GENERAL CATALOGUE

TO SNFA CUSTOMERS

With the commitment we have made in producing this catalogue we hope that we have demonstrated our intention of continuing to support our customers at all times whether it is design or production.

As parts of our continuous improvement programme we are happy to receive constructive comments not only on this catalogue bust also on our customer support; our product, its performance and development and where you, the customer, would like to see SNFA develops itd technology to our mutual benefit.

At SNFA we believe that by developing a partnership between you, the user and us, the manufacturer, we can both grow stronger in terms of research, design, development and ultimately performance to mmeet the demands of this high technology world.

We hope that you will find this catalogue both useful and interesting and that, on the 45th anniversary of the founding of SNFA, we can go forward together towards a successful and profitable future for us all.

SNFA GROUP

TABLE OF CONTENTS

INTRODUCTION

The SNFA Group ..... page 1
The Technologies ..... page 2
SNFA Precision Ball Bearings for Machine Tools and similar Applications ..... page 9
The Product ..... page 10
The Quality System ..... page 11
The Product Range ..... page 12

Symbols and Units ..... page 13

PRODUCT DESCRIPTION

Bearing Configuration ..... page 14
Materials ..... page 15
Precision (Tables ABEC 5 - ABEC 7 - ABEC 9) ..... page 16
Contact Angle ..... page 17
Limiting Speed ..... page 18
Bearing Operating Temperature ..... page 19
Vibration and Noise ..... page 20

BEARING CALCULATION

Calculation of Theoretical Life “L_{10}”; “C_{33}” Dynamic Load Coefficient ..... page 21
Bearing Static Check; “C_0” Static Load Coefficient ..... page 26

MATCHED SETS

Matching (DUPLEX, MULTIPLEX, Sets) ..... page 28
Features of SNFA Sets ..... page 30
Single Universal Bearings “U” ..... page 31
Preload ..... page 32
Limiting Axial Load ..... page 33
Rigidity ..... page 34
Spacers ..... page 35

ASSEMBLY TOLERANCE

Machining Tolerance for Shaft and Housings ..... page 36
Diameters of Shoulders and Corner Radii of Seatings ..... page 39
Diameters of Shoulders and Corner Radii of Bearings ..... page 41

LUBRICATION

Aims of lubrication ..... page 43
Grease lubrication ..... page 43
Oil lubrication ..... page 46
Seals ..... page 52

HANDLING AND MARKING OF BEARINGS

Handling the bearings ..... page 54
Locking of bearing rings ..... page 55
Marking ..... page 59

ISO Series and SNFA Production ..... page 62
Bearing Identification Code ..... page 63

SNFA PRODUCT TABLES

- Series SEA - SEB - EX - E 200 ..... page 65

- Series BS 200 and BS Special for Ballscrews ..... page 89

- BSDU - BSQU - BSQU/1 Cartridge Unit, for Ballscrews ..... page 93

Very High Speed Bearings
- Series VEB, VEX, ED ..... page 96

"NS" Bearings with Ceramic Material Balls ..... page 109

"H1" Bearings ..... page 112

"HBB" Cartidge Units ..... page 113

Examples of Bearing Applications ..... page 115

Comparison Table of SNFA Bearings with Other Makes ..... page 121

The SNFA Group

The SNFA Group has specialised in the manufacture of high precision **ball and roller bearings** ever since its inception in 1952 and has invested continually resources in research and product technology.

As activities expanded, SNFA gradually implemented an organisational structure based on two major product groups with the objective of reaching the highest levels of specialisation in:

- cylindrical roller and ball bearings for the Aerospace industry

- high precision ball bearings for machine tool and other special applications

PRODUCTION UNITS

SNFA SA (France)
Aerospace bearings

SNFA Bearings Ltd (U. K.)
Precision ball bearings

Somecat S.p.A. (Italy)
Precision ball bearings

MARKETING UNITS

SNFA SA
(France)

SNFA Bearings Ltd
(U. K.)

Somecat S.p.A.
(Italy)

SNFA Präzisions Wälzlager Gmbh (Germany)

SNFA S.A. Fribourg (Switzerland)

The Technologies...

Bearing ring **grinding** and **superfinishing** are part and parcel of comprehensive cycle of operation for all ring surfaces.

These operations require special high quality C. N. C. grinding machines and inspection equipment.

All machines, inspection equipment and manufacturing processes satisfy the most stringent and up-to-date requirements, vital for manufacturing high quality precision products.

Rings are manufactured from bar or forged tube. The common element is the raw material used, 100Cr6 steel, which must be high quality and inclusion free.

In high precision applications it is the quality and operation and performance of **SNFA** bearings which stands out.

This is true for all of the **SNFA** Group Companies whose production combines to offer a wide range of bearings for high precision and aerospace applications.

Design, testing, manufacturing and inspection are given all the resources and facilities necessary to satisfy the ever increasing demands of technologically advanced bearings.

…the technologies…

Matching is the operation whereby groups of two or more bearings are formed to achieve the required **preload.**

Precise and uniform preload gives consistent operation between bearing sets.

SNFA uses special equipment to achieve this, the application of required preload and the corresponding reading of bearing surface clearance needing to be very strictly controlled.

Cotton fabric reinforced phenolic resin **cages** are machined from tube.
Good dynamic behaviour of this vital bearing component depends on raw material homogeneity and exact geometry being obtained during manufacture.

Rings are finally inspected 100%. Specially designed computer-controlled equipment performs automatic and simultaneous measurement of all ring geometrical parameters to a high degree of precision.

The results are stored for later quality analysis.

On **assembly** the parts come together to form the completed bearing. At this stage special care is needed to ensure that the rolling surfaces are not damaged.

Assembly of preselected components using induction equipment ensures controlled heating bearing outer ring expansion and ease of assembly.

… the technologies.

Marking ensures complete product identification. Codes identify the basic bearing type, its degree of precision contact angle and type of pairing.
Computer controlled laser marking equipment is used.

Cleanliness is essential to guarantee bearing life. **Washing** requires the use of special machinery equipment and fluids.

Before shipment to their final destination finished bearings are stored in a controlled temperature and humidity environment.

Design of new bearing series uses sophisticated computer programs backed up by rig testing.

This activity is performed in line with the criteria of Quality Assurance Standard ISO 9000.

Production development must be supported by **experimentation.**

Ongoing functional tests at SNFA laboratories are targeted at finding new innovative solutions for the benefit of our customers.

Customer Service

The experience of SNFA's technical offices is at the customers disposal for optimum bearing selection, starting at the design stage.
The tools used for this activity include sophisticated calculation programmes and the **Electronic Catalogue**, the computerised version of the SNFA General Catalogue. It can be used PC based to select the most suitable bearings and perform all necessary application calculations.

ISO 9002-Cert. n°0026/1

HIGH PRECISION ANGULAR CONTACT BALL BEARINGS

SNFA PRECISION BALL BEARINGS FOR MACHINE TOOLS AND OTHER APPLICATIONS

This catalogue presents the entire SNFA product range of high precision, angular contact ball bearings and ballscrew support cartridge units.

These bearings are marketed world wide and used both as original equipment and as spares for machine tools and other applications wherever precision, quiet running and low friction rotation is necessary.

SNFA bearings are recognised everywhere for their technical excellence and quality and are marketed directly by SNFA, who provides an expert and wide ranging Customer Service.

The Product

SNFA's prime objective has always been to reach the highest levels of specialisation in the design, development and manufacture of precision bearings.

The various series illustrated in this catalogue differ by configuration and size. They consist of bearings ranging in size from a minimum of **6 mm** diameter bore to a maximum of **380 mm** outer diameter.

Development has always been in line with international standards, as there is a need to safeguard interchangeability. Bearing specifications are therefore classed in accordance with such standards.

Specifically, SNFA bearings are designed and manufactured in accordance with the following standards:

- Overall dimension, radii	**AFBMA Std 20**	**(Equivalent to ISO 15)**
- Dimensional tolerance	**AFBMA Std 20**	**(Equivalent to ISO 492)**
- Running accuracy tolerances	**AFBMA Std 20**	**(Equivalent to ISO 492)**

The Quality System

SNFA holds ISO 9000 Quality Certification.

Implementing the Quality System is a cornerstone of company organisation and production processes to consolidate quality levels and satisfaction of market expectations.

SNFA Group Companies have given special attention to **Safety**, the **Environment** and **People.** SNFA believes in continuing education and training courses as the basis for achieving **TOTAL QUALITY**.

Product Range

The SNFA product range (see the Table below) includes:
Series **SEA - SEB - EX - E200**, which are different dimensional series
Series **VEB and VEX**, designed for high speed applications
Series **BS200 and BS Special**, 62° contact angle, for ballscrew support
Series **ED**, separable inner ring bearings; produced only on request.

All the series are produced in the AFBMA ABEC 7 - ABEC 9 precision classes.
All the bearings, especially the " high speed " ones, are available in the " **NS** " configuration (Hybrid bearings).
The SNFA range also includes **BSDU - BSQU - BSQU/1** cartridges for ballscrew supports, containing **BS200** bearings.

SNFA Series	I S O	Features
SEA	**18**	Minimum overall dimensions Radial-axial load 1.500.000 ndm (oil)
SEB	**19**	Reduced overal dimensions Radial-axial load 1.500.000 ndm (oil)
VEB	**19**	Reduced overal dimensions (as SEB) Very hight speed (over 2.000.000 ndm; oil)
EX	**10**	Hight load capacity Radial-axial load 1.500.000 ndm (oil).
VEX	**10**	Very hight speed (over 2.000.000 ndm; oil) Good radial axial load capacity.
E200	**02**	Very hight load capacity Radial-axial load 1.500.000 ndm (oil).
BS200	**02**	Hight axial rigidity and load capacity Prevalently axial load Speed 400.000 ndm (grease)
BS (special)	**-**	As BS200
ED	**10**	Very hight speed (over 2.000.000 ndm; oil) Separable inner ring Moderate Radial-axial load capacity.

Symbols and Units

d	: Bearing bore diameter	mm
D	: Bearing outer diameter	mm
B	: Bearing width	mm
Z	: Number of balls	-
Ø	: Ball diameter	mm
α	: Contact angle	degrees
dm	: Bearing pitch diameter	mm
C33	: Dynamic load capacity	daN
C0	: Static load capacity	daN
Pr	: Preload	daN
La	: Static axial load limit	daN
Ra	: Axial rigidity	daN / µm
Vh	: Maximum speed with oil lubrication	rpm
Vg	: Maximum speed with grease lubrication rpm	rpm
Cr	: Low speed rolling torque for bearing group	daN · mm
M	: Bearing Weight	kg
n	: Speed	rpm
ndm	: Speed factor	rpm· mm

Any other symbols mentioned in this catalogue are specified in tha paragraph they refer to.

Bearing configuration

Due to their internal design, angular contact ball bearings can withstand high radial - axial loads and reach high speeds.

They are asymmetrical for manufacturing reasons and can withstand uni-direction axial loads only. They cannot be used on their own.

Angular bearings are mounted in groups of two or more opposed pre-loaded units with rigid or elastic spacers.

Their asymmetrical shape permits installation of a one-piece cage with a large number of balls, thus ensuring high load capacity and rigidity.

The various SNFA bearing configurations are grouped in series, for easy product identification and selection according to application requirements.

	Form Code	SNFA Series	Features
	E-SE	**SEA** **SEB** **EX** **E 200**	CAGE OUTER RING LOCATED COUNTER - BORED OUTER RING NON -SEPARABLE α = 15° to 25° α = 18° *)
	VE	**VEB** **VEX**	CAGE OUTER RING LOCATED OUTER AND INNER RING ASYMMETRICAL NON -SEPARABLE α = 15° to 25° α = 12° to 18° *)
	BS	**BS 200** **BS (special)**	CAGE OUTER RING LOCATED OUTER AND INNER RING ASYMMETRICAL NON -SEPARABLE α = 62°

* Available on request

Materials

Inner and outer races and balls

SNFA bearings are manufactured in SAE 52100 (ISO 100 Cr 6) chrome steel, this being a particularly clean material offering high reliability.
It is hardened and tempered to a process which allows safe operation up to 150 °C.
Where the operating conditions are severe, bearings may have ceramic balls (see NS bearings).

Cage

SNFA design cages to be of low weight and with low friction suitable for operation at high speed.
The most commonly used material is cotton reinforced phenolic resin.
Some bearing series are equipped with glass fibre reinforced polyamide cages.
Brass or Aluminium cages are available for special applications on request.

Precision

Dimensional and Functional Tolerances of Bearings ABEC 5 - ABEC 7 - ABEC 9 (AFBMA STD 20)

Inner ring

(Values indicated in microns)

Bore in mm		> 0 ≤ 10	> 10 ≤ 18	> 18 ≤ 30	> 30 ≤ 50	> 50 ≤ 80	> 80 ≤ 120	> 120 ≤ 150	> 150 ≤ 180	> 180 ≤ 250	> 250 ≤ 315	> 315 ≤ 400	> 400 ≤ 500
Δ_{dmp}	ABEC 5	-5	-5	-6	-8	-9	-10	-13	-13	-15	-18	-23	
	ABEC 7	-4	-4	-5	-6	-7	-8	-10	-10	-12			
	ABEC 9	-2.5	-2.5	-2.5	-2.5	-4	-5	-7	-7	-8			
K_{ia}	ABEC 5	4	4	4	5	5	6	8	8	10	13	15	
	ABEC 7	2.5	2.5	3	4	4	5	6	6	8			
	ABEC 9	1.5	1.5	2.5	2.5	2.5	2.5	2.5	5	5			
S_{ia}	ABEC 5	7	7	8	8	8	9	10	10	13	15	20	
	ABEC 7	3	3	4	4	5	5	7	7	8			
	ABEC 9	1.5	1.5	2.5	2.5	2.5	2.5	2.5	5	5			
S_d	ABEC 5	7	7	8	8	8	9	10	10	11	13	15	
	ABEC 7	3	3	4	4	5	5	6	6	7			
	ABEC 9	1.5	1.5	1.5	1.5	1.5	2.5	2.5	4	5			
V_{Bs}	ABEC 5	5	5	5	5	6	7	8	8	10	13	15	
	ABEC 7	2.5	2.5	2.5	3	4	4	5	5	6			
	ABEC 9	1.5	1.5	1.5	1.5	1.5	2.5	2.5	4	5			
Δ_{Bs}	ABEC 5	-40	-80	-120	-120	-150	-200	-250	-250	-300	-350	-400	
	ABEC 7	-40	-80	-120	-120	-150	-200	-250	-250	-300			
	ABEC 9	-40	-80	-120	-120	-150	-200	-250	-300	-350			
Δ_{B1s}	ABEC 5	-250	-250	-250	-250	-250	-380	-380	-380	-500	-500	-630	
	ABEC 7	-250	-250	-250	-250	-250	-380	-380	-380	-500			

Outer ring

(Values indicated in microns)

O D in mm		> 0	> 6 ≤ 6	> 18 ≤ 18	> 30 ≤ 30	> 50 ≤ 50	> 80 ≤ 80	> 120 ≤ 120	> 150 ≤ 150	> 180 ≤ 180	> 250 ≤ 250	> 315 ≤ 315	> 400 ≤ 400	≤ 500
Δ_{Dmp}	ABEC 5		-5	-5	-6	-7	-9	-10	-11	-13	-15	-18	-20	-23
	ABEC 7		-4	-4	-5	-6	-7	-8	-9	-10	-11	-13	-15	
	ABEC 9		-2.5	-2.5	-4	-4	-4	-5	-5	-7	-8	-8	-10	
K_{ea}	ABEC 5		5	5	6	7	8	10	11	13	15	18	20	23
	ABEC 7		3	3	4	5	5	6	7	8	10	11	13	
	ABEC 9		1.5	1.5	2.5	2.5	4	5	5	5	7	7	8	
S_{ea}	ABEC 5		8	8	8	8	10	11	13	14	15	18	20	23
	ABEC 7		5	5	5	5	5	6	7	8	10	10	13	
	ABEC 9		1.5	1.5	2.5	2.5	4	5	5	5	7	7	8	
S_D	ABEC 5		8	8	8	8	8	9	10	10	11	13	13	15
	ABEC 7		4	4	4	4	4	5	5	5	7	8	10	
	ABEC 9		1.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	4	5	7	
V_{Cs}	ABEC 5		5	5	5	5	6	8	8	8	10	11	13	15
	ABEC 7		2.5	2.5	2.5	2.5	3	4	5	5	7	7	8	
	ABEC 9		1.5	1.5	1.5	1.5	1.5	2.5	2.5	2.5	4	5	7	
Δ_{Cs} Δ_{C1s}	ABEC 5	VALUES IDENTICAL TO THOSE OF THE CORRESPONDING INNER RING OF THE SAME BEARING												
	ABEC 7													

N.B.: The tolerances ABEC 5, 7 and 9 are defined by AFBMA (Anti-Friction Bearing Manufactures Association - U.S.A.) whose proceedings have been approved by the American National Standards Institute.

Δ_{dmp} = Deviation of the mean bore diameter from the nominal ($\Delta_{dmp} = d_{mp} - d$).

Δ_{Dmp} = Deviation of the mean outside diameter from the nominal ($\Delta_{Dmp} = D_{mp} - D$).

K_{ia}, K_{ea} = Radial runout of assembled bearing inner ring and assembled beraing outer ring, respectively.

S_{ia}, S_{ea} = Side face runout of assembled bearing inner ring and assembled bearing outer ring, respectively.

S_d = Side face runout with reference to bore (of inner ring).

S_D = Outside inclination variation: variation in inclination of outside cylindrical surface to outer ring side face.

V_{Bs}, V_{Cs} = Ring width variation: difference between the largest and smallest single widths of inner ring and of outer ring, respectively.

Δ_{Bs}, Δ_{Cs} = Deviation of single inner ring width or single outer ring width from nominal (Δ_{Bs}, = B_s - B ecc.)

Δ_{B1s}, Δ_{C1s} = Deviation of single width of inner ring and outer ring, respectively, of a bearing specially manufactured for paired mounting and universal bearings. (Δ_{B1s}, = B_s - B ecc.)

CE1

CE3

Contact Angle

In practice, the following may affect the bearing contact angle at critical operating speeds and temperature conditions:

. high interference fitting of races
. temperature differential between the outer and inner races
. centrifugal force effects on the balls and rotating race

Neglecting these possible problems could lead to rapid bearing failure.

Where there is concern about contact angle changes, SNFA will analyse the situation using the most up to date methods.
The choice of the contact angle requires careful application analysis keeping in mind at all times the final performance requirements.

CONTACT ANGLE	SNFA CODE
12°	0
15°	1
18°	2
25°	3
62°	62

Limiting Speed

Angular contact ball bearings feature the highest rotational speed capabilities of all precision bearings.

The speeds illustrated in the SNFA catalogue indicate the limit at which bearings can operate continuously, at a safe, constant temperature **(thermal reference speed).**
This temperature varies according to the type of lubricant used. Limiting temperature for grease lubricated bearings is lower than for oil because of greater lubricant deterioration.
Limiting speed for a grease lubrication is consequently about 65% of the value achievable with oil .

To ensure high reliability, the temperature limits referred to in setting SNFA bearing speeds are lower than those commonly used for standard non-precision bearings to ensure high reliability.

Bearing limiting speeds depend on their class, series and internal configuration.

The following are further elements that influence bearing limit speed:

- preload, which affects operating temperature directly
- precision
- composition of the set and type of mounting: Face-to-face arrangement **(FF; TF, 3TF, TFT)** has a lower speed limit.
- contact angle

The maximum speeds indicated in the Data Table refer to ABEC 7 precision class, oil lubrication, individual and matched bearings.

Series VEB and VEX are an exception to this, as they refer to class ABEC 9.

The correction factors indicated below are applied for calculating bearing speed in other variants not listed in the table.

	Precision			Contact angle		Lubrification	
Characteristics bearing	ABEC						
	9	7	5	15°	25°	Oil	Grease
Correction costants	1,1	1	0,9	1	0,9	1	0,65

Achievement of maximum speed is of course affected by correct assembly of the bearings in their application.

The following must therefore be provided:

- housing and spindle components and bearing seats within suitable tolerance limits (Cf. Assembly Tolerances)
- proper dynamic balancing of rotating parts
- efficient lubrication

Bearing Operating Temperature

Maximum allowable operating temperature for angular contact precision ball bearings corresponds to the limiting value below which no geometrical and structural changes occur. This value depends on material and relevant heat treatment adopted.

SNFA bearing rings are stabilised to attain a temperature 150° C; stratified textile - resin or polyamide cages can attain a maximum temperature 120°C.

During operation, the internal bearing temperature is much higher than that measured by probes placed close to the rings.

This situation is particularly critical in the case of rigidy preloaded bearings operating at high speed since dangerous local overheating at the ball to race contact area can occur.

This event, that leads to bearing seizure, can be avoided by ensuring that the temperature measured by the probe is well below the values indicated above. In the case of grease lubricated bearings, the situation is already critical when the temperature of the outer and/or inner ring is over 55 °C, as the grease deteriorates rapidly.

Temperature limits are much higher with oil lubrication and depend on the lubrication system used.

Control Noise and Vibration

This operation, which is undertaken at the customer's request or if the bearings normally run at high speed (ie high ndm levels) checks that the bearing runs correctly.
This machine measures noise levels over three frequency bands and analyses the result using Fast Fourier Transform (FFT) to give an indication of the bearing's dynamic behavour.

Vibration and Noise

The vibration and noise level of a bearing expresses component quality and bearing cleanliness.

SNFA bearings are inspected during final manufacturing stage with special three-frequency band test equipment to get further confirmation of the quality requirements.

This equipment also permits vibration analysis on frequency spectra to analyse the behaviour of each bearing component.

Typical bearing frequencies are closely correlated to their design and can be calculated with the following formulae:

$$BPFO = f \cdot \frac{z}{2} \cdot \left(1 - \frac{\Phi}{dm} \cos\alpha\right) \quad (Hz)$$

$$BPFI = f \cdot \frac{z}{2} \cdot \left(1 + \frac{\Phi}{dm} \cos\alpha\right) \quad (Hz)$$

$$BSF = \frac{f}{2} \cdot \left(\frac{dm}{\Phi} - \frac{\Phi}{dm} \cos^2\alpha\right) \quad (Hz)$$

$$FTF = \frac{f}{2} \cdot \left(1 - \frac{\Phi}{dm} \cos\alpha\right) \quad (Hz)$$

BPFO: Frequency of ball passing over the outer ring.
BPFI: Frequency of ball passing over the inner ring.
BSF: Frequency of ball rotation about its axis.
FTF: Frequency of cage rotation.
where "f" is the frequency, in Hz, of the relative bearing ring rotation.

Dynamic Load Coefficient C_{33} and Theoretical Life Calculation L_{10}

Foreword

Bearing life is defined as the number of revolutions or operating hours a bearing may accumulate before the first signs of defects appear.

If damage caused by major defects or errors are excluded, the commonest bearing failure modules are wear, seizing, permanent deformation, overheating and material fatigue caused by cyclical work stress with spalling.

These complex phenomena are often interdependent and no sure calculation models exist to use as a reference for their assessment. An exception is failure due to race material fatigue on which a theory does exist, together with the calculation method of ISO Standard 281 which derives from that theory.

The most frequent cause of bearing failure in high rotation speed applications, such as high frequency electrical spindles for instance, is not race fatigue but overheating and seizure.

This means assigning priority to design factors improving bearing performance at high speed, such as reducing power loss, better lubrication and cooling even at the expense of bearing load carrying capacity.

Bearings must be checked at the design stage as suitable for supporting work loads without evidencing signs of fatigue, by calculating theoretical life L10 to ISO Standard 281.

Calculation

ISO Standard 281 specifies that the theoretical life of a group of identical type ball bearings with the same contact angle is to be calculated with the following formulae:

$$L_{10} = \left(\frac{K \cdot C_{33}}{Pe} \right)^3 \quad \textbf{(Million rpm)}$$

$$L_{10h} = \frac{\left(L_{10} \cdot 10^6 \right)}{\left(60 \cdot n \right)} \quad \text{(hours)}$$

were :

L_{10} Basic life, in millions of revolutions, with 10% failure probability (90% survival).

L_{10h} Basic life in hours, with 10% failure probability (90% survival).

C_{33} Radial or axial dynamic load capacity with 1 million of revolutions life and 10% failure probability (90% survival);
ISO 281 specifies a formula for calculating C33 for quality steel ring bearings, relative to bea ing internal geometry. These values are given in the bearing data table.

K Additional load capacity coefficient for a group of "i" bearings: $\mathbf{k = i^{0.7}}$

Pe Equivalent dynamic load in daN;
This load has the same effect of axial load Fa and radial load Fr effectively acting on the group of "i" bearings.

Fa Axial load acting on the bearing group (daN).

Fr Radial load acting on the bearing group (daN).

n Rotation speed (rpm).

Notes:

ISO Standard 281 gives the method for calculating capacity (K.C33) of a group of identical bearings when a support consists of different load and pre-load bearings, so the fraction of load acting on load and pre-load bearings must be assessed and the life of both groups calculated separately.

Basic lives L10 and L10h depend on working loads and speeds as well as on bearing design. ISO 281 mentions the possibility of assessing lives that take account of other parameters. Such lives, called corrected and coded L10a and L10ha respectively, are obtained by multiplying basic lives by suitable correction factors "a" that take account of:

- lubricant viscosity and cleanliness
- steel cleanliness
- ultimate bearing steel fatigue resistance.

These calculations can entail difficulties due to data uncertainty. Should the effects of these factors require to be assessed, SNFA Technical Department should be contacted.

The ISO 281 calculation method holds true for steel ball bearings and for rotation speeds where centrifugal forces on the balls are negligible compared with work loads. Should this not be the case, a sophisticated computer program based on the same fatigue-induced failure theory as ISO Standard 281 is available at the SNFA Technical Department

Calculation of Equivalent Dynamic Load Pe

(ISO Standard 281)

The values of the equivalent dynamic load is defined by the following formula:

$$P_e = XF_r + YF_a \qquad \text{(daN)}$$

The values of X and Y are shown in table below.

Note: in the case of a set of preloaded bearings:

1) if the support is subjected solely to a radial load, the axial load is equal to the preload

$$F_a = P_r \qquad \text{(daN)}$$

2) if the support is subjected to a combined external load, radial and axial:

- if the group is rigidly preloaded:
  a) with external F_a not exceeding 3 P_r use F_a = 2/3 F_a external + P_r
  b) with external F_a greater than 3 P_r use F_a = F_a external
- if the bearings are preloaded by springs:
  F_a = F_a external + P_r springs

Values of X and Y for calculating equivalent dynamic load
Single bearings or Tandem (T) sets

α	$\frac{F_a}{i\,C_o}$	e	$\frac{F_a}{F_r} \leqq e$		$\frac{F_a}{F_r} > e$	
			X	Y	X	Y
15°	0,015 0,029 0,058 0,087 0,12 0,17 0,29 0,44 0,58	0,38 0,40 0,43 0,46 0,47 0,50 0,55 0,56 0,56	1	0	0,44	1,47 1,40 1,30 1,23 1,19 1,12 1,02 1,00 1,00
25°	-	0,68	1	0	0,41	0,87
62°	-	2,65	2,06	0,54	0,98	1

Combined Life L10

When the bearing is subjected to a work load with a known spectrum of load, rotation speed and percentage use, that is when the following parameters are known:

F1	n1	U1
F2	n2	U2
F3	n3	U3
.....	.....	.....
Fn	nn	Un

bearing life can be calculated by using the following formula, after calculating life L10 for each cycle condition:

$$L_{10} = \frac{100}{\frac{U1}{L10_1} + \frac{U2}{L10_2} + \cdots\cdots \frac{Un}{L10_n}}$$

Reliability Factor (ISO 281)

Life corresponding to a different degree of reliability can be assessed by multiplying 90% reliability L10 by the required correction coefficient as indicated in the table below:

Reliability	Life		Coefficient	
50%	L50	=	5	· L10
90%	L10	=	1	
95%	L5	=	0.62	
96%	L4	=	0.53	
97%	L3	=	0.44	
98%	L2	=	0.33	
99%	L1	=	0.21	

These coefficients are the result of the theory underlining ISO Standard 281, which states that the statistical distribution of fatigue-induced collapse in a population of identical bearings in equal working conditions follows a well-defined Weibull distribution.

Static Load Coefficient Co and Bearing Static Check

Static Load Coefficient Co

Static Load Coefficient **Co** is used to check whether a static or very slowly rotating bearing can withstand undamaged short bursts of high loads as can be caused by impacts or manoeuvres.

This coefficient is used in machine tools for instance, to check whether spindle bearings can withstand the loads generated by tool holder removal operations.

ISO Specification 76-1987 defines coefficient Co as the static load corresponding to 420 daN/mm^2 in the contact area between the most loaded ball and the race. Stress equal to or in excess of this amount cause permanent deformation in angular contact ball bearings. Load Co is to be considered as purely radial for radial bearings and purely axial and centred for axial bearings.

The values of Co are given in the bearing data table.

Static check and Equivalent Static Load Po

The purpose of static check is to ensure that exceptional external static loads acting on a bearing of group of i bearings do not cause permanent race deformation.

To perform this check, external loads with radial component Fr and axial component Fa must be transformed into an equivalent static load Po to be compared with static load capacity Co of the bearing or group of bearings.

Equivalent static load Po is defined as the radial or axial load which would cause the same damage as real load, if applied.

ISO Standard specifies that Po is obtained by using the following formula:

$$P_o = X_o \cdot Fr + Y_o \cdot Fa$$

where:

Fr actual radial load (daN)
Fa actual axial load (daN)
X_o radial load factor.
Y_o axial load factor.

The values of Xo and Yo are given in Table 1 for individual or tandem ball bearings and in Table 2 for back-to-back (DD) or face-to-face (FF) matched bearings.

Table 1 - Single bearings or Tandem pairs(T)

α	X_o	Y_o
15°	0,50	0,46
25°	0,50	0,38

Table 2 - Bearings grouped Back to Back (DD) or Face to Face (FF)

α	X_o	Y_o
15°	1	0,92
25°	1	0,76

Once equivalent static load Po is known adequacy of static load Po is checked, by verifying that the following equation is respected:

$$i \cdot Co / Po \geq So$$

Where:

i is the number of groups bearings which forces Fa and Fr act on;
i · Co Co is the static load capacity of the groups of i bearings;
So is a safety factor that must have the following value in the case of angular contact precision ball bearings:
So = 2 for regular operation
So = 3 for very frequent static stress conditions.

Advanced computerised calculation methods based on calculation of stress in the contact area between balls and races versus external loads and shaft deformation are available at SNFA Technical Department should more accurate assessment be required and for ceramic material ball bearings.

Matched Bearing Sets

A property of precision angular contact ball bearings is that they allow the creation of groups of two or more units to obtain much higher load capacity and more rigid assembly with the same overall diameter.

The simplest form of a set is **Duplex.** This is an assembly of two ball bearings together in various configurations (see below)

The following page illustrates **Multiple sets** which are mostly used in high load applications.

Duplex

Back to Back (DD)

- symmetrical arrangement;
- possibility to withstand radial
- axial loads in two directions;
- high moment rigidity.

Face to Face (FF)

- symmetrical arrangement;
- possibility to withstand radial
- axial loads in two directions;
- low moment rigidity.

Tandem (T)

- the bearings must be identical;
- possibility to withstand one direction axial load, only;
- requires preloading by springs

Multiple Sets

Groups with more than two bearings, can be employed whenever much higher load capacity and more rigid assembly are requested, with the same overall diameter.

Example of multiple sets:

Groups formed with bearings of different kinds

Duplex and Multiplex sets can be further varied by mixing the contact angles and/or different sizes or series of bearings.
The only rule governing these sets concerns tandem groups, which must be formed with identical bearings.

The main advantages which these sets offer are:
- optimisation of load capacity and rigidity
- possibility to reduce bearing preload and, consequently, to increase operating speed (for example, if preloading bearings of a set have smaller contact angle than loading bearings, the set preload can be reduced without affecting the limiting axial load Pd)
- smaller overall dimensions of the preloading bearings.

Designation exemple:

EX80 7CE3 T / EX 75 7CE1 DL
Group of 3 bearings, formed by 2 EX series bearings, tandem arrangement, 80 mm bore, 25° contact angle and by 1 EX series bearing, 75 mm bore, 15° contact angle, back to back.

Details of SNFA Bearing Sets

The performance of bearing sets depends mostly on the accuracy of the matching operation.
To satisfy this condition SNFA bearing sets are made up as follows:

- reduced tolerance of gap between bearing faces in combination with high precision measurement loading
- uniform contact angle
- minimum bore and outside diameter difference (about one third of respective tolerances)

Observing the following recommendations is essential in using SNFA bearing sets;

- never exchange bearings from different sets
- assemble the bearing sets as indicated by the V marked on the bearing outside diameter surface (the tip of this V points in the direction of the predominant axial thrust **acting on the inner rings**).
  The axis of the V is at the point of maximum eccentricity (maximum radial thickness) of the outer ring of each bearing

Universal Bearings

Bearings subject to selected axial preload (light [L], medium [M] or heavy [F]) and having flush side faces under preload are classed as Universal [U].

SNFA universal bearings have the suffix UL, UM, UF according to the required preload and offer users the possibility of forming groups of bearings in any required arrangement (DD, FF or T) by using their own stock, without having to make any ring face adjustement.

As a consequence of their manufacturing features, the resultant preload of groups of U bearings is obtained by multiplying the preload of the single U bearing by the following coefficients:

Sets	Coefficient
DD - FF	1,00
TD - TF	1,35
3TD - 3TF	1,60
TDT - TFT	2,00

Above mentioned sets formed with "Universal" bearings, when compared to the "SNFA matched sets", offer advantage for stocking requirements but their contact angle and bore / outer diameter tolerance do not maintain SNFA standards.

A variant, consisting of Duplex Universal bearings, coded DUL, DUM and DUF according to preload, is also available.

Its advantages can be summarised as follows:

the bearings of the same pair can be mounted in any configuration (DD, FF or T)
the contact angle difference between the two bearings is minimum (a significant advantage for a tandem configuration)
the difference in the actual bore and outside diameter, between the two bearings, is minimal (one third of overall tolerance)

Universal Duplex bearings from different sets may not be exchanged between each other.

The speed, preload and rigidity values indicated in the bearing table refer to SNFA matched bearings. For asymmetrical groups (TD - TF), formed by single Universal bearings, these values must be calculated for each case, taking proper account of the preload correction coefficients mentioned above.

Contact Angle and Preload

The contact angle on all bearings manufactured is measured by a purpose built machine working to an accuracy better than 30 minutes of arc.
The preloading of a pair or set of bearings is gauged on special presses. These are also purpose built machines which allow close control of the applied load and accurate measurement of the displacement. Such is the accuracy of this equipment that bearings in a set are matched to within 1 micron.

Preload

Preload can be defined as axial load applied permanently to bearings to ensure proper operation under external load. Preload can be **rigid**, as in the case of opposed bearings with or without spacers, or **elastic**, using springs.

Rigid preload involves the formation of a gap between the faces of opposed bearings. This gap is eliminated when bearings are locked axially.

Rigid preload may change during operation due to the effect of thermal expansion. With elastic preload, expansion is compensated for by the springs. Bearing preload variation is minimal in this case.

Bearing preload is essential because of its influence on speed limits, rigidity and applicable work loads.

The preloads commonly recommended to satisfy all requirements are Light **[L]**, Medium **[M]** and Heavy **[F]** and are given in the bearing data table. Bearings can be supplied with special preload.

The tables also indicate maximum speed and axial rigidity Ra, for each preload, for paired bearings and for groups of three units.

Rigid preload reached during operation is often higher than that indicated in the catalogue.

The following factors are involved in this modification:

- bearing fit tolerances (housing and shaft)
- inner ring expansion due to centrifugal force and thermal effect
- ball dynamic effects

In order to prevent premature failure, a lower initial preload should be selected so it reaches the proper value at full operation.

Limiting Axial Load

Limiting axial load, **Pd,** is the external axial load of a preloaded bearing pair or set that causes loss of contact between the balls and race in preload bearings. This effect may lead to balls skidding against the races and surface damage.

This event may not occur as even a light radial load maintains ball/track contact.

In applications (such as in some machine tools) , where the working axial load is predominantly in one direction , limiting axial load Pd can be increased by using a bearing set with a mixed contact angle (C3/C1). The axially more rigid bearing (C3) withstands the work load and the less rigid (C1) one is the reaction element.

The limiting axial load Pd is calculated as follows:

CONFIGURATION		CONTACT ANGLES	
Load bearings α_1	Preload bearings α_2	$\alpha_1 = \alpha_2$	$\alpha_1 = 25°$; $\alpha_2 = 15°$
DD		Pd = 2,83 · Pr Pd' = 2,83 · Pr	Pd = 5,9 · Pr Pd' = 1,75 · Pr
TD		Pd = 4,16 · Pr Pd' = 2,08 · Pr	Pd = 9,85 · Pr Pd' = 1,45 · Pr
TDT		Pd = 2,83 · Pr Pd' = 2,83 · Pr	Pd = 5,9 · Pr Pd' = 1,75 · Pr
3TD		Pd = 5,4 · Pr Pd' = 1,8 · Pr	Pd = 13,66 · Pr Pd' = 1,33 · Pr

Note:
- Pr, set preload
- The above table can also be used for corresponding face-to-face configurations FF, TF, TFT and 3TF, simply by giving Pd the value of Pd1.

Rigidity

Axial Rigidity

Rigidity **Ra** of an angular contact ball bearing is the external axial load causing 1 micron displacement (daN / mm).

Ra of a bearing pair or set can also be defined as the ratio between the limiting axial load Pd and bearing axial deflection δa2 (figure 1). Axial rigidity remains practically constant until external load is greater than off load Pd.

Axial rigidity Ra varies as contact angle and bearing preload vary.

Preloaded bearing deflection curves are used to plot axial rigidity and the limiting axial load as follows

Fig. 1

δat : gap of bearing faces, corresponding to the preload
δ1 : axial deflection of the bearing group due to axial load Fa1
δa1 : axial deflection of the loading bearings
δa2 : axial deflection of preloading bearings

$$R_a = \frac{F_{a1}}{\delta_1} = \frac{P_d}{\delta a2}$$

Radial rigidity

Angular contact ball bearing radial rigidity " **Rr** " too, varies with contact angle and preload; unlike axial rigidity however, radial rigidity decreases as contact angle increases and changes markedly as a function of the ratio between axial and external loads applied to the bearing.

The radial rigidity of a back-to-back or face-to-face bearing set can be empirically calculated as follows:

α = 15°	Rr = 6 ·Ra	where: Ra = axial rigidity
α = 25°	Rr = 2 ·Ra	where: Rr = radial rigidity

Spacers

The addition of spacers between the bearings of a set may be necessary when the following is required:
- increased angular rigidity by separating the bearing
- heat generated by the bearings is to be disipated more effectively
- the space is required for oil jet nozzles.

Spacer manufacture requires good accuracy to ensure:
- parallel and planar faces within reduced tolerance limits (Cf. Bearing tolerances)
- equal width outer and inner spacers to keep bearing original preload unchanged (simultaneous grinding is recommended)
- well-balanced rotating spacer.

The use of appropriate surface hardened (45HRc) or through hardening material is normally recommended. This treatment prevents the risk of spacer surface damage during assembly and wear during subsequent operation.

Many materials are suitable for producing spacers, including the following:

- ISO 100 Cr6 (SAE 52100) : through hardened
- UNI 38 Ni Cr Mo 4 (SAE 9840) : through hardened / tempered
- UNI 18 Ni Cr Mo 7 (SAE 4320) : case hardened

Spacer configuration complexity depends on any other function it may have.

The rotating or static spacer of oil lubricated bearings may, for instance, be deflector shaped to facilitate oil flow through the bearings to ensure good oil drainage and disposal via the discharge channels.
It must never restrict lubricant flow.
Spacer configuration in grease lubricated bearings plays a secondary role. The spacer shape must however be such as to allow dispersal of the excess grease expelled by the bearings, especially during the running in stage.

Preload arrangements of Back to Back (DD) or Face to Face (FF) can be modified by changing outer or inner spacer width.
For instance, reducing the width of the spacer placed between the outside rings, causes:
- reduced preload in DD sets
- increased preload in FF sets

The opposite occurs by reducing the width of the spacer between the inner rings.

The following calculation is used for proper adjustment:

$$\delta a = 2 \cdot 10^{-3} \cdot Pr^{2/3} \cdot Z^{-2/3} \cdot Ø^{-1/3} \cdot \sin\alpha^{-5/3}$$

Where:	δa	= axial deflection	(mm)
	Pr	= preload	(daN)
	Z	= No. of balls	
	Ø	= ball diameter	(mm)
	α	= contact angle	(degrees)

In the case of MULTIPLEX arrangements, it is necessary to remember that deflection δa of the group of bearings in TANDEM, under preload, is less than that of single bearings.

The deflection of the TANDEM group will therefore be:

$$\delta a_{(TANDEM)} = W \cdot \delta a_{(SINGLE)}$$

Where:

No. bearings in TANDEM	1	2	3	4
W	1	0,63	0,48	0,40

The value of the preloading gap will thus be:

$$\delta at = \delta a1 + \delta a2$$

Where: δat = total preload gap

$\delta a1$ = deflection of load-carrying bearings

$\delta a2$ = deflection of preload bearings

The value of reduction of the spacer for altering the preload will therefore be given by the difference between the δat value relating to the initial preload and to that which it is desired to achieve.

Assembly Tolerances

Seat tolerances are very important both for assembly and bearing performance.
The values shown on the following tables are a guideline for shaft, housing and bearing surrounding parts design.
Precision angular ball bearings are widely used in machine tools and the above tolerances mainly involve this field of application, where the shaft generally rotates while the outside ring is stationary.
In the opposite condition, the housing will require greater interference to prevent creep during operation.
The same applies to shafts submitted to high rotating loads, such as winding machine shafts, for instance.

The values given in the following Table are valid for steel shafts and housings.

Critical situations may occur in which the high temperature gradient between shaft and race requires the application of special tolerances to prevent excess bearing preload and subsequent failure.

Shafts and housings for bearings in precision grades ABEC 7 - ABEC 9

Nominal shaft diameter in mm	≥	6	10	18	30	50	80	120	180	250
	<	10	18	30	50	80	120	180	250	315
	Tolerance on shaft diameter in µm	0	0	0	0	0	+2	+3	+4	+5
		-4	-4	-4	-5	-5	-4	-5	-6	-7
	ISO	-	-	h3	-	h3	-	-	-	-

Nominal housing diameter in mm	≥	10	18	30	50	80	120	180	250	315
	<	18	30	50	80	120	180	250	315	400
Support locked axially	Tolerance in µm	+5	+6	+7	+8	+7	+9	+11	+13	+15
		0	0	0	0	-3	-3	-3	-3	-3
	ISO	H4	H4	H4	H4	-	-	-	-	-
Support free axially	Tolerance in µm	+7	+8	+9	+10	+10	+12	+14	+16	+18
		+2	+2	+2	+2	0	0	0	0	0
	ISO	-	-	-	-	H4	H4	H4	H4	H4

N.B. *For special applications consult our Technical Department*

Shafts and housings for bearings to precision grade ABEC 5

Nominal shaft diameter in mm	≥	6	10	18	30	50	80	120	180	250
	<	10	18	30	50	80	120	180	250	315
	Tolerance on shaft diameter in µm	0	0	0	0	0	+3	+4	+5	+6
		-5	-5	-6	-7	-8	-7	-8	-9	-10
	ISO	-	h4	h4	h4	h4	-	-	-	-

Nominal housing diameter in mm	≥	10	18	30	50	80	120	180	250	315
	<	18	30	50	80	120	180	250	315	400
Support locked axially	Tolerance in µm	+8	+9	+11	+13	+12	+14	+16	+19	+21
		0	0	0	0	-3	-4	-4	-4	-4
	ISO	H5	H5	H5	H5	-	-	-	-	-
Support free axially	Tolerance in µm	+10	+11	+13	+15	+15	+18	+20	+23	+25
		+2	+2	+2	+2	0	0	0	0	0
	ISO	-	-	-	-	H5	H5	H5	H5	H5

N.B. *For special applications consult our Technical Department*

Errors of form and squareness
(Maximum permissable theoretical tolerance)

ISO 1101		ABEC 5	ABEC 7	ABEC 9
○	Circularity	IT 3 / 2	IT 2 / 2	IT 1 / 2
⌭	Cylindricity	IT 3 / 2	IT 2 / 2	IT 1 / 2
↗	Run-out	IT 3	IT 2	IT 1
//	Parallelism	IT 3	IT 2	IT 1
◎	Concentricity	IT 4	IT 3	IT 2
Ra	Roughness	0,4 µm	0,4 µm	0,2 µm

ISO 1101		ABEC 5	ABEC 7	ABEC 9
○	Circularity	IT 3 / 2	IT 2 / 2	IT 1 / 2
⌭	Cylindricity	IT 3 / 2	IT 2 / 2	IT 1 / 2
↗	Run-out	IT 3	IT 2	IT 1
//	Parallelism	IT 3	IT 2	IT 1
◎	Concentricity	IT 4	IT 3	IT 2
Ra	Roughness	0,8 µm	0,4 µm	0,4 µm

Nominal diameter in mm	≥	6	10	18	30	50	80	120	180	250	315
	<	10	18	30	50	80	120	180	250	315	400
Tolerance of form and squareness in microns	IT 0	0,6	0,8	1	1	1,2	1,5	2	3	-	-
	IT 1	1	1,2	1,5	1,5	2	2,5	3,5	4,5	6	7
	IT 2	1,5	2	2,5	2,5	3	4	5	7	8	9
	IT 3	2,5	3	4	4	5	6	8	10	12	13
	IT 4	4	5	6	7	8	10	12	14	16	18

Diameters of shoulders and corner radii of seatings

(The max radii of the seatings, correspond to the relevant r_{min} and R_{min} of the bearing)

d	SEA SERIES					SEB SERIES					EX SERIES					E 200 SERIES				
	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}
6											17	8.5	14.5	0.15	0.3					
7											19	9.5	16.5	0.15	0.3	22	11.0	19.0	0.15	0.3
8											22	11.0	19.0	0.15	0.3	24	11.0	21.0	0.15	0.3
9											24	12.5	20.5	0.15	0.3	26	13.0	23.0	0.15	0.3
10	19	12.0	17.0	0.1	0.3						26	13.5	22.5	0.15	0.3	30	14.5	25.5	0.3	0.6
12	21	14.0	19.0	0.1	0.3						28	15.0	25.0	0.15	0.3	32	16.5	27.5	0.3	0.6
15	24	17.0	22.0	0.1	0.3						32	19.0	28.5	0.15	0.3	35	18.5	31.5	0.3	0.6
17	26	19.0	24.0	0.1	0.3	30	19.5	27.5	0.15	0.3	35	20.5	31.5	0.15	0.3	40	21.5	35.5	0.3	0.6
20	32	23.0	29.0	0.1	0.3	37	24.0	33.5	0.15	0.3	42	24.5	37.5	0.3	0.6	47	26.5	40.5	0.6	1.0
25	37	28.0	34.0	0.1	0.3	42	29.0	38.5	0.15	0.3	47	29.0	43.0	0.3	0.6	52	30.5	46.5	0.6	1.0
30	42	33.0	39.0	0.1	0.3	47	34.0	43.5	0.15	0.3	55	34.5	50.5	0.3	1.0	62	36.5	55.5	0.6	1.0
35	47	38.0	44.0	0.1	0.3	55	39.5	50.5	0.3	0.6	62	40.5	56.5	0.3	1.0	72	44.0	63.0	0.6	1.1
40	52	43.0	49.0	0.1	0.3	62	44.5	57.5	0.3	0.6	68	46.0	62.0	0.3	1.0	80	49.0	71.0	0.6	1.1
45	58	48.5	54.5	0.1	0.3	68	50.0	63.0	0.3	0.6	75	50.5	69.5	0.3	1.0	85	54.0	76.0	0.6	1.1
50	65	53.5	61.5	0.1	0.3	72	54.0	68.0	0.3	0.6	80	55.5	74.5	0.3	1.0	90	57.5	83.0	0.6	1.1
55	72	58.5	68.5	0.1	0.3	80	59.5	75.5	0.3	1.0	90	61.5	83.5	0.6	1.1	100	63.0	92.0	1.0	1.5
60	78	63.5	74.5	0.1	0.3	85	64.5	80.5	0.3	1.0	95	66.5	88.5	0.6	1.1	110	71.5	100.5	1.0	1.5
65	85	69.5	80.5	0.3	0.6	90	69.5	85.5	0.3	1.0	100	71.5	93.5	0.6	1.1	120	76.5	108.5	1.0	1.5
70	90	74.5	85.5	0.3	0.6	100	75.5	94.5	0.3	1.0	110	77.5	103.0	0.6	1.1	125	81.5	113.5	1.0	1.5
75	95	79.5	90.5	0.3	0.6	105	80.5	99.5	0.3	1.0	115	82.5	108.0	0.6	1.1	130	86.5	118.5	1.0	1.5
80	100	84.5	95.5	0.3	0.6	110	85.5	104.5	0.3	1.0	125	88.0	117.0	0.6	1.1	140	92.5	128.0	1.0	2.0
85	110	90.5	104.5	0.3	1.0	120	91.5	113.5	0.6	1.1	130	93.0	122.0	0.6	1.1	150	98.5	137.0	1.0	2.0
90	115	95.5	109.5	0.3	1.0	125	96.5	118.5	0.6	1.1	140	100.5	130.0	1.0	1.5	160	103.0	147.0	1.0	2.0
95	120	100.5	114.5	0.3	1.0	130	101.5	123.5	0.6	1.1	145	104.0	136.0	1.0	1.5	170	112.0	153.0	1.1	2.1
100	125	105.5	119.5	0.3	1.0	140	107.5	133.0	0.6	1.1	150	109.0	141.0	1.0	1.5	180	116.0	164.0	1.1	2.1
105	130	110.5	124.5	0.3	1.0						160	115.0	150.0	1.0	2.0	190	122.0	173.0	1.1	2.1
110	140	116.5	134.0	0.3	1.0	150	117.5	143.0	0.6	1.1	170	121.0	159.0	1.0	2.0	200	130.0	181.0	1.1	2.1
120	150	126.5	144.0	0.3	1.0	165	128.0	157.0	0.6	1.1	180	131.0	169.0	1.0	2.0	215	143.0	192.0	1.1	2.1
130	165	138.0	157.0	0.6	1.1	180	140.0	170.0	0.6	1.5	200	143.0	188.0	1.0	2.0	230	152.0	209.0	1.5	3.0
140	175	148.0	167.0	0.6	1.1	190	151.0	180.0	0.6	1.5	210	153.0	198.0	1.0	2.0	250	165.0	225.0	1.5	3.0
150	190	159.0	181.0	0.6	1.1	210	161.0	199.0	1.0	2.0	225	164.0	212.0	1.0	2.1					
160						220	171.0	209.0	1.0	2.0	240	175.0	226.0	1.0	2.1					
170						230	181.0	219.0	1.0	2.0	260	188.0	242.0	1.0	2.1					
180						250	192.0	238.0	1.0	2.0	280	201.0	259.0	1.0	2.1					
190						260	202.0	248.0	1.0	2.0	290	211.0	269.0	1.0	2.1					
200						280	215.0	266.0	1.0	2.1	310	220.0	290.0	1.0	2.1					
220						300	234.0	286.0	1.0	2.1	340	242.0	319.0	1.5	3.0					
240						320	254.5	305.5	1.0	2.1	360	262.0	339.0	1.5	3.0					
260						360	278.5	342.0	1.0	2.1										
280						380	299	361	1.0	2.1										

Values in mm

Diameters of shoulders and corner radii of seatings

(The max radii of the seatings, correspond to the relevant r_{min} and R_{min} of the bearing)

d	VEB SERIES					VEX SERIES					BS 200 SERIES					BS (special) SERIES				
	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}	D	$d_{a\,min}$	DL_{max}	r_{max}	R_{max}
6						17	8.5	14.5	0.15	0.3										
7						19	9.5	16.5	0.15	0.3										
8	19	10.5	16.5	0.15	0.3	22	11.0	19.0	0.15	0.3										
9						24	12.5	20.5	0.15	0.3										
10	22	13.0	19.0	0.15	0.3	26	13.5	22.5	0.15	0.3										
12	24	15.0	21.0	0.15	0.3	28	15.0	25.0	0.15	0.3	32	17.0	26.5	0.6	0.6					
15	28	17.5	25.5	0.15	0.3	32	19.0	28.5	0.15	0.3	35	20.0	30.0	0.6	0.6					
17	30	19.5	27.5	0.15	0.3	35	20.5	31.5	0.15	0.3	40	23.0	34.0	0.6	0.6					
20	37	24.0	33.5	0.15	0.3	42	24.5	37.5	0.3	0.6	47	27.0	40.0	0.6	1.0	47	27.0	40.0	1.0	1.0
25	42	29.0	38.5	0.15	0.3	47	29.5	42.0	0.3	0.6	52	32.0	45.0	0.6	1.0	62	34.0	53.5	1.0	1.0
30	47	34.0	43.5	0.15	0.3	55	36.5	48.5	0.3	1.0	62	39.0	53.5	0.6	1.0	62	39.0	53.5	1.0	1.0
35	55	39.5	50.5	0.3	0.6	62	41.5	55.5	0.3	1.0	72	45.0	61.5	0.6	1.1	72	45.0	61.5	1.1	1.1
40	62	44.5	57.5	0.3	0.6	68	47.0	61.0	0.3	1.0	80	51.0	69.0	0.6	1.1					
45	68	50.0	63.0	0.3	0.6	75	53.0	67.0	0.3	1.0	85	56.0	74.0	0.6	1.1					
50	72	54.0	68.0	0.3	0.6	80	57.5	72.5	0.3	1.0	90	61.0	79.0	0.6	1.1					
55	80	59.5	75.5	0.3	1.0	90	64.5	80.5	0.6	1.1										
60	85	64.5	80.5	0.3	1.0	95	69.5	85.5	0.6	1.1	110	74.0	96.0	0.6	1.5					
65	90	69.5	85.5	0.3	1.0	100	74.0	91.0	0.6	1.1										
70	100	75.5	94.5	0.3	1.0	110	80.5	99.5	0.6	1.1										
75	105	80.5	99.5	0.3	1.0	115	85.5	104.5	0.6	1.1	130	91.0	114.0	0.6	1.5					
80	110	85.5	104.5	0.3	1.0	125	91.5	113.5	0.6	1.1										
85	120	91.5	113.5	0.6	1.1	130	96.5	118.5	0.6	1.1										
90	125	96.5	118.5	0.6	1.1	140	104.0	126.0	1.0	1.5										
95	130	101.5	123.5	0.6	1.1	145	107.3	132.5	1.0	1.5										
100	140	107.5	133.0	0.6	1.1	150	112.5	137.5	1.0	1.5										
105																				
110						170	127.5	152.5	1.0	2.0										
120						180	135.5	164.0	1.0	2.0										
130																				
140																				
150																				
160																				
170																				
180																				
190																				
200																				
220																				
240																				
260																				
280																				

Values in mm

Diameters of shoulders and corner radii of bearings

VE SERIES

SE - E SERIES

BS SERIES

d	SEA SERIES					SEB SERIES					EX SERIES					E 200 SERIES				
	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin
6											17	9.2	14.0	0.15	0.3					
7											19	10.3	15.7	0.15	0.3	22	12.1	17.9	0.15	0.3
8											22	12.1	17.9	0.15	0.3	24	13.1	18.8	0.15	0.3
9											24	13.6	19.4	0.15	0.3	26	14.8	21.3	0.15	0.3
10	19	13.1	16.1	0.1	0.3						26	15.4	20.6	0.15	0.3	30	16.3	23.7	0.3	0.6
12	21	15.1	18.1	0.1	0.3						28	17.0	23.3	0.15	0.3	32	18.0	26.0	0.3	0.6
15	24	18.1	21.1	0.1	0.3						32	20.7	26.9	0.15	0.3	35	20.8	29.1	0.3	0.6
17	26	20.1	23.0	0.1	0.3	30	21.1	25.9	0.15	0.3	35	22.7	29.3	0.15	0.3	40	24.2	32.8	0.3	0.6
20	32	24.1	28.1	0.1	0.3	37	25.7	32.0	0.15	0.3	42	27.2	34.8	0.3	0.6	47	29.0	38.0	0.6	1.0
25	37	29.1	33.1	0.1	0.3	42	30.7	36.4	0.15	0.3	47	31.7	40.3	0.3	0.6	52	33.8	43.2	0.6	1.0
30	42	34.1	38.1	0.1	0.3	47	35.8	41.4	0.15	0.3	55	37.9	47.2	0.3	1.0	62	40.3	51.7	0.6	1.0
35	47	39.1	43.1	0.1	0.3	55	41.7	48.3	0.3	0.6	62	43.9	53.2	0.3	1.0	72	47.8	59.2	0.6	1.1
40	52	44.1	48.1	0.1	0.3	62	47.2	54.8	0.3	0.6	68	49.2	58.8	0.3	1.0	80	53.3	66.8	0.6	1.1
45	58	49.6	53.6	0.1	0.3	68	52.7	60.3	0.3	0.6	75	54.3	65.7	0.3	1.0	85	58.8	71.5	0.6	1.1
50	65	55.1	60.0	0.1	0.3	72	56.7	65.3	0.3	0.6	80	59.3	70.8	0.3	1.0	90	62.4	77.7	0.6	1.1
55	72	60.7	66.5	0.1	0.3	80	62.8	72.3	0.3	1.0	90	65.8	79.2	0.6	1.1	100	69.0	86.1	1.0	1.5
60	78	65.7	72.5	0.1	0.3	85	67.8	77.3	0.3	1.0	95	70.8	84.2	0.6	1.1	110	77.4	94.6	1.0	1.5
65	85	71.7	78.5	0.3	0.6	90	72.8	82.3	0.3	1.0	100	75.8	89.2	0.6	1.1	120	83.0	102.0	1.0	1.5
70	90	76.7	83.5	0.3	0.6	100	79.3	90.5	0.3	1.0	110	82.4	97.6	0.6	1.1	125	88.0	107.0	1.0	1.5
75	95	81.7	88.5	0.3	0.6	105	84.3	95.5	0.3	1.0	115	87.4	102.6	0.6	1.1	130	93.0	112.0	1.0	1.5
80	100	86.7	93.5	0.3	0.6	110	89.3	100.5	0.3	1.0	125	94.0	111.0	0.6	1.1	140	99.4	120.6	1.0	2.0
85	110	93.2	102.1	0.3	1.0	120	96.0	109.2	0.6	1.1	130	99.0	116.0	0.6	1.1	150	106.0	129.0	1.0	2.0
90	115	98.2	107.1	0.3	1.0	125	101.0	114.2	0.6	1.1	140	106.4	123.6	1.0	1.5	160	113.9	136.4	1.0	2.0
95	120	103.2	112.1	0.3	1.0	130	106.0	119.2	0.6	1.1	145	110.5	129.5	1.0	1.5	170	120.1	144.9	1.1	2.1
100	125	108.2	117.0	0.3	1.0	140	112.4	127.5	0.6	1.1	150	115.5	134.5	1.0	1.5	180	126.5	153.5	1.1	2.1
105	130	113.2	122.0	0.3	1.0						160	122.0	143.6	1.0	2.0	190	132.3	162.7	1.1	2.1
110	140	119.8	130.6	0.3	1.0	150	122.4	137.5	0.6	1.1	170	128.5	151.5	1.0	2.0	200	139.7	170.3	1.1	2.1
120	150	129.8	140.6	0.3	1.0	165	134.0	151.0	0.6	1.1	180	138.5	161.5	1.0	2.0	215	152.3	182.7	1.1	2.1
130	165	141.8	153.2	0.6	1.1	180	146.4	163.6	0.6	1.5	200	151.7	178.3	1.0	2.0	230	162.8	197.1	1.5	3.0
140	175	151.3	163.7	0.6	1.1	190	156.4	173.6	0.6	1.5	210	161.7	188.3	1.0	2.0	250	177.0	213.0	1.5	3.0
150	190	163.3	176.7	0.6	1.1	210	168.6	191.5	1.0	2.0	225	173.2	201.8	1.0	2.1					
160						220	178.6	201.5	1.0	2.0	240	185.0	215.0	1.0	2.1					
170						230	188.6	211.5	1.0	2.0	260	199.0	231.0	1.0	2.1					
180						250	201.7	228.4	1.0	2.0	280	212.9	247.2	1.0	2.1					
190						260	211.7	238.4	1.0	2.0	290	222.9	257.2	1.0	2.1					
200						280	224.8	255.2	1.0	2.1	310	234.1	275.9	1.0	2.1					
220						300	244.8	275.2	1.0	2.1	340	257.2	302.8	1.5	3.0					
240						320	264.8	295.2	1.0	2.1	360	277.2	322.8	1.5	3.0					
260						360	291.0	329.1	1.0	2.1										
280						380	311.0	349.0	1.0	2.1										

Values in mm

Diameters of shoulders and corner radii of bearings

VE SERIES SE - E SERIES BS SERIES

d	VEB SERIES					VEX SERIES					BS 200 SERIES					BS (special) SERIES				
	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin	D	d1	D1	rmin	Rmin
6						17	9.2	14.0	0.15	0.3										
7						19	10.3	15.7	0.15	0.3										
8	19	11.3	15.7	0.15	0.3	22	12.1	17.9	0.15	0.3										
9						24	13.6	19.4	0.15	0.3										
10	22	14.0	17.9	0.15	0.3	26	15.4	20.6	0.15	0.3										
12	24	16.0	19.9	0.15	0.3	28	17.0	23.3	0.15	0.3	32	22.0	22.1	0.6	0.6					
15	28	19.1	23.9	0.15	0.3	32	20.7	26.9	0.15	0.3	35	25.0	25.1	0.6	0.6					
17	30	21.1	25.9	0.15	0.3	35	22.7	29.3	0.15	0.3	40	28.5	28.6	0.6	0.6					
20	37	25.7	32.0	0.15	0.3	42	27.2	34.8	0.3	0.6	47	33.5	33.6	0.6	1.0	47	33.5	33.6	1.0	1.0
25	42	30.7	36.4	0.15	0.3	47	32.2	39.8	0.3	0.6	52	38.5	38.6	0.6	1.0	62	46.0	46.1	1.0	1.0
30	47	35.8	41.4	0.15	0.3	55	38.7	46.3	0.3	1.0	62	46.0	46.1	0.6	1.0	62	46.0	46.1	1.0	1.0
35	55	41.7	48.3	0.3	0.6	62	44.2	52.8	0.3	1.0	72	53.5	53.6	0.6	1.1	72	53.5	53.6	1.1	1.1
40	62	47.2	54.8	0.3	0.6	68	49.7	58.2	0.3	1.0	80	60.0	60.1	0.6	1.1					
45	68	52.7	60.3	0.3	0.6	75	55.7	64.2	0.3	1.0	85	65.0	65.1	0.6	1.1					
50	72	56.7	65.3	0.3	0.6	80	60.2	69.8	0.3	1.0	90	70.0	70.1	0.6	1.1					
55	80	62.8	72.3	0.3	1.0	90	67.7	77.3	0.6	1.1										
60	85	67.8	77.3	0.3	1.0	95	72.7	82.3	0.6	1.1	110	85.0	85.1	0.6	1.5					
65	90	72.8	82.3	0.3	1.0	100	77.3	87.7	0.6	1.1										
70	100	79.3	90.5	0.3	1.0	110	84.3	95.3	0.6	1.1										
75	105	84.3	95.5	0.3	1.0	115	89.3	100.7	0.6	1.1	130	102.5	102.7	0.6	1.5					
80	110	89.3	100.5	0.3	1.0	125	95.8	109.2	0.6	1.1										
85	120	96.0	109.2	0.6	1.1	130	100.8	114.2	0.6	1.1										
90	125	101.0	114.2	0.6	1.1	140	108.3	121.7	1.0	1.5										
95	130	106.0	119.2	0.6	1.1	145	112.4	127.6	1.0	1.5										
100	140	112.4	127.5	0.6	1.1	150	117.4	132.6	1.0	1.5										
105																				
110						170	132.4	147.6	1.0	2.0										
120						180	141.4	158.6	1.0	2.0										
130																				
140																				
150																				
160																				
170																				
180																				
190																				
200																				
220																				
240																				
260																				
280																				

Values in mm

Greasing of Bearings
To reduce the risk of contamination during spindle assembly and to ensure correct lubrication it is possible for customers to have bearings greased by SNFA.
This operation is performed in a clean room using specialist equipment immediately after the bearings have been washed. In this way the cleanness of the bearing, the correct amount of grease and its uniform distribution can be ensured.

Lubrication

Lubrication reduces friction and heat generation inside the bearing and ensures the lubricant acts in the rolling and sliding areas even in the presence of high stress. The lubricant also protects metal surfaces against corrosion.

Greasing

Greasing is the most common form of lubrication as it is simple and easy to use.

When operation conditions such as speed, temperature and cleanliness are within the limits indicated by the grease lubricant vendor, bearings require no special maintenance, nor subsequent topping up. This can therefore be called life-long lubrication.

Grease type selection is critical for safe bearing operation, depending on:

operating temperature
life
protection
noise level

A wide range of quality synthetic grease lubricants is available commercially. Products satisfying the standards listed in the Table below are frequently used.

Speed, load and operating temperature are basic parameters for grease selection.

Bearings operating at high temperatures, such as in electrospindles, must be lubricated with long life grease with a base oil of adequate viscosity and high wear resistance.

APPLICATION		GREASE		
Speed (ndm)	Load	Apparent Viscosity (m Pas)	NLGI Consistency	Thickener
Up to 600.000	Light/Medium	3.000	2	Lithium
Up to 600.000	Hight	4.000	2	Calcium/Lithium
Up to 900.000	Medium	3.000/4.000	2	Calcium/Barium/Lithium
Up to 900.000	Light	3.500/5.000	2	Calcium/Barium/Lithium

Grease Life

The effectiveness of a grease reduces in time due to operating conditions such as temperature, dynamic stress and contamination and to its chemical and physical characteristics.

These parameters are hard to estimate, so grease life hours **"Lg"** are calculated prevalently on statistical data.

Figure 2 gives the necessary elements for assessing the life of quality synthetic greases in optimum operating conditions. The upper part of the curve refers to operation in moderate temperature conditions, such as in belt driven spindles; the lower part refers to applications where the presence of another heat source, such as an electric motor, increases bearing temperature markedly, with negative effects on the lubricant.

Running in

Grease lubricated bearings require an initial running-in period to ensure the correct lubricant distribution and to avoid bearing overheating at the starting operation.

The commonest form of running-in entails gradually reaching maximum speed and achieving stable temperatures at each step.
Another procedure is an intensive sequence of run and stop cycles according to a pre-set programme. The latter reduces running-in time but requires constant observation and is only recommended for automated running-in equipment. This is not advisable for bearings which have to operate at a particularly high speed.

Fig. 2

Grease Quantities

The amount of grease to be introduced into the bearing depends on operating speed. The amount is calculated by multiplying factor **K** (function of maximum rotation speed, expressed in **ndm** - Figure 3)by the **" reference quantity "** shown in the diagram (bore and bearing series function; Fig.4)

K factor

Fig. 3

Reference Grease Quantity

Fig. 4

In the case of small bearings where grease quantities are very small it is advised thet before greasing the bearings are immersed in a grease solution (containing 3-5% grease) then removed and allowed to drain (and the solvent to evaporate) before applyng the grease. This ensures that all the bearing surface are covered with a thin layer of the lubricant.

Factory Greased Bearings

SNFA bearings are very often supplied with the type and amount of grease as specified by the Customer.

This solution offers operating and economic advantages for the user, as the bearing is greased during the manufacturing route with greater control over cleanliness, quantity and distribution.

Oil Lubrication

Oil lubrication is mandatory when greasing limits are exceeded.

Several different oil lubrication systems are used, the commonest for machine tools being:

- Oil Injection
- Oil Mist
- Air-Oil

Oil Injection

Oil injection is preferred for bearings having to operate at very high speed and high load, that is in conditions that do not allow "oil mist " lubrication because of the need to cool the bearings.

Oil is injected into the bearings through nozzles placed so as to lubricate the ball to race contacts with minimum oil churning. Drainage channels must be provided to prevent oil from stagnating and churning and hence generating heat.

Besides ensuring proper lubrication, the amount of oil crossing the bearings also removes the heat generated by bearing operation and maintains overall temperature at acceptable levels.

The assembly should also include oil filtering, a heat exchanger to dissipate the heat removed from the bearings and an adequate oil reserve. A suitable size reservoir facilitates heat dispersion and the settling out of debris and avoids early lubricant ageing.

This type of lubrication obviously requires accurate and proper analysis. Precise rules for calculating oil flow take account of the bearing type to be lubricated (series and pitch diameter) and assembly composition. Oil viscosity in an injection system is according to **ISO standards VG10 or VG15**

Viscosity Grade ISO	Kinematic viscosity at 40° deg C	Kinematic viscosity limits at 40° deg C	
		minimum	maximum
VG 2	2.2	1.98	2.42
VG 3	3.2	2.88	3.52
VG 5	4.6	4.14	5.06
VG 7	6.8	6.12	7.48
VG 10	10.0	9.00	11.00
VG 15	15.0	13.50	16.50
VG 22	22.0	19.80	24.20
VG 32	32.0	28.80	35.20
VG 46	46.0	41.40	50.60
VG 68	68.0	61.20	74.80
VG 100	100.0	90.00	110.00
VG 150	150.0	135.00	165.00

Bore (mm)	> ≤	 50	50 120	120 280
Quantity of oil (l/h)		2 ... 24	15 ...120	60 ... 300

Oil Mist

Oil mist lubrication is widely used, especially in high speed applications, as it offers the following advantages:
satisfactory efficiency even with complex bearing arrangements
low temperature, reduced power absorption
low cost assembly
simple construction (channels, spacers etc)
good protection against outside contamination (pressurised environment)

Oil mist lubrication systems must be designed to precise standards taking account of the features and speed of the bearings to be lubricated. (Oil mist equipment manufacturers are generally in a position to supply the required specific data).

Oil recommended for use in oil mist lubrication systems is **ISO VG32**

Air - Oil

An important peculiarity of this system is the use of a high viscosity synthetic oil (generally **ISO VG68**) which, even when applied in small amounts, ensures the presence of a resistant film between rolling parts and bearing races.

This means simultaneous reduced ball rolling resistance and excellent bearing behaviour even under high stress.
The system is moderately polluting for the following reasons:
low oil consumption
reduced misting effect

The conveyer element air and the oil reach the bearing **via side nozzles** (Figure. 5) **or through holes in the bearing outer ring** (Cf. paragraph **H1** bearings) without being mixed during their passage.

Fig. 5

Air - oil lubrication has led to outstanding results in high frequency, high power electrospindles.

Series VEB and VEX high speed bearings in the air-oil lubricated version, with ceramic material balls and outer ring with radial lubrication holes (H1/NS execution) can reach high speeds of over 2,500,000 ndm.

Oil quantity (Q) required can be calculated, roughly, with the following formula:

$Q = 1.2 \cdot dm$ mm^3/h (for each bearing)

where **dm** is the bearing pitch diameter in millimetres

Air-oil flow to the bearings must be homogeneous and without losses along its path. Individual air-oil supply to each bearing is therefore strongly recommended, even if a more elaborate supply system may be required in certain instances.

"H1" BEARING

Minimum oil

Any system capable of supplying a bearing with the amount of oil required for proper operation can be considered as minimum.

This type of lubrication can be used for high speed bearings too, by direct injection of small amounts of oil directly into the bearings, through the outside ring (H1 version bearings).

Oil type and dosage are monitored by a central control and a circuit ensuring continuous pressure and flow.

Nozzle Position

Maximum efficiency is achieved for all oil lubrication systems when the lubrication flow reaches the bearing contact areas with minimum turbulence.

Nozzle positioning, as indicated in the table below, is therefore strongly recommended.

" P " and " S " values of nozzle position

Diameter d	SERIES									
	SEA		SEB - VEB		EX		VEX		E 200	
	P	S	P	S	P	S	P	S	P	S
6					10.10	0.90	10.10	0.90		
7					11.30	1.00	11.30	1.00	13.10	1.00
8			12.10	0.85	13.30	1.20	13.30	1.20	13.80	0.70
9					14.80	1.20	14.80	1.20	16.10	1.30
10	13.40	0.30	14.80	0.75	16.40	1.00	16.40	1.00	17.90	1.55
12	15.40	0.30	16.80	0.75	18.20	1.20	18.20	1.20	19.60	1.60
15	18.40	0.30	19.80	1.15	21.90	1.20	21.90	1.20	22.30	1.45
17	20.40	0.30	22.00	0.90	24.10	1.35	24.10	1.35	25.70	1.55
20	24.50	0.35	26.70	1.05	28.70	1.50	28.70	1.50	30.80	1.75
25	29.50	0.35	31.80	1.05	33.50	1.75	33.80	1.65	35.50	1.65
30	34.50	0.35	36.80	1.00	39.70	1.90	40.30	1.65	42.40	2.05
35	39.50	0.35	43.00	1.25	45.70	1.90	46.10	1.90	49.90	2.05
40	44.50	0.35	48.70	1.45	51.10	1.90	51.60	1.85	55.80	2.50
45	50.00	0.35	54.20	1.45	56.60	2.30	57.60	1.85	60.90	2.10
50	55.60	0.45	58.40	1.65	61.60	2.30	62.30	2.10	65.20	2.75
55	61.30	0.55	64.60	1.85	68.10	2.30	69.60	1.90	72.20	3.15
60	66.40	0.65	69.60	1.85	73.10	2.30	74.60	1.85	80.20	2.80
65	72.40	0.65	74.50	1.75	78.10	2.30	79.30	2.05	86.00	3.00
70	77.40	0.65	81.50	2.20	85.20	2.80	86.50	2.15	91.00	3.00
75	82.40	0.65	86.50	2.15	90.20	2.80	91.50	2.25	95.80	2.75
80	87.40	0.65	91.50	2.15	97.00	3.00	98.50	2.70	102.70	3.30
85	94.10	0.90	98.60	2.55	102.00	3.00	103.50	2.70	110.00	4.00
90	99.10	0.90	103.50	2.50	109.50	3.10	111.00	2.65	116.00	2.05
95	104.10	0.90	108.50	2.50	113.60	3.10	115.40	3.05	123.80	3.70
100	109.10	0.90	115.40	3.00	118.80	3.25	120.40	3.05	130.30	3.75
105	114.60	1.40			126.00	4.00			137.20	4.85
110	120.90	1.10	125.40	2.95	132.80	4.25	135.40	3.05	144.40	4.65
120	130.90	1.10	137.40	3.40	142.80	4.25	144.90	3.50	157.20	4.85
130	144.00	2.20	149.80	3.40	157.10	5.40			168.60	5.70
140	153.20	1.85	159.80	3.35	167.10	5.40			182.50	5.50
150	165.60	2.20	173.30	4.65	178.90	5.65				
160			183.30	4.65	190.80	5.75				
170			193.30	4.65	204.50	5.50				
180			207.40	5.65	219.50	6.55				
190			217.30	5.60	229.00	6.05				
200			231.10	6.30	240.30	6.20				
220			251.10	6.30	264.10	6.90				
240			271.00	6.20	283.60	6.40				
260			298.90	7.95						
280			318.3	7.30						

*"P" and "S" in mm

Lubricant contamination effects on bearing life and behaviour

Cleanliness affects bearing life and efficiency. It is necessary to achieve an application where bearings operate in free of external contamination.

It is important, therefore, to keep bearings clean during greasing and to provide good sealing during operation.

Additional precautions must be taken for **oil lubricated** bearings to monitor **lubrication contamination levels**. In the case of oil re-circulation systems in particular, this depends on the rate of contamination, the filtration standard and the size of the filter.

Contamination by the ingress of coolants, cutting oils, etc alter lubricant properties thereby effecting bearing life. This should be eliminated at the design stage by providing adequate sealing.

Contaminating particle classifications are available, which specify limit sizes and amounts per unit volume of 100 cm^3.

CONTAMINATION LEVEL (ISO 4406)

Fig. 6

With reference to **ISO Standard 4406** (Figure. 6) for high precision application as, for instance, high performance electrospindles, **contamination should be restricted to level 10/7, for new spindles and to level 13/10, after long use**. In any case the maximum particle size should not exceed 5 µm.
Figure 6 shows the area with acceptable pollution levels

Seals

The simplest of the many systems used to protect bearings during operation is the application of commercially available seals, whose rubber or similar material lips is always in contact with the rotating shaft.

This system generates friction and cannot be used in high speed applications. **Efficient labyrinth seals** are important in these cases. Their design varies according to available space, lubricant type and operating environment.

The seals illustrated herein are commonly used in the machine tool industry and are quite suitable for other applications with similar operating conditions.

Figure **7**

The bearing is protected by the barrier created by the cover, with small clearance to the shaft. This solution, suitable for moderately dusty environments, is not recommended for liquid contaminants.

7

Figure **8**

This is a slightly more complex but more efficient seal than the former. It features a supplementary internal barrier consisting of commercially available laminar rings that fit to the static housing. Rubbing on the rotating parts must be avoided.

8

Figures **9** and **10**

These **single and multiple type** labyrinth seals are more elaborate than the previous ones but are more effective, especially in the presence of dust or coolant jets etc.

9 - 10

Figures **11** and **12**

These single and multiple type labyrinth seals are provided with **drainage**. The upper cover, shown in Figure 12 (vertical axis), acts as a **centrifugal ring** and ensures additional protection against debris from the outside.

11- 12

Figure **13**

This seal is very effective due to the presence of a **pressure air barrier** (p = 0.2 bar) in the labyrinth space. In this system, particularly suitable for grease lubrication, the air must be supplied filtered and dried, through a specific channel.

Oil lubricated bearings operate in a pressurised environment, so sealing efficiency is less important than for grease lubricated ones. All contamination should be avoided for oil lubricated bearings especially when a re-circulation circuit is provided:

13

Handling

SNFA angular contact, precision bearings are produced in environmental conditions controlled strictly throughout the whole manufacturing process, handling and packaging included.

Bearings users can take advantage of bearing performance only by using them properly and observing the following advice very carefully:

- **store bearings in their original packaging, in a dry environment**
- **plan assembly sequence carefully**
- **operate in a suitable environment**
- **inspect components close to the bearings and check their cleanliness**
- **check with the drawing that the bearing designation is correct**
- **open the package when the bearings are required for installation**
- **if grease lubrication is specified, introduce the proper amount lubricant and distribute it carefully.** Compatibility issues with the bearing protection oil can arise when synthetic grease is used. Whenever possible, wash it with well filtered products compatible with the environment and the metal and dry it immediately after with dry and filtered compressed air.
- **assemble the bearing in accordance with the instructions enclosed with the packaging (excessive force should be avoided)**
- **if necessary, pre-heat the bearing bore or the outer housing**

Fitting and clamping of Bearing Rings

Bearings are tightened axially on journals or into housings with either ring nuts or end caps. These are manufactured to have:

- high geometrical precision
- good mechanical strength
- reliable locking

Force *Pa*, obtained by tightening the ring nut or end cap, is extremely important and must:

prevent relative movement of adjacent components ensure correct bearing positioning without deformation minimise material fatigue

Proper assessment of *Pa* is a little uncertain. The following formula can be used as a rule of thumb for calculating tightening force Pa and resultant tightening torque *C* for ring nuts and screws. It should be verified during operation.

Calculation of the tightening force Pa

The value of Pa can be obtained from:

$$P_a = F_s + (N_{cp} \cdot F_c) + P_r$$

where:

Pa	Axial clamping force (daN)
Fs	Minimum axial clamping force (daN)
Fc	Axial fitting force (daN)
Pr	Bearing preload (daN)
Ncp	Number of preload bearings

The values for F_s and F_c can be found in the tables on pages 56, 57 and 58.
The standard values of P_r can, be found from the general catalogue or, in the case of a special preload, from the bearing designation. The preload value is usually a negligible part of the clamping force value except in the case of the BS series.

Calculation of the tightening torque

With values for P_a the tightening torque, C (daN · mm) can be calculated:

$$C = K \cdot P_a \quad \text{for a locking nut}$$

$$C = K \cdot P_a / N_b \quad \text{for bolts in an end cap}$$

where:
K = factor based on the thread (see the table on page 58)
N_b = number of bolts in the end cap
Advice on the tightening procedure is given in "SNFA Bearing Assembly" booklet.

Axial force tightening calculation

SEA SERIES			SEB SERIES			VEB SERIES		
d	Fs	Fc	d	Fs	Fc	d	Fs	Fc
6			6			6		
7			7			7		
8			8			8	33	28
9			9			9		
10	37	24	10			10	50	28
12	43	21	12			12	60	28
15	55	18	15			15	65	28
17	60	16	17	75	28	17	75	28
20	95	25	20	130	40	20	130	40
25	120	21	25	160	34	25	160	34
30	140	18	30	190	30	30	190	30
35	160	21	35	260	44	35	260	44
40	180	18	40	310	50	40	310	50
45	240	19	45	380	48	45	380	48
50	290	18	50	310	38	50	310	38
55	330	23	55	410	43	55	410	43
60	330	24	60	450	40	60	450	40
65	470	26	65	480	37	65	480	37
70	500	24	70	650	50	70	650	50
75	550	23	75	650	48	75	650	48
80	550	30	80	700	65	80	700	65
85	750	55	85	900	90	85	900	90
90	800	50	90	950	85	90	950	85
95	800	48	95	1000	85	95	1000	85
100	850	46	100	1200	100	100	1200	100
105	900	45	105					
110	1100	60	110	1300	90			
120	1200	60	120	1600	120			
130	1700	90	130	2300	160			
140	1600	80	140	2400	150			
150	2100	100	150	2700	180			
			160	2800	170			
			170	3000	160			
			180	3700	220			
			190	3900	260			
			200	4800	320			
			220	5200	290			
			240	5700	270			
			260	7700	400			
			280	8300	400			

Axial force tightening calculation

VEX SERIES			EX SERIES			E 200 SERIES		
d	Fs	Fc	d	Fs	Fc	d	Fs	Fc
6	26	40	6	26	43	6		
7	31	38	7	31	41	7	49	55
8	45	46	8	45	49	8	49	60
9	60	46	9	60	49	9	65	60
10	65	50	10	65	55	10	85	70
12	70	44	12	70	47	12	100	70
15	100	46	15	100	49	15	95	60
17	100	45	17	100	49	17	130	70
20	160	60	20	160	65	20	230	85
25	180	50	25	180	50	25	240	75
30	250	55	30	250	55	30	340	80
35	330	75	35	330	75	35	550	120
40	410	75	40	410	75	40	600	120
45	450	75	45	450	75	45	700	120
50	500	65	50	500	65	50	600	100
55	600	80	55	600	80	55	750	110
60	650	75	60	650	75	60	1100	130
65	700	70	65	700	70	65	1300	130
70	850	80	70	850	80	70	1400	130
75	900	75	75	900	75	75	1500	130
80	1100	120	80	1100	120	80	1700	190
85	1100	140	85	1100	140	85	1900	250
90	1600	170	90	1600	170	90	1900	250
95	1400	150	95	1400	150	95	2700	300
100	1500	140	100	1500	140	100	2700	310
105			105	1700	160	105	3100	330
110	2000	180	110	2000	180	110	3700	360
120	2200	190	120	2200	190	120	4500	430
			130	2700	270	130	4800	450
			140	2900	250	140	5900	500
			150	3400	270			
			160	3800	290			
			170	5100	350			
			180	6400	450			
			190	6800	500			
			200	6600	550			
			220	7900	600			
			240	8600	550			
			260					
			280					

Axial force tightening calculation

BS 200 SERIES			ED SERIES		
d	Fs	Fc	d	Fs	Fc
6			6		
7			7		
8			8		
9			9		
10			10		
12	120	75	12	70	44
15	140	75	15	100	46
17	190	80	17	100	45
20	260	95	20	130	55
25	320	95	25	160	45
30	480	95			
35	650	130			
40	800	140			
45	900	130			
50	1000	130			
55					
60	1500	150			
65					
70					
75	2100	210			

Coefficient “K” for calculation of the tightening torque

THREAD	“K” FACTOR		THREAD	“K” FACTOR
	NUTS	BOLTS		NUTS
M 4		0.8	M 70	9.0
M 5		1.0	M 75	9.6
M 6		1.2	M 80	10.0
M 8		1.6	M 85	11.0
M 10	1.4	2.0	M 90	11.0
M 12	1.6	2.4	M 95	12.0
M 14	1.9	2.7	M 100	12.0
M 15	2.0	2.9	M 105	13.0
M 16	2.1	3.1	M 110	14.0
M 17	2.2		M 120	15.0
M 20	2.6		M 130	16.0
M 25	3.2		M 140	17.0
M 30	3.9		M 150	18.0
M 35	4.5		M 160	19.0
M 40	5.1		M 170	21.0
M 45	5.8		M 180	22.0
M 50	6.4		M 190	23.0
M 55	7.0		M 200	24.0
M 60	7.6		M 220	26.0
M 65	8.1		M 240	27.0
			M 260	29.0
			M 280	32.0

Note: *The values of “K” in the table are only for “fine hitch thread”.*

Bearing identification

Individual Bearings and Bearing Groups

Bearing designation is placed on the wider surface of the outer ring. Codes are given in bold characters below:

• Trade Mark:	**SNFA**
• Place of Manufactured:	**ITALY** **UK**
• Bearing type: (series)	**SEA... SEB...** **EX... E2...** **VEB... VEX...** **BS2.. ED...**
• Precision:	
ABEC 5	**5**
ABEC 7	**7**
Special precision	**(e.g.: SQ)**
ABEC 9	**9**
• Cage material:	
Stratified textile resin	**C**
Polyamide	**P**
Brass	**L**
• Cage location:	
On outer ring	**E**
on inner ring	**I**

• Nominal contact angle:	
12°	**0**
15°	**1**
18°	**2**
25°	**3**
62°	**62**
• Matched sets:	
Tandem	**T**
Back-to-back	**DD**
Tandem - back-to-back	**TD**
Face-to-face	**FF**
Tandem - face-to-face	**TF**
Tandem - back - Tandem	**TDT**
Tandem - Face - Tandem	**TFT**
Duplex Universal	**DU**
Universal	**U**
• Preload	
Light	**L**
Medium	**M**
Heavy	**F**
Special	**Value in daN**

(in case of axial play, value is given in µm)

Complete designation marking (contact angle, precision, arrangement type, etc.) of medium - large size bearing sets, maybe marked on one bearing only. The remaining bearings of the group have markings indicating: type, trade mark and country of origin, only

Micron deviations from the nominal value of each bearing bore and outside diameter are marked on that surface, at the point of maximum eccentricity (maximum radial thickness).

Maximum assembly concentricity is obtained by locating this point at 180° to maximum shaft or housing eccentricity.

Other markings that may appear on ring faces are manufacturing references; e.g.:manufacturing date, serial No., etc.

Notes:
The 'V' arrow on the bearing outer diameter indicates the direction of thrust applicable to the inner rings of the bearing group.
The arrow is placed at the point of maximum outer ring eccentricity.

Boxes

SNFA bearings are normally packaged in individual boxes, even when they belong to a bearing set. In this case boxes are grouped together. Marking is with labels applied to each of the boxes,

The label bears the following information:

- **bearing set designation**
- **grease type** (for SNFA greased bearings)
- **actual contact angle** (for single Universal bearings only)

Boxes are cardboard, marked with the **SNFA** trade name and carrying the description: **Precision Bearings** (in four languages). Moreover the box contains bearing mounting instructions in four languages.

Bearings with ceramic material balls are contained in boxes bearing a red colour label with the wording "**ceramic**" in gold characters.

ISO Series and SNFA Production

FORM

ISO 18	ISO 19	ISO 10	ISO 02
SEA bore from 10 up to 150	SEB bore from 17 up to 280	EX bore from 6 up to 240	E 200 bore from 7 up to 140
	VEB bore from 8 up to 100	VEX bore from 6 up to 120	BS 200 bore from 12 up to 75

∅ BORE	D	B	D	B	D	B	D	B
6	13	3.5	15	5	17	6	19	6
7	14	3.5	17	5	19	6	22	7
8	16	4	19	6	22	7	24	8
9	17	4	20	6	24	7	26	8
10	19	5	22	6	26	8	30	9
12	21	5	24	6	28	8	32	10
15	24	5	28	7	32	9	35	11
17	26	5	30	7	35	10	40	12
20	32	7	37	9	42	12	47	14
25	37	7	42	9	47	12	52	15
30	42	7	47	9	55	13	62	16
35	47	7	55	10	62	14	72	17
40	52	7	62	12	68	15	80	18
45	58	7	68	12	75	16	85	19
50	65	7	72	12	80	16	90	20
55	72	9	80	13	90	18	100	21
60	78	10	85	13	95	18	110	22
65	85	10	90	13	100	18	120	23
70	90	10	100	16	110	20	125	24
75	95	10	105	16	115	20	130	25
80	100	10	110	16	125	22	140	26
85	110	13	120	18	130	22	150	28
90	115	13	125	18	140	24	160	30
95	120	13	130	18	145	24	170	32
100	125	13	140	20	150	24	180	34
105	130	13	145	20	160	26	190	36
110	140	16	150	20	170	28	200	38
120	150	16	165	22	180	28	215	40
130	165	18	180	24	200	33	230	40
140	175	18	190	24	210	33	250	42
150	190	20	210	28	225	35	270	45
160	200	20	220	28	240	38	290	48
170	215	22	230	28	260	42	310	52
180	225	22	250	33	280	46	320	52
190	240	24	260	33	290	46	340	55
200	250	24	280	38	310	51	360	58
220	270	24	300	38	340	56	400	65
240	300	28	320	38	360	56	440	72
260	320	28	360	46	400	65	480	80
280	350	33	380	46	420	65	500	80

Bearing identification code

VE X 50 /NS 7 CE 1 DD L

FORM

E SE	
VE	
BS	

SERIES

A	ISO 18
B	ISO 19
X	ISO 10
2	ISO 02

BORE DIAMETER in mm

SPECIAL CARACTERISTIC

/NS	CERAMIC BALLS
/H1	LUBRICATION THROUGH OUTER RING

PRECISION

5	ABEC 5
7	ABEC 7
9	ABEC 9
.....	SPECIAL

CAGE MATERIAL

C	STRATIFIED TEX.-RESIN
P	POLYAMIDE
L	BRASS

CAGE LOCATION

E	EXTERNAL
I	INNER

CONTACT ANGLE

0	12°
1	15°
2	18°
3	25°
62	62°

PRELOAD

L	HIGHT
M	MEDIUM
F	HEAVY
.....daN	special preload in daN
.....µm	axial play in microns

PAIRING SET

U	Universal
DU	Duplex Universal
TU	Triplex Universal

DD

FF

T

TD

TDT

3TD

SEA
ISO 18

series **SEA** ISO 18

SEA
ISO 18

SNFA	d	D	B	z	Ø	15°		25°		Weight
						C33	C0	C33	C0	
SEA 10	10	19	5	12	2.38	190	125	185	119	0.005
SEA 12	12	21	5	14	2.38	210	150	200	143	0.006
SEA 15	15	24	5	17	2.38	235	189	220	179	0.007
SEA 17	17	26	5	18	2.38	240	200	230	193	0.010
SEA 20	20	32	7	17	3.17	390	340	370	320	0.018
SEA 25	25	37	7	20	3.17	420	410	400	390	0.021
SEA 30	30	42	7	23	3.17	450	480	425	450	0.026
SEA 35	35	47	7	26	3.17	470	550	445	520	0.028
SEA 40	40	52	7	29	3.17	490	620	465	590	0.031
SEA 45	45	58	7	31	3.17	500	670	470	630	0.039
SEA 50	50	65	7	30	3.97	750	1 000	710	950	0.051
SEA 55	55	72	9	29	4.76	1 045	1 380	985	1 310	0.081
SEA 60	60	78	10	28	5.55	1 370	1 800	1 290	1 700	0.100
SEA 65	65	85	10	29	5.55	1 375	1 890	1 295	1 780	0.126
SEA 70	70	90	10	31	5.55	1 410	2 030	1 330	1 920	0.134
SEA 75	75	95	10	33	5.55	1 450	2 170	1 365	2 050	0.142
SEA 80	80	100	10	35	5.55	1 485	2 320	1 395	2 180	0.151
SEA 85	85	110	13	30	7.14	2 200	3 220	2 070	3 040	0.266
SEA 90	90	115	13	31	7.14	2 210	3 350	2 090	3 160	0.279
SEA 95	95	120	13	32	7.14	2 245	3 470	2 110	3 280	0.292
SEA 100	100	125	13	34	7.14	2 305	3 710	2 165	3 500	0.310
SEA 105	105	130	13	35	7.14	2 320	3 830	2 180	3 610	0.320
SEA 110	110	140	16	32	8.73	3 235	5 200	3 041	4 880	0.505
SEA 120	120	150	16	35	8.73	3 365	5 700	3 160	5 400	0.550
SEA 130	130	165	18	35	9.53	3 920	6 800	3 690	6 400	0.770
SEA 140	140	175	18	35	10.32	4 550	7 900	4270	7 500	0.800
SEA 150	150	190	20	35	11.11	5 200	9 200	4 880	8 700	1.100

For larger sizes consult our Technical Department

SEA
ISO 18

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
SEA 10	109 000	87 000	78 300	71 000	63 900	43 000	38 700
SEA 12	95 500	76 000	68 400	63 000	56 700	38 000	34 200
SEA 15	80 500	64 000	57 600	53 000	44 700	32 000	28 800
SEA 17	73 000	58 000	52 200	48 000	43 200	29 000	26 100
SEA 20	60 000	48 000	43 200	39 000	35 100	24 000	21 600
SEA 25	50 000	40 000	36 000	33 000	29 700	20 000	18 000
SEA 30	43 000	34 000	30 600	28 000	25 200	17 000	15 300
SEA 35	37 500	30 000	27 000	25 000	22 500	15 000	13 500
SEA 40	33 000	27 000	24 300	22 000	19 800	13 500	12 150
SEA 45	29 500	24 000	21 600	19 000	17 100	12 000	10 800
SEA 50	26 500	21 000	18 900	17 000	15 300	10 500	9 500
SEA 55	23 500	19 000	17 100	15 500	14 000	9 500	8 600
SEA 60	21 500	17 000	15 300	14 000	12 600	8 500	7 700
SEA 65	20 000	16 000	14 400	13 000	11 700	8 000	7 200
SEA 70	18 500	15 000	13 500	12 000	10 800	7 500	6 800
SEA 75	17 500	14 000	12 600	11 500	10 400	7 000	6 300
SEA 80	16 000	13 000	11 700	10 500	9 500	6 500	5 900
SEA 85	15 000	12 000	10 800	9 500	8 600	6 000	5 400
SEA 90	14 000	11 000	9 900	9 000	8 100	5 500	5 000
SEA 95	13 500	10 500	9 500	8 500	7 700	5 300	4 800
SEA 100	13 000	10 000	9 000	8 000	7 200	5 000	4 500
SEA 105	12 200	9 600	8 600	7 700	7 100	4 800	4 300
SEA 110	11 500	9 200	8 300	7 500	6 900	4 600	4 200
SEA 120	10 500	8 400	7 600	6 800	6 300	4 200	3 800
SEA 130	9 500	7 600	6 900	6 200	5 500	3 800	3 400
SEA 140	8 800	7 100	6 400	5 700	5 100	3 500	3 100
SEA 150	8 100	6 500	5 800	5 200	4 700	3 200	2 800

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9
ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

SEA
ISO 18

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
SEA 10	1.0	1.0	1.5	3.0	1.5	2.2	6.0	1.9	2.8
SEA 12	1.1	1.2	1.7	3.3	1.7	2.5	6.6	2.2	3.2
SEA 15	1.2	1.4	2.1	3.6	2.0	3.0	7.2	2.5	3.7
SEA 17	1.2	1.5	2.1	3.7	2.1	3.1	7.5	2.7	3.9
SEA 20	2.0	1.8	2.7	6.0	2.6	3.9	12.0	3.3	4.9
SEA 25	2.2	2.1	3.1	6.6	3.0	4.4	13.2	3.8	5.6
SEA 30	2.3	2.3	3.4	7.0	3.4	5.0	14.0	4.3	6.3
SEA 35	2.5	2.6	3.8	7.5	3.7	5.5	15.0	4.7	7.0
SEA 40	2.6	2.8	4.2	7.8	4.1	6.0	15.5	5.1	7.6
SEA 45	2.7	3.0	4.4	8.0	4.3	6.3	16.0	5.4	8.0
SEA 50	4.0	3.6	5.3	12.0	5.2	7.7	24.0	6.5	9.6
SEA 55	5.5	4.2	6.1	16.5	6.0	8.8	33.0	7.5	11.1
SEA 60	7.0	4.7	6.8	21.0	6.7	9.9	42.0	8.4	12.4
SEA 65	7.1	4.8	7.0	21.5	7.0	10.2	43.0	8.7	12.8
SEA 70	7.3	5.0	7.4	22.0	7.3	10.7	44.0	9.2	13.5
SEA 75	7.6	5.4	7.8	22.5	7.7	11.2	45.0	9.6	14.2
SEA 80	7.8	5.7	8.2	23.5	8.1	11.9	47.0	10.2	15.0
SEA 85	11.5	6.2	9.2	34.5	9.0	13.2	69.0	11.3	16.7
SEA 90	11.6	6.4	9.4	35.0	9.2	13.6	70.0	11.6	17.1
SEA 95	11.7	6.6	9.6	35.5	9.5	13.9	71.0	11.9	17.6
SEA 100	12.0	6.9	10.1	36.0	9.9	14.6	72.0	12.5	18.4
SEA 105	13.0	7.2	10.6	39.0	10.4	15.3	78.0	13.1	19.3
SEA 110	16.0	7.7	11.4	50.0	11.3	16.7	100.0	14.3	21.0
SEA 120	18.0	8.5	12.6	55.0	12.4	18.3	110.0	15.6	23.0
SEA 130	20.5	9.2	13.6	61.5	13.3	19.6	123.0	16.8	24.7
SEA 140	24.0	10.0	14.7	72.0	14.4	21.2	144.0	18.2	26.7
SEA 150	27.0	10.6	15.7	82.0	15.4	22.7	163.0	19.4	28.5

SEA
ISO 18

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 25°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
SEA 10	1.6	2.8	4.0	4.8	4.0	5.8	10.0	5.1	7.5
SEA 12	1.7	3.2	4.6	5.3	4.5	6.7	10.5	5.7	8.4
SEA 15	1.9	3.8	5.4	5.8	5.5	7.8	11.5	6.8	9.9
SEA 17	2.0	4.0	5.7	6.0	5.7	8.2	12.0	7.1	10.4
SEA 20	3.2	4.9	7.1	10.0	7.0	10.4	20.0	9.0	13.1
SEA 25	3.5	5.8	8.1	10.5	8.0	11.7	21.0	10.0	14.8
SEA 30	3.7	6.6	9.1	11.0	8.9	13.1	22.0	11.3	16.5
SEA 35	3.9	6.9	10.0	11.5	9.8	14.4	23.0	12.5	18.2
SEA 40	4.0	7.5	10.9	12.0	11.0	15.7	24.0	13.5	19.8
SEA 45	4.1	8.2	11.5	12.5	11.8	16.7	25.0	14.4	21.0
SEA 50	6.0	9.4	13.8	18.0	13.3	19.8	36.0	16.9	25.0
SEA 55	8.7	11.1	16.2	26.0	15.9	23.3	52.0	20.0	29.3
SEA 60	11.4	12.3	18.2	34.0	17.8	26.2	68.0	22.6	33.0
SEA 65	11.5	13.0	18.7	34.5	18.4	26.9	69.0	23.2	33.9
SEA 70	11.7	13.7	19.6	35.0	19.3	28.3	70.0	24.4	35.7
SEA 75	12.0	14.2	20.7	36.0	20.4	29.8	72.0	25.4	37.5
SEA 80	12.3	15.0	21.7	37.0	21.4	31.3	74.0	26.8	39.4
SEA 85	18.3	16.6	24.3	55.0	23.9	35.0	110.0	30.1	44.1
SEA 90	18.4	17.3	24.8	55.5	24.5	35.9	111.0	30.8	45.1
SEA 95	18.6	17.5	25.5	56.0	25.1	36.7	112.0	31.6	46.3
SEA 100	19.0	18.5	26.7	57.0	26.4	38.5	114.0	32.2	48.5
SEA 105	20.0	18.8	27.7	60.0	27.2	40.0	120.0	34.2	50.3
SEA 110	26.0	20.6	30.4	80.0	30.1	44.2	160.0	37.9	55.8
SEA 120	28.0	22.5	33.1	85.0	32.6	47.9	170.0	41.0	60.4
SEA 130	32.5	24.4	35.8	98.0	35.2	51.8	196.0	44.3	65.3
SEA 140	38.0	26.4	38.8	114.0	38.0	55.9	228.0	47.9	70.5
SEA 150	43.0	28.2	41.4	130.0	40.7	59.9	259.0	51.2	75.4

SEB
ISO 19

series **SEB** ISO 19

SEB
ISO 19

SNFA	d	D	B	z	Ø	15° C33	15° C0	25° C33	25° C0	Weight
* EB 10										
* EB 12	* EB 10 - EB 12 - EB 15 bearings have been replaced by VEB 10 - VEB 12 - VEB 15									
* EB 15										
SEB 17	17	30	7	13	3.97	510	370	485	350	0.016
SEB 20	20	37	9	14	4.76	745	580	705	550	0.036
SEB 25	25	42	9	15	4.76	765	650	735	620	0.042
SEB 30	30	47	9	17	4.76	815	750	765	720	0.049
SEB 35	35	55	10	18	5.55	1 115	1 090	1 050	1 030	0.075
SEB 40	40	62	12	18	6.35	1 420	1 420	1 340	1 350	0.110
SEB 45	45	68	12	20	6.35	1 495	1 600	1 415	1 520	0.130
SEB 50	50	72	12	21	7.14	1 925	2 110	1 820	2 010	0.130
SEB 55	55	80	13	22	7.94	2 415	2 730	2 280	2 590	0.178
SEB 60	60	85	13	24	7.94	2 520	3 020	2 375	2 860	0.192
SEB 65	65	90	13	25	7.94	2 550	3 180	2 400	3 010	0.202
SEB 70	70	100	16	24	9.52	3 515	4 330	3 315	4 110	0.338
SEB 75	75	105	16	25	9.52	3 570	4 560	3 360	4 320	0.357
SEB 80	80	110	16	26	9.52	3 620	4 780	3 410	4 520	0.376
SEB 85	85	120	18	25	11.11	4 735	6 200	4 460	5 900	0.532
SEB 90	90	125	18	26	11.11	4 810	6 500	4 530	6 100	0.558
SEB 95	95	130	18	27	11.11	4 880	6 800	4 595	6 400	0.584
SEB 100	100	140	20	26	12.70	6 145	8 400	5 795	8 000	0.801
SEB 110	110	150	20	28	12.70	6 340	9 200	5 970	8 700	0.861
SEB 120	120	165	22	26	14.28	7 515	10 700	7 100	10 200	1.193
SEB 130	130	180	24	28	14.28	7 750	11 700	7 280	11 100	1.628
SEB 140	140	190	24	30	14.28	7 995	12 600	7 540	12 000	1.730
SEB 150	150	210	28	24	19.05	12 080	17 500	11 400	16 600	2.555
SEB 160	160	220	28	26	19.05	12 610	19 100	11 895	18 100	2.713
SEB 170	170	230	28	27	19.05	12 790	20 000	12 050	18 900	2.848
SEB 180	180	250	33	25	22.22	16 315	24 900	15 340	23 600	4.225
SEB 190	190	260	33	26	22.22	16 560	26 100	15 600	24 700	4.410
SEB 200	200	280	38	24	25.40	20 255	31 100	19 160	29 400	5.100
SEB 220	220	300	38	26	25.40	20 695	34 100	19 825	32 300	6.500
SEB 240	240	320	38	29	25.40	22 200	38 400	20 900	36 300	7.500
SEB 260	260	360	46	26	31.75	29 050	52 900	27 360	50 100	12.000
SEB 280	280	380	46	27	31.75	29 300	55 400	27 600	52 500	13.000

For larger sizes consult our Technical Department

SEB
ISO 19

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
* EB 10 * EB 12 * EB 15 SEB 17	66 500	* EB 10 - EB 12 - EB 15 bearings have been replaced by VEB 10 - VEB 12 - VEB 15 53 000	47 700	43 500	39 200	26 500	23 850
SEB 20	54 500	43 500	39 200	35 500	32 000	22 000	19 800
SEB 25	46 000	37 000	33 300	30 000	27 000	18 500	16 700
SEB 30	40 000	32 000	28 800	26 000	23 400	16 000	14 400
SEB 35	34 000	27 000	24 300	22 500	20 300	13 500	12 200
SEB 40	30 000	23 500	21 200	19 500	17 600	12 000	10 800
SEB 45	27 000	21 500	19 400	17 500	15 800	10 500	9 500
SEB 50	24 500	19 500	17 600	16 000	14 400	9 500	8 600
SEB 55	22 000	17 500	15 800	14 500	13 100	8 500	7 700
SEB 60	20 500	16 500	14 900	13 500	12 200	8 000	7 200
SEB 65	19 000	15 500	14 000	12 500	11 300	7 500	6 800
SEB 70	17 500	14 000	12 600	11 500	10 400	7 000	6 300
SEB 75	16 000	13 000	11 700	10 500	9 500	6 500	5 900
SEB 80	15 000	12 000	10 800	10 000	9 000	6 000	5 400
SEB 85	14 000	11 000	9 900	9 000	8 100	5 500	5 000
SEB 90	13 000	10 500	9 500	8 500	7 700	5 300	4 800
SEB 95	12 500	10 000	9 000	8 000	7 200	5 000	4 500
SEB 100	12 000	9 500	8 600	7 500	6 800	4 700	4 300
SEB 110	11 000	8 500	7 700	7 000	6 300	4 300	3 900
SEB 120	10 000	7 500	6 800	6 500	5 900	3 800	3 500
SEB 130	9 000	7 000	6 300	5 500	4 950	3 500	3 150
SEB 140	8 000	6 500	5 900	5 300	4 800	3 200	2 900
SEB 150	7 500	6 000	5 400	4 800	4 400	2 900	2 650
SEB 160	7 000	5 500	5 000	4 500	4 100	2 700	2 450
SEB 170	6 500	5 200	4 700	4 200	3 800	2 600	2 350
SEB 180	6 000	4 700	4 300	3 800	3 450	2 300	2100
SEB 190	5 500	4 400	4 000	3 600	3 250	2 200	2000
SEB 200	5 000	4 100	3 700	3 300	3 000	2 000	1800
SEB 220	4 500	3 700	3 350	3 000	2 700	1 800	1650
SEB 240	4 300	3 500	3 150	2 800	2 550	1 750	1550
SEB 260	3 850	3 150	2 850	2 550	2 300	1 550	1400
SEB 280	3 500	2 800	2 500	2 300	2 000	1 400	1250

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9
ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

SEB
ISO 19

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
* EB 10									
* EB 12		* EB 10 - EB 12 - EB 15 bearings have been replaced by VEB 10 - VEB 12 - VEB 15							
* EB 15									
SEB 17	2.6	1.8	2.6	8.0	2.6	3.8	16.0	3.3	4.8
SEB 20	3.9	2.3	3.4	11.5	3.3	4.8	23.0	4.1	6.1
SEB 25	4.0	2.4	3.6	12.0	3.5	5.1	24.0	4.4	6.5
SEB 30	4.2	2.7	3.9	12.5	3.8	5.6	25.0	4.8	7.1
SEB 35	5.8	3.3	4.8	17.5	4.7	6.9	35.0	5.9	8.7
SEB 40	7.4	3.7	5.4	22.3	5.3	7.8	44.5	6.7	9.9
SEB 45	8.0	4.3	6.0	24.0	6.2	8.6	48.0	7.8	10.8
SEB 50	10.0	4.7	6.9	30.0	6.8	10.0	60.0	8.5	12.5
SEB 55	12.5	5.4	7.9	38.0	7.8	11.5	76.0	9.8	14.5
SEB 60	13.0	5.8	8.5	39.0	8.3	12.3	78.0	10.5	15.5
SEB 65	13.5	6.0	8.8	40.0	8.6	12.8	80.0	10.9	16.0
SEB 70	18.5	6.8	10.1	55.0	9.8	14.7	110.0	12.5	18.5
SEB 75	18.5	7.1	10.5	56.0	10.2	15.1	112.0	12.9	19.0
SEB 80	19.0	7.4	10.8	57.0	10.6	15.7	114.0	13.4	19.7
SEB 85	24.5	8.3	12.2	74.0	11.8	17.6	148.0	15.0	22.1
SEB 90	25.0	8.5	12.5	75.0	12.1	18.1	150.0	15.4	22.7
SEB 95	25.5	8.7	12.9	76.5	12.5	18.7	153.0	15.9	23.4
SEB 100	32.0	9.6	14.2	96.0	13.8	20.5	192.0	17.5	25.8
SEB 110	33.0	10.2	15.1	99.0	14.7	21.8	198.0	18.6	27.4
SEB 120	39.3	10.8	15.8	118.0	15.5	22.8	236.0	19.6	28.8
SEB 130	40.5	11.4	16.8	122.0	16.5	24.3	244.0	20.8	30.6
SEB 140	41.8	12.0	17.8	125.5	17.4	25.6	251.0	22.0	32.3
SEB 150	63.2	13.1	19.4	189.5	19.0	27.9	379.0	23.9	35.2
SEB 160	66.0	14.0	20.7	198.0	20.3	29.9	396.0	25.6	37.6
SEB 170	67.0	14.5	21.3	201.0	20.9	30.8	402.0	26.4	38.8
SEB 180	85.4	15.7	23.1	256.0	22.7	33.4	512.0	28.6	42.0
SEB 190	87.0	16.2	23.9	260.0	23.4	34.4	520.0	29.5	43.4
SEB 200	106.0	17.2	26.1	318.0	24.8	37.2	636.0	31.2	47.0
SEB 220	108.0	18.2	26.9	325.0	26.3	38.8	650.0	33.2	48.9
SEB 240	115.0	20.0	29.5	350.0	29.0	42.7	700.0	36.6	53.8
SEB 260	152.0	22.0	32.4	456.0	31.7	46.7	912.0	40.0	58.9
SEB 280	154.0	22.7	33.4	460.0	32.7	48.1	920.0	41.2	60.6

SEB
ISO 19

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 25°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	triplex
* EB 10									
* EB 12		EB 10 - EB 12 - EB 15 bearings have been replaced by VEB 10 - VEB 12 - VEB 15							
* EB 15									
SEB 17	4.3	4.8	7.0	13.0	6.9	10.2	26.0	8.7	12.8
SEB 20	6.2	6.0	8.9	18.5	8.7	12.8	37.0	11.0	16.1
SEB 25	6.4	6.5	9.4	19.0	9.2	13.5	38.0	11.5	17.0
SEB 30	6.7	7.0	10.4	20.0	9.8	14.9	40.0	12.7	18.8
SEB 35	9.3	8.7	12.7	28.0	12.5	18.3	56.0	15.6	23.0
SEB 40	12.0	10.0	14.4	36.0	14.1	20.8	72.0	17.8	26.2
SEB 45	12.5	10.4	15.7	37.5	16.0	22.6	75.0	19.5	28.5
SEB 50	16.0	12.6	18.3	48.0	17.8	26.4	96.0	22.5	33.2
SEB 55	20.0	14.3	21.1	60.0	20.5	30.5	120.0	26.0	38.3
SEB 60	21.0	15.4	22.7	63.0	22.1	32.9	126.0	28.0	41.3
SEB 65	21.0	15.8	23.4	63.5	22.8	33.8	127.0	28.8	42.5
SEB 70	29.0	18.3	26.9	88.0	26.2	39.0	176.0	33.2	48.9
SEB 75	30.0	18.9	27.8	89.0	27.1	40.3	178.0	34.3	50.6
SEB 80	30.0	19.4	28.7	90.0	27.9	41.5	180.0	35.3	52.0
SEB 85	39.5	21.8	32.2	118.0	31.3	46.5	236.0	39.6	58.4
SEB 90	40.0	22.5	33.2	120.0	32.3	48.1	240.0	40.9	60.3
SEB 95	40.5	23.2	34.3	122.0	33.4	49.6	244.0	42.2	62.2
SEB 100	51.0	25.5	37.7	153.0	36.7	54.6	306.0	46.4	68.4
SEB 110	53.0	27.1	40.0	158.0	39.0	58.0	316.0	49.3	72.7
SEB 120	62.8	28.5	41.9	188.0	41.0	60.4	376.0	51.7	76.1
SEB 130	64.4	30.2	44.4	193.0	43.5	64.0	386.0	54.8	80.6
SEB 140	66.7	32.0	47.0	200.0	46.1	67.8	400.0	58.1	85.5
SEB 150	100.8	34.8	51.2	302.0	50.2	73.8	604.0	63.2	93.0
SEB 160	105.0	37.2	54.7	315.0	53.7	79.0	630.0	67.6	99.5
SEB 170	107.0	38.4	56.5	320.0	55.3	81.4	640.0	69.7	102.5
SEB 180	135.6	41.5	61.1	407.0	60.0	88.2	814.0	75.5	111.1
SEB 190	138.0	43.0	63.1	414.0	61.9	91.0	828.0	78.0	114.7
SEB 200	169.0	45.5	71.0	508.0	65.7	99.5	1 016.0	82.7	127.8
SEB 220	175.0	48.5	71.4	526.0	70.0	103.1	1 052.0	88.3	129.9
SEB 240	185.0	53.2	78.3	555.0	76.7	112.9	1 110.0	96.6	142.2
SEB 260	242.0	58.2	85.7	726.0	84.0	123.7	1 452.0	105.8	155.8
SEB 280	244.0	59.9	88.2	732.0	86.4	127.0	1 460.0	109.0	160.0

EX
ISO 10

series EX ISO 10

EX
ISO 10

SNFA	d	D	B	z	Ø	15°		25°		Weight
						C33	C0	C33	C0	
EX 6	6	17	6	8	3.17	160	61	155	59	0.006
EX 7	7	19	6	8	3.57	198	77	191	75	0.008
EX 8	8	22	7	8	3.97	311	150	300	145	0.011
EX 9	9	24	7	9	3.97	341	176	328	169	0.014
EX 10	10	26	8	10	4.37	433	240	416	230	0.018
EX 12	12	28	8	10	4.76	507	280	488	270	0.019
EX 15	15	32	9	12	4.76	576	360	550	350	0.028
EX 17	17	35	10	12	5.55	761	480	728	460	0.037
EX 20	20	42	12	12	6.35	967	640	924	610	0.064
EX 25	25	47	12	13	7.14	1 261	890	1 203	850	0.075
EX 30	30	55	13	13	7.94	1 520	1 110	1 450	1 060	0.108
EX 35	35	62	14	15	7.94	1 950	1 730	1 846	1 650	0.135
EX 40	40	68	15	16	7.94	2 015	1 900	1 885	1 810	0.190
EX 45	45	75	16	15	9.52	2 770	2 510	2 630	2 400	0.228
EX 50	50	80	16	16	9.52	2 860	2 730	2 700	2 600	0.246
EX 55	55	90	18	16	11.11	3 720	3 680	3 520	3 510	0.360
EX 60	60	95	18	17	11.11	3 835	3 980	3 630	3 780	0.384
EX 65	65	100	18	18	11.11	3 940	4 270	3 740	4 060	0.408
EX 70	70	110	20	18	12.70	5 160	5 500	4 880	5 200	0.580
EX 75	75	115	20	19	12.70	5 290	5 900	5 000	5 600	0.613
EX 80	80	125	22	18	14.28	6 360	7 000	6 010	6 700	0.826
EX 85	85	130	22	19	14.28	6 540	7 500	6 180	7 100	0.868
EX 90	90	140	24	21	14.28	6 790	8 400	6 400	7 900	1.145
EX 95	95	145	24	20	15.87	8 020	9 700	7 590	9 200	1.160
EX 100	100	150	24	21	15.87	8 255	10 300	7 760	9 800	1.211
EX 105	105	160	26	20	17.46	9 700	11 800	9 150	11 200	1.535
EX 110	110	170	28	20	19.05	11 400	13 900	10 780	13 200	1.942
EX 120	120	180	28	21	19.05	11 620	14 800	10 970	14 100	2.055
EX 130	130	200	33	20	22.22	15 020	19 000	14 180	18 000	3.080
EX 140	140	210	33	21	22.22	15 340	20 200	14 480	19 100	3.280
EX 150	150	225	35	21	23.81	17 370	23 100	16 390	22 000	4.030
EX 160	160	240	38	21	25.40	19 500	26 300	18 400	25 000	5.000
EX 170	170	260	42	21	26.99	21 190	29 800	19 990	28 300	6.650
EX 180	180	280	46	22	28.57	23 630	35 000	22 290	33 300	9.000
EX 190	190	290	46	23	28.57	24 120	36 900	22 750	35 100	9.460
EX 200	200	310	51	20	34.92	30 290	46 600	28 600	44 400	12.200
EX 220	220	340	56	20	38.10	34 140	55 600	32 240	52 900	15.600
EX 240	240	360	56	22	38.10	35 930	62 000	33 930	58 900	17.250

For larger sizes consult our Technical Department

EX
ISO 10

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
EX 6	160 000	127 900	115 000	104 000	93 500	64 000	57 500
EX 7	141 500	113 200	101 800	92 000	82 700	56 600	50 900
EX 8	121 000	96 500	87 000	78 500	70 600	48 300	43 500
EX 9	109 500	87 400	78 700	71 000	63 900	43 700	39 300
EX 10	100 500	80 500	72 500	65 400	58 900	40 300	36 200
EX 12	90 500	72 200	65 000	58 700	52 800	36 100	32 500
EX 15	76 500	61 200	55 000	49 700	44 700	30 600	27 500
EX 17	69 000	55 200	49 700	44 900	40 400	27 600	24 800
EX 20	58 000	46 400	41 800	37 700	33 950	23 200	20 900
EX 25	50 000	40 000	36 000	32 500	29 250	20 000	18 000
EX 30	42 500	34 000	30 600	27 650	24 900	17 000	15 300
EX 35	31 500	25 200	22 700	20 500	18 500	12 600	11 400
EX 40	28 000	22 600	20 400	18 400	16 600	11 300	10 200
EX 45	25 000	20 200	18 200	16 400	14 800	10 100	9 100
EX 50	23 000	18 500	16 700	15 100	13 600	9 300	8 400
EX 55	20 500	16 500	14 900	13 400	12 100	8 300	7 500
EX 60	19 000	15 400	13 900	12 500	11 300	7 700	7 000
EX 65	18 000	14 300	12 900	11 700	10 600	7 200	6 500
EX 70	16 500	13 100	11 800	10 600	9 600	6 500	5 900
EX 75	15 500	12 300	11 100	10 000	9 000	6 200	5 600
EX 80	14 000	11 300	10 200	9 200	8 300	5 700	5 200
EX 85	13 500	10 700	9 700	8 700	7 900	5 400	4 900
EX 90	12 500	10 000	9 000	8 100	7 300	5 000	4 500
EX 95	12 000	9 500	8 600	7 800	7 100	4 800	4 400
EX 100	11 500	9 100	8 200	7 400	6 700	4 600	4 200
EX 105	10 500	8 500	7 700	6 900	6 300	4 300	3 900
EX 110	10 000	8 000	7 200	6 500	5 900	4 000	3 600
EX 120	9 000	7 400	6 700	6 000	5 400	3 700	3 400
EX 130	8 500	6 600	6 000	5 400	4 900	3 300	3 000
EX 140	7 500	6 200	5 600	5 000	4 500	3 100	2 800
EX 150	7 000	5 700	5 200	4 600	4 200	2 900	2 650
EX 160	6 500	5 300	4 800	4 300	3 900	2 600	2 350
EX 170	6 000	4 800	4 400	3 900	3 600	2 400	2 200
EX 180	5 500	4 400	4 000	3 600	3 300	2 200	2 000
EX 190	5 200	4 200	3 800	3 400	3 100	2 100	1 900
EX 200	4 800	3 800	3 500	3 200	2 900	1 900	1 750
EX 220	4 250	3 400	3 100	2 800	2 600	1 700	1 550
EX 240	3 900	3 100	2 800	2 500	2 300	1 600	1 450

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9 ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

EX

ISO 10

Values of preload and rigidity

(Bearings rigidly preloaded)

contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
EX 6	0.8	0.8	1.1	2.5	1.2	1.7	5.0	1.5	2.1
EX 7	1.0	0.9	1.3	3.0	1.3	1.9	6.0	1.6	2.4
EX 8	1.6	1.1	1.6	5.0	1.6	2.3	10.0	2.0	2.9
EX 9	1.8	1.2	1.7	5.5	1.7	2.4	11.0	2.1	3.0
EX 10	2.3	1.5	2.1	7.0	2.1	3.1	14.0	2.7	3.9
EX 12	2.7	1.5	2.2	8.0	2.2	3.2	16.0	2.8	4.0
EX 15	3.0	1.9	2.7	9.0	2.7	4.0	18.0	3.4	5.0
EX 17	4.0	2.2	3.2	12.0	3.2	4.6	24.0	4.0	5.8
EX 20	5.0	2.3	3.3	15.0	3.3	4.8	30.0	4.2	6.0
EX 25	6.5	3.0	4.3	19.5	4.2	6.2	39.0	5.3	7.8
EX 30	8.0	3.3	4.8	24.0	4.7	6.9	48.0	6.0	8.7
EX 35	10.0	3.8	5.8	30.5	5.6	8.3	61.0	7.1	10.4
EX 40	10.5	4.1	6.1	32.0	5.9	8.7	63.5	7.4	11.0
EX 45	14.0	4.6	6.8	42.5	6.7	9.8	85.0	8.4	12.3
EX 50	14.5	4.8	7.3	44.0	6.9	10.5	88.0	8.8	13.2
EX 55	19.5	5.6	8.3	58.5	8.2	12.0	117.0	10.2	15.1
EX 60	20.0	5.9	8.8	60.5	8.6	12.6	120.5	10.8	15.9
EX 65	21.0	6.3	9.2	62.0	9.1	13.3	124.0	11.4	16.8
EX 70	27.0	7.1	10.4	80.0	10.2	15.0	160.0	12.8	18.9
EX 75	27.5	7.4	10.9	82.0	10.7	15.7	164.0	13.5	19.8
EX 80	33.0	7.9	11.7	98.5	11.5	16.9	197.0	14.4	21.2
EX 85	34.0	8.3	12.2	101.0	12.0	17.7	202.0	15.1	22.2
EX 90	36.0	9.0	13.3	107.0	13.0	19.1	214.0	16.8	24.1
EX 95	42.0	9.6	14.1	127.0	13.8	20.3	253.0	17.4	25.6
EX 100	43.0	10.0	14.7	130.0	14.4	21.1	259.0	18.1	26.6
EX 105	50.0	10.5	15.7	150.0	15.1	22.2	300.0	19.0	28.0
EX 110	59.0	11.4	16.7	177.0	16.4	23.9	354.0	20.7	30.4
EX 120	60.0	11.8	17.4	180.0	17.1	25.1	360.0	21.5	31.6
EX 130	78.0	13.2	19.4	234.0	19.0	27.9	468.0	23.9	35.2
EX 140	80.0	13.7	20.2	240.0	19.8	29.1	480.0	24.9	36.6
EX 150	90.0	14.6	21.5	270.0	21.0	30.9	540.0	26.5	39.0
EX 160	102.0	15.5	22.9	306.0	22.4	33.0	612.0	28.2	41.5
EX 170	110.0	16.3	23.9	330.0	24.5	34.5	660.0	29.6	43.5
EX 180	123.0	17.7	26.1	369.0	25.6	37.6	738.0	32.2	47.4
EX 190	126.0	18.4	27.1	378.0	26.6	39.1	756.0	33.5	49.2
EX 200	160.0	19.4	28.6	480.0	28.0	41.2	960.0	35.3	51.9
EX 220	180.0	20.8	30.6	540.0	30.0	44.1	1 080.0	37.8	55.6
EX 240	190.0	22.6	33.2	570.0	32.5	47.9	1 140.0	41.0	60.3

EX

ISO 10

Values of preload and rigidity

(Bearings rigidly preloaded)

contact angle = 25°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
EX 6	1.5	2.2	3.3	4.0	3.2	4.6	8.0	4.0	5.8
EX 7	1.7	2.5	3.6	5.0	3.5	5.1	10.0	4.5	6.5
EX 8	2.5	2.9	4.2	8.0	4.3	6.2	16.0	5.4	7.9
EX 9	3.0	3.0	4.5	9.0	4.4	6.5	18.0	5.5	8.2
EX 10	3.5	3.9	5.7	11.0	5.7	8.3	22.0	7.1	10.5
EX 12	4.5	4.0	5.9	13.0	5.8	8.4	26.0	7.2	10.6
EX 15	5.0	5.0	7.4	15.0	7.3	10.7	30.0	9.1	13.5
EX 17	6.5	5.8	8.5	19.5	8.4	12.3	39.0	10.6	15.5
EX 20	8.0	6.0	8.8	24.0	8.7	12.7	48.0	11.0	16.0
EX 25	10.5	7.9	11.5	32.0	11.4	16.7	64.0	14.3	21.0
EX 30	13.0	8.7	12.8	38.5	12.5	18.4	77.0	15.8	23.2
EX 35	16.5	10.4	15.2	49.0	14.8	22.0	98.0	18.6	27.7
EX 40	17.0	10.9	16.1	51.0	15.8	23.3	102.0	19.9	29.3
EX 45	23.0	12.3	18.1	69.0	17.8	26.2	137.0	22.4	33.0
EX 50	23.5	13.1	19.1	70.5	18.8	27.7	141.0	23.7	34.9
EX 55	31.5	14.9	22.1	94.0	21.6	31.8	188.0	27.2	40.1
EX 60	32.5	15.9	23.4	97.0	23.0	33.8	194.0	28.9	42.6
EX 65	33.0	16.7	24.6	99.0	24.1	35.5	199.0	30.4	44.7
EX 70	42.5	18.9	27.8	128.0	27.3	40.1	255.0	34.3	50.5
EX 75	43.5	19.7	29.0	131.0	28.5	41.9	262.0	35.9	52.8
EX 80	52.5	21.1	30.1	157.5	30.4	44.7	315.0	38.3	56.3
EX 85	54.0	22.0	32.3	162.0	31.7	46.6	323.0	40.0	58.7
EX 90	57.0	23.8	35.3	171.0	34.4	50.6	341.0	43.1	63.8
EX 95	67.0	25.2	37.2	202.0	36.5	53.7	404.0	45.7	67.7
EX 100	69.0	26.4	38.8	207.0	38.1	56.0	415.0	48.0	70.6
EX 105	80.0	27.7	40.8	240.0	40.0	58.0	480.0	50.4	74.1
EX 110	95.0	30.2	44.4	285.0	43.6	64.1	570.0	54.9	80.8
EX 120	97.0	31.4	46.2	291.0	45.3	66.7	582.0	57.1	84.0
EX 130	125.0	34.9	51.3	375.0	50.3	74.0	750.0	63.4	93.2
EX 140	128.0	36.3	53.4	384.0	52.4	77.0	768.0	66.0	97.0
EX 150	144.0	38.6	56.8	432.0	55.7	82.0	864.0	70.2	103.3
EX 160	162.0	41.0	60.4	486.0	59.2	87.1	972.0	74.6	109.7
EX 170	176.0	43.1	63.3	528.0	62.1	91.4	1 056.0	78.3	115.1
EX 180	197.0	47.0	69.1	591.0	67.8	99.7	1 182.0	85.4	125.6
EX 190	200.0	48.7	71.8	600.0	70.2	103.2	1 200.0	88.4	130.1
EX 200	250.0	51.0	75.1	750.0	73.6	108.3	1 500.0	92.8	136.5
EX 220	280.0	54.6	80.3	840.0	78.7	115.8	1 680.0	99.2	145.9
EX 240	300.0	59.5	87.6	900.0	85.9	126.3	1 800.0	108.2	159.1

E 200

ISO 02

series **E 200** ISO 02

E 200
ISO 02

SNFA	d	D	B	z	Ø	15°		25°		Weight
						C33	C0	C33	C0	
E 207	7	22	7	8	3.97	365	194	350	187	0.012
E 208	8	24	8	7	4.76	455	230	440	220	0.016
E 209	9	26	8	9	4.76	550	320	530	300	0.021
E 210	10	30	9	8	5.55	655	370	640	360	0.029
E 212	12	32	10	9	5.55	720	440	695	420	0.035
E 215	15	35	11	9	6.35	915	570	885	550	0.042
E 217	17	40	12	9	7.14	1 140	720	1 090	700	0.060
E 220	20	47	14	11	7.14	1 315	940	1 260	910	0.105
E 225	25	52	15	12	7.94	1 720	1 290	1 640	1 230	0.125
E 230	30	62	16	12	9.52	2 350	1 850	2 250	1 770	0.194
E 235	35	72	17	14	9.52	2 600	2 270	2 480	2 170	0.300
E 240	40	80	18	14	11.11	3 430	3 050	3 280	2 920	0.359
E 245	45	85	19	15	11.11	3 590	3 350	3 410	3 200	0.414
E 250	50	90	20	14	12.70	4 370	4 010	4 150	3 830	0.442
E 255	55	100	21	14	14.28	5 560	5 000	5 300	4 830	0.591
E 260	60	110	22	15	14.28	5 770	5 600	5 490	5 300	0.782
E 265	65	120	23	15	15.87	6 800	6 800	6 490	6 500	0.980
E 270	70	125	24	16	15.87	7 085	7 400	6 730	7 100	1.084
E 275	75	130	25	17	15.87	7 345	8 000	6 980	7 600	1.188
E 280	80	140	26	17	17.46	8 960	9 600	8 490	9 100	1.417
E 285	85	150	28	16	19.05	9 830	10 700	9 330	10 200	1.755
E 290	90	160	30	15	22.22	12 490	13 200	11 920	12 700	2.212
E 295	95	170	32	17	20.64	11 780	13 400	11 190	12 800	2.720
E 200/100	100	180	34	16	23.81	14 740	16 400	14 050	15 700	3.267
E 200/105	105	190	36	16	25.40	17 030	18 600	16 190	17 800	4.000
E 200/110	110	200	38	17	25.40	17 670	20 100	16 760	19 100	4.630
E 200/120	120	215	40	18	25.40	17 900	21 700	16 900	20 700	5.600
E 200/130	130	230	40	17	28.57	20 400	25 600	19 400	24 400	6.300
E 200/140	140	250	42	18	30.16	23 140	30 400	21 900	29 000	8.260

For larger sizes consult our Technical Department

E 200
ISO 02

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
E 207	109 000	87 000	78 300	71 000	63 900	44 000	39 600
E 208	98 500	78 800	71 000	64 600	58 200	39 400	35 500
E 209	90 000	72 000	64 800	59 000	53 100	36 000	32 400
E 210	78 500	63 000	56 700	51 000	45 900	31 000	27 900
E 212	71 500	57 000	51 300	46 000	41 400	28 500	25 700
E 215	62 500	50 000	45 000	40 000	36 000	25 000	22 500
E 217	55 000	44 000	39 600	35 500	32 000	22 000	19 800
E 220	46 500	37 000	33 300	30 000	27 000	18 500	16 700
E 225	40 000	32 000	28 800	26 000	23 400	16 000	14 400
E 230	33 500	27 000	24 300	21 500	19 400	13 500	12 200
E 235	28 500	23 000	20 700	18 500	16 700	11 500	10 400
E 240	25 500	20 000	18 000	16 500	14 900	10 000	9 000
E 245	23 000	18 500	16 700	15 000	13 500	9 000	8 100
E 250	21 500	17 000	15 300	14 000	12 600	8 500	7 700
E 255	19 000	15 000	13 500	12 500	11 300	7 500	6 800
E 260	17 500	14 000	12 600	11 000	9 900	7 000	6 300
E 265	16 000	12 500	11 300	10 000	9 000	6 300	5 700
E 270	15 000	12 000	10 800	9 500	8 600	6 000	5 400
E 275	14 000	11 000	9 900	9 000	8 100	5 500	5 000
E 280	13 000	10 500	9 500	8 500	7 700	5 200	4 700
E 285	12 000	10 000	9 000	8 000	7 200	4 800	4 400
E 290	11 500	9 000	8 100	7 500	6 800	4 500	4 100
E 295	10 500	8 500	7 700	7 000	6 300	4 200	3 800
E 200/100	10 000	8 000	7 200	6 500	5 900	4 000	3 600
E 200/105	9 300	7 500	6 800	6 100	5 500	3 700	3 400
E 200/110	9 000	7 000	6 300	5 500	5 000	3 600	3 200
E 200/120	8 200	6 600	5 900	5 300	4 700	3 200	2 900
E 200/130	7 500	6 000	5 400	4 800	4 400	3 000	2 700
E 200/140	6 700	5 300	4 800	4 400	4 000	2 700	2 400

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9
ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

E 200

ISO 02

Values of preload and rigidity

(Bearings rigidly preloaded)

contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
E 207	2.0	1.2	1.7	6.0	1.7	2.5	12.0	2.2	3.2
E 208	2.3	1.2	1.8	7.0	1.8	2.6	14.0	2.2	3.2
E 209	2.9	1.5	2.3	8.7	2.2	3.3	17.0	2.8	4.1
E 210	3.5	1.6	2.4	10.5	2.3	3.4	21.0	2.9	4.3
E 212	3.5	1.8	2.6	11.5	2.5	3.7	23.0	3.2	4.7
E 215	4.8	2.0	2.9	14.4	2.8	4.2	28.8	3.6	5.3
E 217	6.0	2.3	3.3	18.0	3.2	4.8	36.0	4.0	6.0
E 220	7.0	2.7	4.0	21.0	3.9	5.7	42.0	4.9	7.2
E 225	9.0	3.2	4.8	27.0	4.7	6.9	54.0	5.9	8.6
E 230	12.0	3.8	5.6	36.5	5.5	8.1	73.0	6.9	10.1
E 235	13.5	4.4	6.4	41.0	6.3	9.2	82.0	7.9	11.6
E 240	18.0	5.0	7.4	54.5	7.2	10.7	109.0	9.2	13.5
E 245	18.7	5.3	7.9	56.0	7.7	11.4	112.0	9.7	14.3
E 250	22.8	5.7	8.4	68.5	8.2	12.1	137.0	10.4	15.3
E 255	29.0	6.4	9.5	87.0	9.3	13.7	174.0	11.7	17.2
E 260	30.5	6.9	10.1	92.0	9.9	14.6	184.0	12.5	18.4
E 265	35.5	7.5	11.0	107.0	10.8	15.9	214.0	13.5	20.0
E 270	37.0	7.9	11.6	111.0	11.4	16.8	222.0	14.3	21.1
E 275	38.5	8.3	12.3	115.0	12.0	17.7	230.0	15.0	22.3
E 280	46.0	9.1	13.4	138.0	13.2	19.4	276.0	16.6	24.4
E 285	51.5	9.3	13.8	154.5	13.5	19.9	309.0	17.0	25.1
E 290	65.5	10.2	15.1	196.0	14.7	21.7	392.0	18.6	27.4
E 295	61.5	10.7	15.7	185.0	15.6	22.6	370.0	19.3	28.5
E 200/100	77.0	11.5	17.0	231.0	16.5	24.5	462.0	21.0	30.9
E 200/105	89.0	12.4	18.2	267.0	17.9	26.3	534.0	22.5	33.1
E 200/110	92.0	13.0	19.2	276.0	18.8	27.7	552.0	23.7	34.9
E 200/120	95.0	13.7	20.2	280.0	19.6	28.9	560.0	24.7	36.4
E 200/130	107.0	14.3	21.0	320.0	20.6	30.2	641.0	25.9	38.1
E 200/140	121.0	15.7	23.1	363.0	22.7	33.3	726.0	28.6	42.0

E 200

ISO 02

Values of preload and rigidity

(Bearings rigidly preloaded)

contact angle = 25°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
E 207	3.0	3.1	4.5	9.0	4.4	6.5	18.0	5.6	8.2
E 208	3.5	3.1	4.6	10.5	4.5	6.7	21.0	5.7	8.4
E 209	4.7	4.1	6.0	14.0	5.9	8.7	28.0	7.4	10.9
E 210	5.6	4.3	6.2	17.0	6.6	9.0	34.0	7.6	11.4
E 212	6.0	4.8	6.9	18.5	6.8	10.0	37.0	8.6	12.6
E 215	8.0	5.4	7.9	23.7	7.7	11.4	47.4	9.7	14.3
E 217	9.6	6.0	8.8	29.0	8.6	12.7	58.0	10.9	16.0
E 220	11.5	7.2	10.6	34.0	10.3	15.0	68.0	13.0	19.2
E 225	15.0	8.7	12.8	44.0	12.4	18.3	87.0	15.6	23.0
E 230	20.0	10.1	14.9	60.0	14.6	21.5	120.0	18.3	27.1
E 235	22.0	11.7	17.1	66.5	16.7	24.6	132.5	21.0	31.0
E 240	29.5	13.4	19.7	88.0	19.3	28.4	176.0	24.3	35.0
E 245	30.0	14.1	20.9	90.0	20.4	30.1	180.0	25.8	37.9
E 250	36.7	15.3	22.3	110.0	21.8	32.1	220.0	27.5	40.5
E 255	46.0	17.0	25.0	138.0	24.5	36.1	276.0	30.9	45.4
E 260	48.0	18.0	26.6	144.0	26.0	38.3	288.0	32.8	48.2
E 265	57.3	20.0	29.2	172.0	28.6	42.1	344.0	36.0	53.0
E 270	59.5	21.2	30.8	178.5	30.1	44.5	357.0	38.0	56.0
E 275	61.7	22.0	32.5	185.0	31.8	46.9	370.0	39.3	59.1
E 280	75.0	24.3	35.8	225.0	35.1	51.6	450.0	44.2	65.1
E 285	82.5	24.8	36.5	247.5	35.8	52.7	495.0	45.0	66.4
E 290	105.3	27.2	40.0	316.0	38.9	57.7	632.0	49.3	72.6
E 295	99.0	27.9	41.5	297.0	40.6	59.9	594.0	51.2	75.5
E 200/100	124.2	30.7	45.1	372.5	44.2	65.1	745.0	55.7	82.0
E 200/105	143.0	32.8	48.3	429.0	47.4	69.7	858.0	59.7	87.8
E 200/110	148.0	34.6	50.9	444.0	49.9	73.4	888.0	62.9	92.5
E 200/120	150.0	36.1	53.1	450.0	52.1	76.6	900.0	65.6	96.5
E 200/130	171.0	37.8	55.6	513.0	54.5	80.1	1 027.0	68.6	101.0
E 200/140	194.0	41.6	61.3	582.0	60.0	88.4	1 164.0	75.7	111.3

BS 200 - BS

ISO 02 SPECIAL

series BS 200 ISO 02 - BS SPECIAL

Ball Screw Support Bearings

BS200 (ISO 02) and BS Special Size bearings are particularly suitable for precision applications with predominantly axial loads, due to their high axial rigidity and load capacity.

BS bearings are manufactured to class ABEC 7 with reduced axial runout error of 2.5 mm.

This high degree of precision translates into

- constant torque and uniform rotation even at high preload
- limited axial position error
- low operating temperature.

Similarly to the precision angular contact ball bearings described so far, BS bearings are supplied either individually or in sets to better satisfy a wide range of different applications.

BS 200
ISO 02

SNFA	d	D	B	z	Ø	C33	C0	Vh Pairs	Vh Quads	Weight
BS 212	12	32	10	10	4.76	945	1 440	9 000	7 600	0.037
BS 215	15	35	11	12	4.76	1 025	1 760	8 000	6 800	0.047
BS 217*	17	40	12	12	5.55	1 365	2 380	7 000	6 000	0.069
BS 220	20	47	14	13	6.35	1 820	3 380	6 000	5 000	0.111
BS 225	25	52	15	15	6.35	1 937	3 970	5 200	4 400	0.138
BS 230	30	62	16	16	7.14	2 460	5 400	4 400	3 700	0.220
BS 235	35	72	17	17	7.94	3 055	7 100	3 800	3 200	0.320
BS 240	40	80	18	18	8.73	3 745	9 100	3 400	2 900	0.400
BS 245	45	85	19	19	8.73	3 785	9 700	3 100	2 600	0.460
BS 250	50	90	20	20	8.73	3 835	10 300	2 900	2 400	0.520
BS 260	60	110	22	19	11.11	5 805	15 800	2 400	2 000	0.860
BS 275	75	130	25	24	11.11	6 400	20 200	2 000	1 700	1.500

* Made on request

BS
(special)

SNFA	d	D	B	z	Ø	C33	C0	Vh Pairs	Vh Quads	Weight
BS 20/47	20	47	15	13	6.35	1 820	3 380	6 000	5 000	0.128
BS 25/62	25	62	15	16	7.14	2 460	5 400	4 400	3 700	0.242
BS 30/62	30	62	15	16	7.14	2 460	5 400	4 400	3 700	0.217
BS 35/72	35	72	15	17	7.94	3 055	7 100	3 800	3 200	0.282

Maximum speed with grease = Vh • 0,65

BS 200
ISO 02

SNFA	PAIRS				QUADS				Maximum axial runout (µm)
	Pr	Ra	La	Cr	Pr	Ra	La	Cr	
BS 212	100	42	625	2.8	200	84	1 250	5.6	2.5
BS 215	120	50	755	4	240	100	1 510	8	2.5
BS 217*	165	58	1 030	6	330	116	2 060	12	2.5
BS 220	230	72	1 450	10	460	144	2 900	20	2.5
BS 225	270	83	1 670	12	540	166	3 340	23	2.5
BS 230	360	100	2 260	19	720	200	4 520	37	2.5
BS 235	475	118	2 960	33	950	236	5 920	67	2.5
BS 240	600	137	3 790	41	1 200	274	7 580	81	2.5
BS 245	640	145	4 020	47	1 280	290	8 040	92	2.5
BS 250	680	153	4 220	53	1 360	306	8 440	106	2.5
BS 260	1 040	185	6 500	88	2 080	370	13 000	176	2.5
BS 275	1 310	233	7 600	169	2 620	466	15 200	338	2.5

* Made on request

BS
(special)

SNFA	PAIRS				QUADS				Maximum axial runout (µm)
	Pr	Ra	La	Cr	Pr	Ra	La	Cr	
BS 20/47	230	72	1 450	10	460	144	2 900	20	2.5
BS 25/62	360	100	2 260	19	720	200	4 520	37	2.5
BS 30/62	360	100	2 260	19	720	200	4 520	37	2.5
BS 35/72	475	118	2 960	33	950	236	5 920	67	2.5

BSDU, BSQU and BSQU / 1 Cartridge Units

Another effective solution for ballscrews is the use of **BSDU** and **BSQU** cartridges, containing two and four BS200 bearings respectively, with different arrangements, as shown in this catalogue, or to specific requirements.
Cartridges can be easily assembled, and allow high precision and rigidity. They are well sealed and lubricated for a long life.
BSQU/1 cartridges, supplied on request, differ from standard BSQUs in the position of the clamping flange. In this case they contain four BS 200 bearings in any combination.

Ball screw bearing cartridge units, series BSDU

Shaft Dia.. mm	SNFA	Dimensions: ± 0,13 mm													C33	Co	Cr	Ra	Axial Runout µm	Weight	Vg*
		A	B	C	D	E	F	G	H	I	J	K	L	M							
20	BSDU 220 DD 230	20.000	26.0	60.000	90.0	32.0	13.0	44.260	47.0	36.0	64.0	32.0	6.6	76.0	1820	3380	10	72	2.5	1.1	3900
	BSDU 220 FF 230	19.996		59.987				43.240													
25	BSDU 225 DD 270	25.000	34.0	80.000	120.0	32.0	15.0	50.260	52.0	36.0	88.0	44.0	9.2	102.0	1937	3970	12	83	2.5	2.3	3400
	BSDU 225 FF 270	24.996		79.987				49.240													
30	BSDU 230 DD 360	30.000	41.0	80.000	120.0	32.0	15.0	50.260	52.0	50.0	88.0	44.0	9.2	102.0	2460	5400	19	100	2.5	2.3	2850
	BSDU 230 FF 360	29.996		79.987				49.240													
35	BSDU 235 DD 475	35.000	46.0	90.000	130.0	32.0	15.0	50.260	52.0	60.0	98.0	49.0	9.2	113.0	3055	7100	33	118	2.5	3.2	2500
	BSDU 235 FF 475	34.995		89.987				49.240													
40	BSDU 240 DD 600	40.000	55.0	124.000	165.0	43.5	17.0	64.260	66.0	66.0	128.0	64.0	11.4	146.0	3745	9100	41	137	2.5	6.1	2200
	BSDU 240 FF 600	39.995		123.982				63.240													
45	BSDU 245 DD 640	45.000	66.0	124.000	165.0	43.5	17.0	64.260	66.0	76.0	128.0	64.0	11.4	146.0	3785	9700	47	145	2.5	5.9	2000
	BSDU 245 FF 640	44.995		123.982				63.240													
50	BSDU 250 DD 680	50.000	66.0	124.000	165.0	43.5	17.0	64.260	66.0	76.0	128.0	64.0	11.4	146.0	3835	10300	53	153	2.5	5.7	1900
	BSDU 250 FF 680	49.995		123.982				63.240													

Final number in reference is the bearing set preload value in daN (1 daN = 10 N). Special preload values are available on request.
* Grease lubrication - cartridge units will be supplied greased with high quality synthetic grease.

Balls screw bearing cartridge units, series BSQU

Shaft Diam. mm	SNFA	Dimensions: ± 0,13 mm													C33	Co	Cr	Ra	Axial Runout µm	Weight	Vg*
		A	B	C	D	E	F	G	H	I	J	K	L	M							
20	BSQU 220 TDT 460	20.000	26.0	60.000	90.0	32.0	13.0	74.260	77.0	36.0	64.0	32.0	6.6	76.0	2950	6760	20	144	2.5	1.7	3250
	BSQU 220 TFT 460	19.996		59.987				72.740													
25	BSQU 225 TDT 540	25.000	34.0	80.000	120.0	32.0	15.0	80.260	82.0	40.0	88.0	44.0	9.2	102.0	3140	7940	23	166	2.5	3.5	2850
	BSQU 225 TFT 540	24.996		79.987				78.740													
30	BSQU 230 TDT 720	30.000	41.0	80.000	120.0	32.0	15.0	82.260	84.0	50.0	88.0	44.0	9.2	102.0	3985	10800	37	200	2.5	3.5	2400
	BSQU 230 TFT 720	29.996		79.987				80.740													
35	BSQU 235 TDT 950	35.000	46.0	90.000	130.0	32.0	15.0	84.260	86.0	60.0	98.0	49.0	9.2	113.0	4950	14200	67	236	2.5	4.6	2100
	BSQU 235 TFT 950	34.995		89.987				82.740													
40	BSQU 240 TDT 1200	40.000	55.0	124.000	165.0	43.5	17.0	104.260	106.0	66.0	128.0	64.0	11.4	146.0	6070	18200	81	274	2.5	9.7	1900
	BSQU 240 TFT 1200	39.995		123.982				102.740													
45	BSQU 245 TDT 1280	45.000	66.0	124.000	165.0	43.5	17.0	104.260	106.0	76.0	128.0	64.0	11.4	146.0	6130	19400	92	290	2.5	9.4	1700
	BSQU 245 TFT 1280	44.995		123.982				102.740													
50	BSQU 250 TDT 1360	50.000	66.0	124.000	165.0	43.5	17.0	104.260	106.0	76.0	128.0	64.0	11.4	146.0	6210	20600	106	306	2.5	9.1	1550
	BSQU 250 TFT 1360	49.995		123.982				102.740													

Final number in reference is the bearing set preload value in daN (1 daN = 10 N). Special preload values are available on request.
* Grease lubrication - cartridge units will be supplied greased with high quality synthetic grease.

Ball screw bearing cartridge units, series BSQU/1

Shaft Diam. mm	SNFA	Dimensions: ± 0,13 mm															C33	Co	Cr	Ra	Axial Runout µm	Weight	Vg*
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	P							
30	BSQU 230/1 TDT 720	30.000	41.0	88.000	120.0	3.5	15.0	86.260	86.0	50.0	88.0	45.0	9.2	102.0	35.0	M8x	3985	10800	37	200	2.5	3.7	2400
	BSQU 230/1 TFT 720	29.996		87.985				84.740								1.25							
40	BSQU 240/1 TDT 1200	40.000	55.0	128.000	165.0	4.0	24.0	106.260	106.0	66.0	128.0	65.5	11.4	146.0	35.0	M10x	6070	18200	81	274	2.5	10.0	1900
	BSQU 240/1 TFT 1200	39.995		127.982				104.740								1.5							
50	BSQU 250/1 TDT 1360	50.000	66.0	128.000	165.0	4.0	24.0	106.260	106.0	76.0	128.0	65.5	11.4	146.0	35.0	M10x	6210	20600	106	306	2.5	9.3	1550
	BSQU 250/1 TFT 1360	49.995		127.982				104.740								1.5							
60	BSQU 260/1 TDT 2080	60.000	80.0	145.000	185.0	20.5	25.0	114.260	114.0	92.0	145.0	74.5	11.4	165.0	40.0	M10x	9400	31600	176	370	2.5	12.3	1300
	BSQU 260/1 TFT 2080	59.993		144.982				112.740								1.5							

Final number in reference is the bearing set preload value in daN (1 daN = 10 N). Special preload values are available on request.
* Grease lubrication - cartridge units will be supplied greased with high quality synthetic grease.

Series VEB-VEX very high speed bearings

SNFA Series **VEB (ISO 19)** and **VEX (ISO 10)** have been developed to offer outstanding performance even in very demanding and advanced applications.

The different issues affecting high speed applications have been analysed when designing and producing these series. Particular attention has been paid to dynamic and heat effects and lubrication problems without neglecting other features such as the load capacity and rigidity.

VEB and VEX bearings offer a wide range of application possibilities both with grease and oil lubrication.

The speeds indicated in the Tables are valid for optimum operating conditions.

The values given for rigidly preloaded bearings are valid as long as operating conditions do not involve marked heat-induced preload increase. In some applications, such as electrospindles for instance, the electric motor generated heat thermally increases bearing preload and reduces the speed obtainable.

In such cases a lower than indicated catalogue value of preload should be used so that at operating temperature the correct preload is obtained.

H1/NS version VEB and VEX bearings (with ceramic balls and air-oil lubrication feed holes in the outer ring) are the ideal solution for reaching maximum speed.

Minimum air-oil lubrication, controlled constant preload, accurate bearing mounting and good spindle balance are necessary for obtaining satisfactory results with VEB and VEX bearings.

VEB
ISO 19

series **VEB** ISO 19

VEB
ISO 19

SNFA	d	D	B	z	Ø	15°		25°		Weight
						C33	C0	C33	C0	
VEB 8	8	19	6	9	3.17	178	73			0.007
VEB 10	10	22	6	11	3.17	210	95	198	91	0.009
VEB 12	12	24	6	12	3.17	220	107	210	102	0.010
VEB 15	15	28	7	12	3.97	330	166	310	158	0.015
VEB 17	17	30	7	13	3.97	340	184	330	175	0.016
VEB 20	20	37	9	14	4.76	500	290	480	270	0.036
VEB 25	25	42	9	16	4.76	540	340	510	320	0.040
VEB 30	30	47	9	18	4.76	580	390	540	370	0.050
VEB 35	35	55	10	19	5.55	790	560	750	540	0.075
VEB 40	40	62	12	19	6.35	1 000	740	950	700	0.100
VEB 45	45	68	12	21	6.35	1 050	830	1 000	780	0.130
VEB 50	50	72	12	21	7.14	1 310	1040	1 240	980	0.130
VEB 55	55	80	13	21	7.94	1 590	1 280	1 500	1 220	0.170
VEB 60	60	85	13	23	7.94	1 670	1 420	1 580	1 340	0.190
VEB 65	65	90	13	24	7.94	1 690	1 500	1 600	1 420	0.200
VEB 70	70	100	16	22	9.52	2 260	1 950	2 130	1 850	0.320
VEB 75	75	105	16	23	9.52	2 300	2 050	2 170	1 950	0.340
VEB 80	80	110	16	24	9.52	2 340	2 160	2 210	2 040	0.360
VEB 85	85	120	18	23	11.11	3 050	2 790	2 880	2 640	0.500
VEB 90	90	125	18	24	11.11	3 110	2 930	2 940	2 770	0.540
VEB 95	95	130	18	25	11.11	3 170	3 070	2 990	2 900	0.560
VEB 100	100	140	20	24	12.70	3 970	3 810	3 760	3 610	0.770

For larger sizes consult our Technical Department

VEB
ISO 19

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
VEB 8	184 000	147 000	132 000	119 000	107 000	72 700	65 500
VEB 10	155 000	124 000	112 000	100 000	90 300	61 300	55 200
VEB 12	137 000	110 000	99 000	89 000	80 100	54 400	49 000
VEB 15	115 000	91 900	82 700	74 400	66 900	45 500	40 900
VEB 17	105 000	84 000	75 600	68 000	61 200	41 500	37 400
VEB 20	86 200	69 100	62 200	55 900	50 300	34 100	30 700
VEB 25	73 100	58 600	52 700	47 400	42 600	29 000	26 100
VEB 30	63 400	50 800	45 700	41 100	37 000	25 100	22 600
VEB 35	54 100	43 300	39 000	35 000	31 500	21 400	19 300
VEB 40	47 500	38 100	34 300	30 800	27 700	18 800	16 900
VEB 45	42 700	34 200	30 800	27 700	24 900	16 900	15 200
VEB 50	39 500	31 600	28 500	25 600	23 000	15 600	14 100
VEB 55	35 500	28 500	25 600	23 000	20 700	14 100	12 700
VEB 60	33 000	26 400	23 800	21 400	19 200	13 100	11 800
VEB 65	30 800	24 600	22 200	19 900	17 900	12 200	11 000
VEB 70	27 900	22 400	20 100	18 100	16 300	11 100	9 900
VEB 75	26 300	21 000	18 900	17 000	15 300	10 400	9 400
VEB 80	24 800	19 900	17 900	16 100	14 500	9 800	8 800
VEB 85	22 900	18 300	16 500	14 800	13 300	9 100	8 200
VEB 90	21 800	17 400	15 700	14 100	12 700	8 600	7 800
VEB 95	20 700	16 600	14 900	13 400	12 100	8 200	7 400
VEB 100	19 300	15 500	13 900	12 500	11 300	7 700	6 900

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9
ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

VEB
ISO 19

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
VEB 8	0.9	0.8	1.2	2.7	1.3	1.8	5.5	1.8	2.5
VEB 10	1.1	1.0	1.4	3.2	1.5	2.2	6.5	2.1	3.1
VEB 12	1.1	1.0	1.5	3.4	1.7	2.4	6.8	2.3	3.3
VEB 15	1.7	1.3	1.9	5.1	2.0	2.9	10.2	2.8	4.0
VEB 17	1.8	1.4	2.0	5.4	2.2	3.1	10.8	3.0	4.3
VEB 20	2.6	1.7	2.5	7.9	2.8	4.0	15.7	3.8	5.4
VEB 25	2.8	1.9	2.8	8.5	3.1	4.4	17.0	4.2	6.0
VEB 30	3.0	2.1	3.1	9.0	3.4	4.8	18.0	4.6	6.6
VEB 35	4.1	2.6	3.8	12.5	4.1	5.9	25.0	5.5	7.9
VEB 40	5.2	2.9	4.3	15.7	4.6	6.6	31.5	6.3	9.0
VEB 45	5.5	3.2	4.6	16.6	5.0	7.2	33.1	6.8	9.7
VEB 50	6.9	3.6	5.2	21.0	5.5	8.0	41.0	7.6	10.8
VEB 55	8.3	3.9	5.7	25.0	6.1	8.8	50.0	8.3	11.9
VEB 60	8.7	4.2	6.2	26.2	6.6	9.5	52.3	8.9	12.8
VEB 65	8.9	4.4	6.4	26.6	6.8	9.8	53.2	9.2	13.2
VEB 70	12.0	4.8	7.1	36.0	7.5	10.8	71.0	10.2	14.6
VEB 75	12.0	5.0	7.3	36.1	7.7	11.2	72.2	10.5	15.1
VEB 80	12.3	5.2	7.5	37.0	8.0	11.6	74.0	10.8	15.6
VEB 85	16.0	5.8	8.4	47.9	8.9	12.9	95.7	12.1	17.4
VEB 90	16.3	6.0	8.7	48.8	9.2	13.3	97.7	12.5	17.9
VEB 95	16.6	6.2	9.0	50.0	9.5	13.8	99.5	12.9	18.5
VEB 100	20.8	6.8	9.8	62.4	10.5	15.1	125.0	14.1	20.3

VEB
ISO 19

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 25°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
VEB 10	1.7	2.4	3.5	5.0	3.5	5.2	10.0	4.6	6.7
VEB 12	1.8	2.6	3.8	5.5	3.9	5.7	11.0	5.1	7.4
VEB 15	2.8	3.2	4.7	8.4	4.8	7.0	17.0	6.3	9.2
VEB 17	2.9	3.4	5.0	8.7	5.1	7.5	17.5	6.7	9.8
VEB 20	4.2	4.3	6.3	13.0	6.5	9.5	25.0	8.4	12.2
VEB 25	4.5	4.8	7.1	14.0	7.3	10.7	27.0	9.4	13.7
VEB 30	4.8	5.4	7.8	14.5	8.0	11.6	29.0	10.4	15.1
VEB 35	6.6	6.5	9.5	20.0	9.6	14.1	40.0	12.5	18.2
VEB 40	8.4	7.3	10.8	25.0	10.9	15.9	50.5	14.2	20.6
VEB 45	8.8	8.0	11.7	26.5	11.8	17.3	52.9	15.4	22.4
VEB 50	11.0	8.9	13.1	33.0	13.2	19.3	66.0	17.2	25.0
VEB 55	13.3	9.8	14.4	40.0	14.6	21.3	80.0	18.9	27.6
VEB 60	13.9	10.6	15.6	41.8	15.7	23.0	83.6	20.4	29.7
VEB 65	14.2	11.0	16.1	42.5	16.3	23.8	85.0	21.1	30.7
VEB 70	19.0	12.1	17.8	57.0	17.9	26.2	113.0	23.3	33.9
VEB 75	19.2	12.5	18.4	57.7	18.6	27.2	115.0	24.1	35.1
VEB 80	19.5	13.0	19.0	59.0	19.2	28.1	117.0	24.9	36.3
VEB 85	25.5	14.5	21.3	76.5	21.5	31.4	153.0	27.8	40.5
VEB 90	26.0	15.0	22.0	78.0	22.2	32.5	156.0	28.8	41.9
VEB 95	26.5	15.5	22.8	79.5	23.0	33.6	159.0	29.7	43.3
VEB 100	33.2	17.0	25.0	99.6	25.2	36.8	199.0	32.6	47.5

VEX
ISO 10

series VEX ISO 10

VEX
ISO 10

SNFA	d	D	B	z	Ø	15°		25°		Weight
						C33	C0	C33	C0	
VEX 6	6	17	6	8	3.17	160	61			0.006
VEX 7	7	19	6	8	3.57	198	77			0.008
VEX 8	8	22	7	8	3.97	240	97			0.012
VEX 9	9	24	7	9	3.97	260	113			0.015
VEX 10	10	26	8	10	4.37	340	152			0.019
VEX 12	12	28	8	10	4.76	390	182			0.021
VEX 15	15	32	9	12	4.76	450	230			0.028
VEX 17	17	35	10	12	5.55	600	310			0.035
VEX 20	20	42	12	12	6.35	760	410			0.065
VEX 25	25	47	12	14	6.35	840	500	800	480	0.078
VEX 30	30	55	13	17	6.35	950	630	900	600	0.110
VEX 35	35	62	14	17	7.14	1170	800	1110	770	0.150
VEX 40	40	68	15	19	7.14	1250	920	1180	870	0.190
VEX 45	45	75	16	21	7.14	1310	1040	1250	980	0.240
VEX 50	50	80	16	21	7.94	1600	1270	1510	1210	0.250
VEX 55	55	90	18	24	7.94	1710	1480	1620	1400	0.400
VEX 60	60	95	18	25	7.94	1740	1560	1650	1480	0.420
VEX 65	65	100	18	25	8.73	2080	1880	1970	1780	0.450
VEX 70	70	110	20	25	9.52	2430	2230	2300	2110	0.640
VEX 75	75	115	20	26	9.52	2670	2630	2520	2490	0.670
VEX 80	80	125	22	25	11.11	3470	3400	3290	3220	0.850
VEX 85	85	130	22	26	11.11	3540	3560	3340	3370	0.900
VEX 90	90	140	24	28	11.11	3670	3870	3470	3660	1.200
VEX 95	95	145	24	26	12.70	4520	4630	4270	4390	1.250
VEX 100	100	150	24	27	12.70	4600	4840	4350	4580	1.300
VEX 110	110	170	28	30	12.70	4830	5500	4560	5200	2.100
VEX 120	120	180	28	29	14.28	5900	6600	5600	6300	2.200

For larger sizes consult our Technical Department

VEX
ISO 10

Maximum reference speed (Vh)

(for oil-lubricated bearing, ABEC 7, contact angle = 15°)

SNFA	Spring preload	Solid preload					
		Light L		Medium M		Heavy F	
	Single	Pairs	Triplex	Pairs	Triplex	Pairs	Triplex
VEX 6	210 000	168 000	151 200	136 500	122 900	84 000	75 600
VEX 7	190 000	152 000	136 800	123 500	111 200	76 000	68 400
VEX 8	165 000	132 000	118 800	107 200	96 300	66 000	58 400
VEX 9	150 000	120 000	108 000	97 500	87 800	60 000	54 000
VEX 10	140 000	112 000	100 800	91 000	81 900	56 000	50 400
VEX 12	125 000	100 000	90 000	81 300	73 100	50 000	45 000
VEX 15	105 000	84 000	75 600	68 300	61 400	42 000	37 800
VEX 17	95 000	76 000	68 400	62 000	55 800	38 000	34 200
VEX 20	80 000	64 000	57 600	52 000	46 800	32 000	28 800
VEX 25	70 000	56 000	50 400	45 500	41 000	28 000	25 200
VEX 30	60 000	48 100	43 300	39 100	35 200	24 100	21 700
VEX 35	50 000	40 100	36 100	32 600	29 400	20 100	18 100
VEX 40	45 000	36 000	32 400	29 300	26 300	18 000	16 200
VEX 45	41 000	32 800	29 300	26 700	24 000	16 400	14 800
VEX 50	38 000	30 400	27 400	24 700	22 200	15 200	13 700
VEX 55	32 000	25 600	23 000	20 700	18 600	12 700	11 400
VEX 60	30 000	24 000	21 600	19 400	17 400	11 900	10 700
VEX 65	28 000	22 400	20 200	18 100	16 200	11 100	10 000
VEX 70	26 000	20 800	18 700	16 800	15 100	10 300	9 300
VEX 75	24 000	19 200	17 300	15 500	13 900	9 500	8 500
VEX 80	21 600	17 300	15 500	14 000	12 600	8 600	7 700
VEX 85	21 000	16 800	15 100	13 600	12 200	8 300	7 500
VEX 90	19 400	15 500	14 000	12 600	11 300	7 700	6 900
VEX 95	18 600	14 900	13 400	12 100	10 800	7 400	6 600
VEX 100	17 900	14 300	12 900	11 600	10 400	7 100	6 400
VEX 110	15 500	12 400	11 200	10 000	9 000	6 100	5 500
VEX 120	14 000	11 200	10 100	9 100	8 200	5 500	5 000

With grease = Vh · 0,65 - With 25° contact angle = Vh · 0,9
ABEC 9 = Vh · 1,1 - ABEC 5 = Vh · 0,9
Tandem = Vh single · 0,9

VEX
ISO 10

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
VEX 6	1.0	0.9	1.3	2.5	1.2	1.7	5.0	1.5	2.2
VEX 7	1.0	0.9	1.3	3.0	1.3	1.9	6.0	1.7	2.4
VEX 8	1.5	1.1	1.6	3.5	1.4	2.1	7.5	1.8	2.7
VEX 9	1.5	1.2	1.7	4.0	1.6	2.4	8.0	2.0	3.0
VEX 10	1.5	1.3	1.9	5.0	1.9	2.8	10.0	2.4	3.6
VEX 12	2.0	1.5	2.2	6.0	2.1	3.1	12.0	2.7	3.9
VEX 15	2.5	1.8	2.6	7.0	2.5	3.7	14.0	3.2	4.6
VEX 17	3.0	2.0	2.9	9.0	2.9	4.2	18.5	3.6	5.4
VEX 20	4.0	2.3	3.4	12.0	3.3	4.9	23.5	4.1	6.1
VEX 25	4.5	2.7	3.9	13.0	3.9	5.5	26.0	4.9	7.0
VEX 30	5.0	3.1	4.6	15.0	4.5	6.6	30.0	5.7	8.3
VEX 35	6.0	3.5	5.1	18.0	5.0	7.3	37.0	6.3	9.3
VEX 40	6.5	3.8	5.6	20.0	5.5	8.1	39.0	6.9	10.2
VEX 45	7.0	4.2	6.1	21.0	6.0	8.8	41.0	7.5	11.1
VEX 50	8.5	4.6	6.8	25.0	6.6	9.7	50.0	8.3	12.2
VEX 55	9.0	5.1	7.6	27.0	7.4	10.9	54.0	9.3	13.7
VEX 60	9.2	5.3	7.8	27.5	7.7	11.3	55.0	9.6	14.2
VEX 65	11.0	5.8	8.6	33.0	8.4	12.4	65.0	10.5	15.5
VEX 70	13.0	6.3	9.3	38.0	9.1	13.3	76.0	11.4	16.8
VEX 75	14.0	6.7	9.8	42.0	9.6	14.1	84.0	12.1	17.8
VEX 80	18.0	7.4	10.9	55.0	10.8	15.9	109.0	13.5	19.9
VEX 85	18.5	7.7	11.3	56.0	11.1	16.4	111.0	14.0	20.6
VEX 90	19.0	8.2	12.0	58.0	11.8	17.4	115.0	14.9	21.9
VEX 95	23.0	8.7	12.7	70.0	12.5	18.5	140.0	15.8	23.3
VEX 100	24.0	9.0	13.2	72.0	13.0	19.1	144.0	16.4	24.1
VEX 110	25.0	9.8	14.4	76.0	14.2	20.9	152.0	17.9	26.3
VEX 120	31.0	10.7	15.7	93.0	15.4	22.7	185.0	19.4	28.5

VEX
ISO 10

Values of preload and rigidity
(Bearings rigidly preloaded)
contact angle = 15°

SNFA	Light preload L			Medium preload M			Heavy preload F		
	Pr	Ra		Pr	Ra		Pr	Ra	
		Pairs	Triplex		Pairs	Triplex		Pairs	Triplex
VEX 25	7.0	6.9	10.2	21.0	10.0	14.7	43.0	12.7	18.7
VEX 30	8.0	8.2	12.1	24.0	11.9	17.5	48.0	15.0	22.0
VEX 35	10.0	9.2	13.6	30.0	13.3	19.6	59.0	16.7	24.6
VEX 40	10.5	10.1	14.9	31.0	14.5	21.3	63.0	18.4	27.0
VEX 45	11.0	11.0	16.1	33.0	15.8	23.3	66.0	19.9	29.3
VEX 50	13.0	12.0	17.7	40.0	17.5	25.7	80.0	22.0	32.4
VEX 55	14.0	13.5	19.8	43.0	19.6	28.8	86.0	24.7	36.3
VEX 60	15.0	14.2	20.8	44.0	20.3	29.8	87.0	25.4	37.4
VEX 65	17.0	15.2	22.4	52.0	22.1	32.5	104.0	27.9	41.0
VEX 70	20.0	16.6	24.4	61.0	24.0	35.3	122.0	30.3	44.5
VEX 75	22.0	17.5	25.8	67.0	25.4	37.4	134.0	32.0	47.2
VEX 80	28.0	19.5	28.7	85.0	28.2	41.5	170.0	35.6	52.3
VEX 85	29.0	20.3	29.8	89.0	29.4	43.3	178.0	37.1	54.6
VEX 90	30.0	21.5	31.7	92.0	31.3	46.0	184.0	39.4	58.0
VEX 95	38.0	23.2	34.1	113.0	33.3	49.0	227.0	42.0	61.9
VEX 100	39.0	24.0	35.3	115.0	34.4	50.6	231.0	43.4	63.8
VEX 110	40.0	25.9	38.2	121.0	37.5	55.2	242.0	47.2	69.5
VEX 120	49.0	28.2	41.5	148.0	40.8	60.0	295.0	51.3	75.5

ED (Separable)
ISO -10

These bearings are produced on special request as spare parts

SNFA	d	D	B	z	Ø	Contact angle = 15°			Weight
						C_{33}	C_0	Vh (ABEC7)	
ED 12	12	28	8	9	4.76	345	150	88 000	0.020
ED 15	15	32	9	11	4.76	395	190	74 500	0.029
ED 17	17	35	10	11	5.55	520	255	67 500	0.037
ED 20	20	42	12	10	7.14	765	375	56 000	0.063
ED 25	25	47	12	11	7.14	819	430	48 000	0.073

NS Bearings with Ceramic Balls

SNFA has extensive experience in the manufacture and supply of these bearings commonly known as " Hybrid ".
They are usually used in particularly arduous applications to give low temperature operation at high speeds.

The successful use of this product in a range of applications has greatly increased the demand for it.

The ceramic ball material most commonly used is Silicon Nitride Si3N4.

Balls made of this material combine its excellent mechanical and physical properties with high technology machining processes.

They feature good material homogeneity, high precision, reduced mass (40% of steel), high hardness and good fatigue resistance.

Comparative table (Silicon Nitride/Bearing Steel)

Material characteristics data				Silicon nitride	Bearing steel
Density	δ	[g/cm^3]		3,19	7,80
Linear thermal expansion	α	[10^{-6}/°C]	20 - 1000 °C 20 - 300 °C	3,20 -	- 11
Modulus of elasticity	E	[kN/mm^2]	20 °C	315	210
Poisson's ratio	μ			0,26	0,30
HV10 Hardness			20 °C	1700	700
Impact strength	K_{IC}	[MN/m$^{1.5}$]	20 °C	6 - 8	25
Thermal conducivity	λ	[W/m °C]	20 °C	30-40	40-50
Limiting Temperature		[°C]		ca. 1000	ca. 300
Hardenss in hot condition				good	bad
Dimensional stability				good	good
Corrosion resistance				good	bad
Magnetism				absent	present
Electrical insulation				good	bad

Compared with steel ball bearings, NS bearings offer the following advantages:

- longer life, even at higher load
- higher resistance to seizure in critical lubrication situations
- lower power dissipation (Figure 14)
- lower operating temperature (Figure 5)
- higher speed both with oil and grease lubrication
- higher acceleration and deceleration limits
- greater static and dynamic rigidity (Figure 16)
- lower wear (Figure 17)

Fig. 14

Fig. 15

Fig. 16

Field experience and laboratory tests have proven that maximum speed achievable by hybrid bearings can be 15 to 30% more than conventional bearings.

The greatest benefits are obtained in applications with grease lubrication, which have high operating temperature with steel ball bearings.

For bearings operating at high speed where there is significant centrifugal force on the balls it has been shown that bearing life can be markedly increased by the use of ceramic balls.

All SNFA series can be equipped with ceramic material balls. VEB and VEX series bearings designed for high speed operation, use the features of this material to the most effect.

Ceramic material ball bearings are coded with the suffix /NS placed after the bore diameter.
E.g. VEX 50/**NS** 9 CE1
N.B. For bearings with balls greater than 14,28 mm diameter check with SNFA for availability.

Fig. 17

H1 Bearings

This designation identifies an SNFA bearing with through the outer race holes for minimum oil lubrication.

This type of lubrication is typical of high speed applications; the H1 version is particularly suitable for series VEB and VEX.

The feed holes of H1 bearings cross to a point (Fig. 18) very close to the ball and rolling track contact area.

H1 design

Fig. 18

These holes allow the lubricant to reach directly the ball raceway contacts and so ensure the presence of an oil film even at high speed. All this means a series of advantages which translate into reduced pollution due to low lubricant consumption and improved performance. The most evident advantage is the possibility of **reaching high speeds of over 2,500,00 ndm with a remarkable degree of reliability**.

The oil supply system of H1 bearings does not differ substantially from the conventional system for minimum lubrication. The small amounts of circulating lubricant demand accurate jets that must be simple, direct and of constant cross section. They also require efficient seals to avoid pressure drops and leakage. Each bearing must be provided with its own feed.

SNFA Technical Service can play an important information role during the development stage.

An example of an **H1** designation bearing is:

VEX 70/**H1** 7CE1

HBB Cartridge Units

The HBB cartridge unit is an SNFA product developed for application on spindles and electrospindles where the severe operating conditions (high speed and great temperature difference between the shaft and the bearing outer housing) preclude the use of bearings rigidly preloaded, for the risk of seizure.

The HBB cartridge unit has a special preloading device, prepared and adjusted by SNFA, which allows bearings to operate without slackness assuring, at the same time, good stiffness, rigidity and stability.

In addition to these advantages, HBB cartridge units allow an easy handling and assembling in the spindle.

The compact shape and reduced dimension HBB cartridge unit can be adopted for a wide range of new and old applications. The latter ones without modification of the existing seatings.

The bearings of HBB cartridges, matched back to back, can be of different types depending on shaft diameter and operating conditions:
HBB../1 and HBB../2.

In all cases the bearings can be equipped with ceramic balls.

This special product is only supplied on request

HBB cartridge placed on the front end of an electrospindle

Example of bearing applications

Electrospindle for high speed milling
Bearing series VEX/NS/H1 - variable preload
Air/oil lubrication throught the outer ring

Electrospindle for high speed milling
Bearing series VEX/NS - variable preload
Air/oil lubrication via external nozzles

Electrospindle for high speed milling
Bearing series VEX - *Grease lubrication*

Electrospindle for high speed milling
Bearing series VEX - *Grease lubrication*

Motorised work head for turning
Bearing series SEB - EX - *Grease lubrication*

Spindle for a CNC lathe
Bearing series EX - *Grease lubrication*

Spindle for a surface grinder
Bearing series EX - *Grease lubrication*

Electrospindle for an internal grinder
Bearing series VEX - *Grease lubrication*

Spindle for a boring machine
Bearing series EX - SEB - *Oil injection lubrication*

Turbomolecular pump
Bearing series VEX/NS - *Grease lubrication*

Support for a recirculating ball screw
Control side bearings: SERIES BS200 - opposite side: SERIES E200

Support for a recirculating ball screw
Control side bearings a BSQU cartridge unit with series BS200
Opposite side: bearing series E200

Comparison Table of SNFA Bearings with Other Makes

This table is for information only and does not in any way guarantee that the bearing will achieve the same operating standards.

SERIE	SNFA	FAG BARDEN		FAFNIR	GMN	NSK	RHP	SKF	SNR
ISO 18	SEA								71800
ISO 19	SEB	B 71900	1900 H	9300 WI	S 61900	7900	7900	71900	71900
ISO 19 (AV)	VEB	HS 71900		99300 WN		BNC 19	S 7900	71900 CE	
ISO 10	EX	B 7000	100 H	9100 WI	S 6000	7000	7000	7000	7000
ISO 10 (AV)	VEX	HS 7000		99100 WN	SH 6000	BNC 10	S 7000	7000 CC 7000 CE	
ISO 02	E 200	B 7200	200 H	200 WI	S 6200	7200	7200	7200	7200
ISO 02	BS 200	76020						BSA 2	

AV = High speed

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The SNFA Group

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