4.1 Membership

The participation in ISO/TC 4, of P-members (Participating Members) and O-members (Observing Members) can be seen here:
Members of ISO/TC 4 on ISO Online

4.2 Analysis of the participation

Liaisons with other organizations are with FEM (European Federation of Handling Industries) and WCO (World Customs Organization).

Internal ISO liaisons are currently with:

ISO/TC 10/SC 6:	Technical product documentation; Mechanical engineering documentation
ISO/TC 17/SC 4:	Steel; Heat treatable and alloy steels
ISO/TC 20:	Aircraft and space vehicles
ISO/TC 28:	Petroleum and related products, fuels and lubricants from natural or synthetic sources
ISO/TC 108/SC 2:	Mechanical vibration, shock and condition monitoring; Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures
ISO/TC 123:	Plain bearings
ISO/TC 123/SC 2:	Plain bearings; Materials and lubricants, their properties, characteristics, test methods and testing conditions
ISO/TC 123/SC 3:	Plain bearings; Dimensions, tolerances and construction details
ISO/TC 123/SC 6:	Plain bearings; Terms and common items
ISO/TC 206:	Fine ceramics
ISO/TC 213:	Dimensional and geometrical product specifications and verification
ISO/TC 269/SC 2:	Railway applications; Rolling stock

5 Objectives of the ISO/TC and strategies for their achievement

5.1 Defined objectives of the ISO/TC 4

The objectives of ISO/TC 4 are to standardize all types and all sizes of bearing and bearing elements based on the principle of rolling motion, their accessories, application, identification, characteristics, and performance criteria. Similarly, the objective is also to standardize spherical plain bearings, i.e., plain bearings with spherical contact surfaces.

5.2 Identified strategies to achieve the ISO/TC's defined objectives

5.2.1 Strategies adopted to reach objectives

With the purpose of assisting the user in the selection, specification and application of correct rolling bearing products as well as ensuring interchangeability, irrespective of origin, the strategy of ISO/TC 4 is:

— standardization of boundary dimensions and tolerances, thereby ensuring dimensional interchangeability,
— standardization of measuring principles including the Geometrical Product Specification (ISO GPS) implementation, thereby ensuring uniform interpretation and
evaluation of quality requirements,
— definition of performance criteria, thereby facilitating the consistent prediction of service performance
— standardization of vocabulary and designations required to define the product.

ISO/TC 4 is a long-standing committee, which was originally established in 1926 by the International Standards Association as committee ISA 4. Therefore, the fields in need of standardization are to a large extent covered by today's ISO/TC 4 Standards.
Very few new bearing types are standardized. Standards have been made for linear motion bearings regarding dimensions, load ratings and vocabulary.

Over the years the quality of the bearing steel has been improved and also the machining accuracy in bearing production. It is possible today to improve the bearing cleanliness throughout operation, e.g., by using sealed bearings or by selecting improved filtering of oil circulating systems. The standardized methods for calculating bearing load ratings and life have been and will be adapted to all these improvements.
European Standards have not yet been used as a basis for ISO/TC 4 Standards, but national standards as DIN, ABMA, GB, JISC, ONORM etc. are sometimes used as a basis or as initiation of work for new or improved standards.
The standardization work is carried out by physical and remote digital meetings. To reduce the environmental impact of traveling and to save time and cost remote digital meetings are to be preferred when possible. English is used at the meetings and the need for translation is normally not required.
Of the ISO deliverables, International Standards dominate and are preferred, but in exceptional cases Technical Reports have been used and also Technical Specifications.
The work within ISO/TC 4 and its subcommittees is mainly based on research results and knowledge from the different bearing companies and their sub-suppliers and practical experience from bearing applications. External research is not used to support the work of the ISO committees, and there is thus no need for funding to cover research costs.
Besides a subcommittee for "Load ratings and life", subcommittees for "Tolerances" and the common bearing types have been established.

Changing needs led also to the establishment of a new Subcommittee in 2011, SC 12: Ball bearings, under the responsibility of JISC (Japan). Changes were also made to the scope and responsibilities of the other SCs.

Besides a subcommittee for “Load ratings and life”, subcommittees for “Tolerances” and the common bearing types have been established, and SAC has taken responsibility of SC 6 and SC 11 secretariat from ANSI.

6 Factors affecting completion and implementation of the ISO/TC work programme

The demand on the Secretariats to deliver the DIS and the FDIS with the aid of a template still means a lot of work and increased cost for the ISO/TC 4 Secretariat and the Secretariats of the subcommittees. However, this does not influence the time for completion of standards.

P-members voting discipline is acceptable, both on ISO/TC and ISO/TC 4/SCs levels. However, often too many P-members abstain of voting.
A frequent problem for the active experts in the working groups is lack of time to spend on standardization. The daily work takes up most of their time. This can cause delay, but the problems are mostly overcome well.

7 Structure, current projects and publications of the ISO/TC

Information on ISO online

The link below is to the TC’s page on ISO’s website:

Click on the tabs and links on this page to find the following information:

- About (Secretariat, Secretary, Chair, Date of creation, Scope, etc.): https://www.iso.org/committee/45544.html
- Contact details: https://www.iso.org/committee/45544.html
- Structure (Subcommittees and working groups): https://www.iso.org/committee/45544.html
- Liaisons: https://www.iso.org/committee/45544.html
- Meetings: https://www.iso.org/committee/45544.html
- Work programme (published standards and standards under development): https://www.iso.org/committee/45544/x/catalogue/p/1/u/0/w/0/d/0

Reference information

https://www.iso.org/governance-of-technical-work.html