JÖRG VOGELSANG
UMFORMTECHNOLOGIE

Tension Bushes

Elementary Technology
in Station and Rotation

Index

Quality products from Vogelsang: Tension Bushes for static and dynamic loads

Solving problems related to static and dynamic bearing loads of machine parts has been our forte for decades.

Performance optimization, material selection, quality of manufacture and accuracy of fit are the bywords which describe the solutions developed to overcome difficult bearing load problems.

This brochure, in addition to listing the size range and geometry of our internal and external tension bushes, also present examples of the multitude of functional variations available.
It provides an overview of applications and serves as a handy reference for designers.

The performance of Vogelsang's products is founded in the creative dialog established between our customers and engineers. Through their collaborative efforts, Vogelsang engineers and our customer, world wide, have developed solutions to problems which touch many aspects of our daily lives.

Tension Bush Designs

Spring Steel Tension Bush Product Range

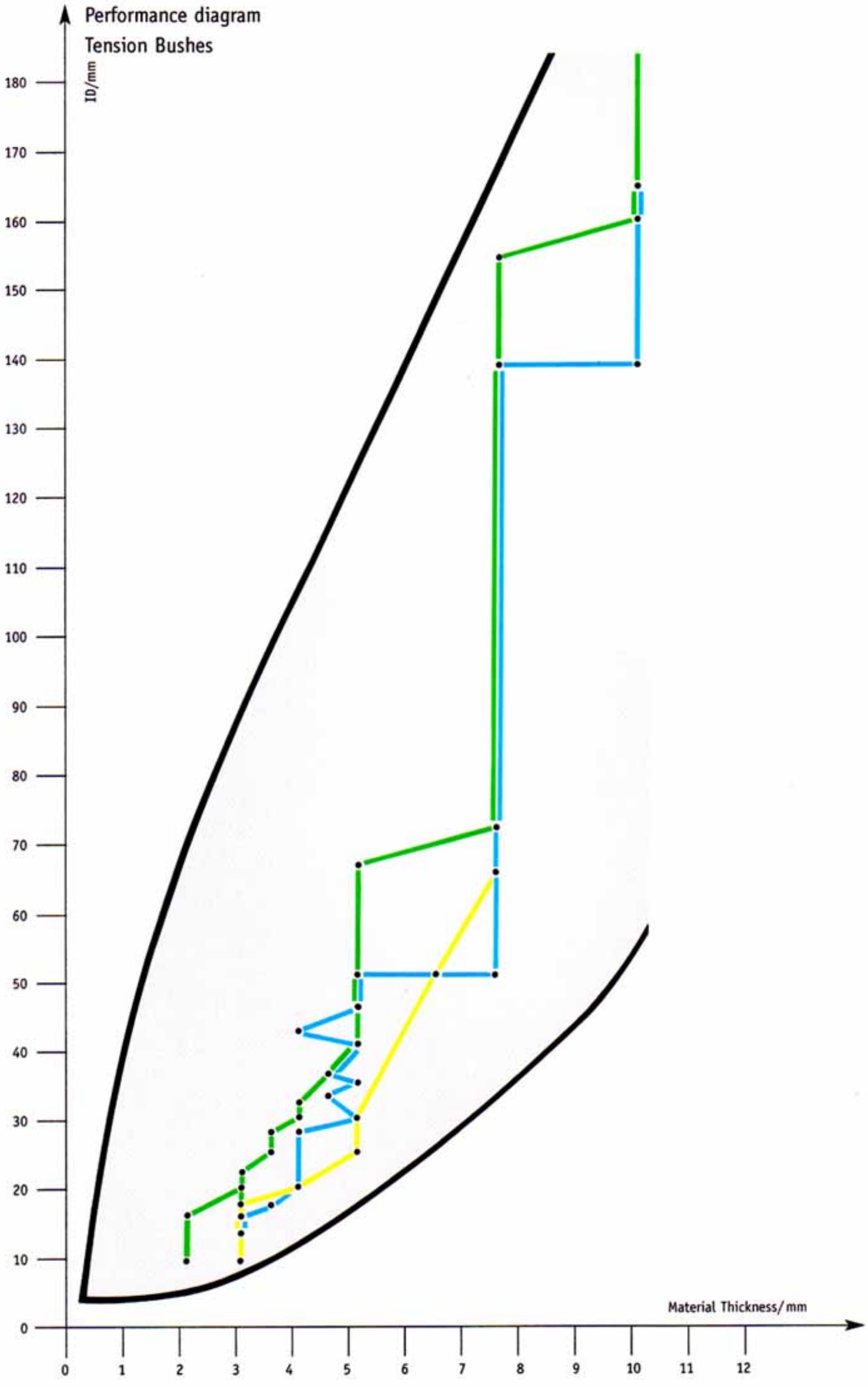
Internal Tension Bushes i.a.w. DIN 1498, are used as bearings and External Bushes, i.a.w. DIN 1499, are pressed over spindles or shafts.

Ø	min 5 - max 220
Length	min 5 - max 300

DIN 1498 Line 1

DIN 1498 Line 2

DIN 1499



Flange Sleeve Internal Tension Bush
flange guards against axial
displacement and permits
the bush to handle both
radial and axial loads

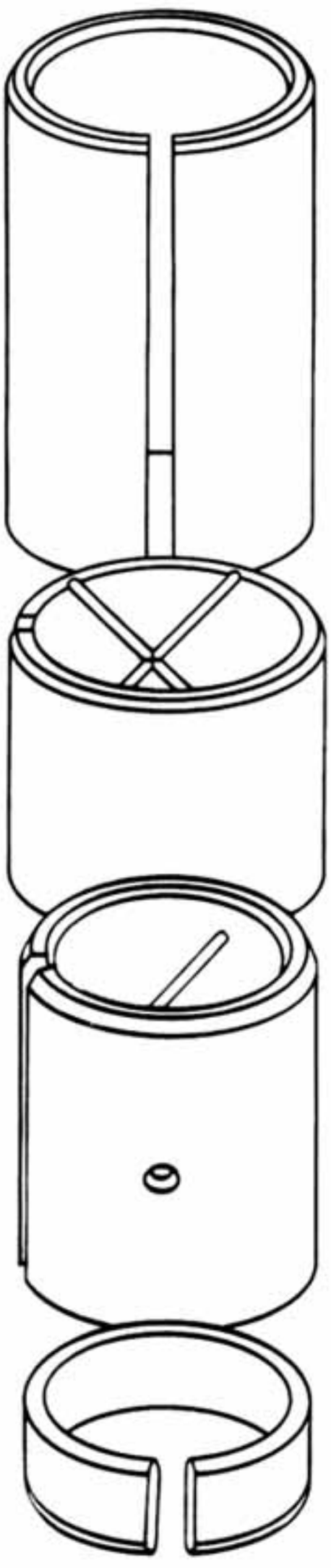
external grease groove and
holes assure lubrication without
regard to assembly position

Internal Tension Bush with Arrow Slot (EP)
arrow or "V" slot assures
uniform load distribution
on dynamic applications

external chamfer facilitates
bush insertion

External Tension Bush with Arrow Slot (AP)
arrow or "V" slot assures uniform
load distribution on dynamic applications

internal chamfer assures easy application
on spindles or shaft



Internal Tension Bush (EG)
with external chamfer
to assist in assembly
beveled/rounded inner edge

Internal Tension Bush (EG)
with open "X" pattern grease
grooves to permit flange
sided lubrication

Internal Tension Bush (EG)
with closed internal grease groove
pattern and lubrication holes for
radial lubrication application

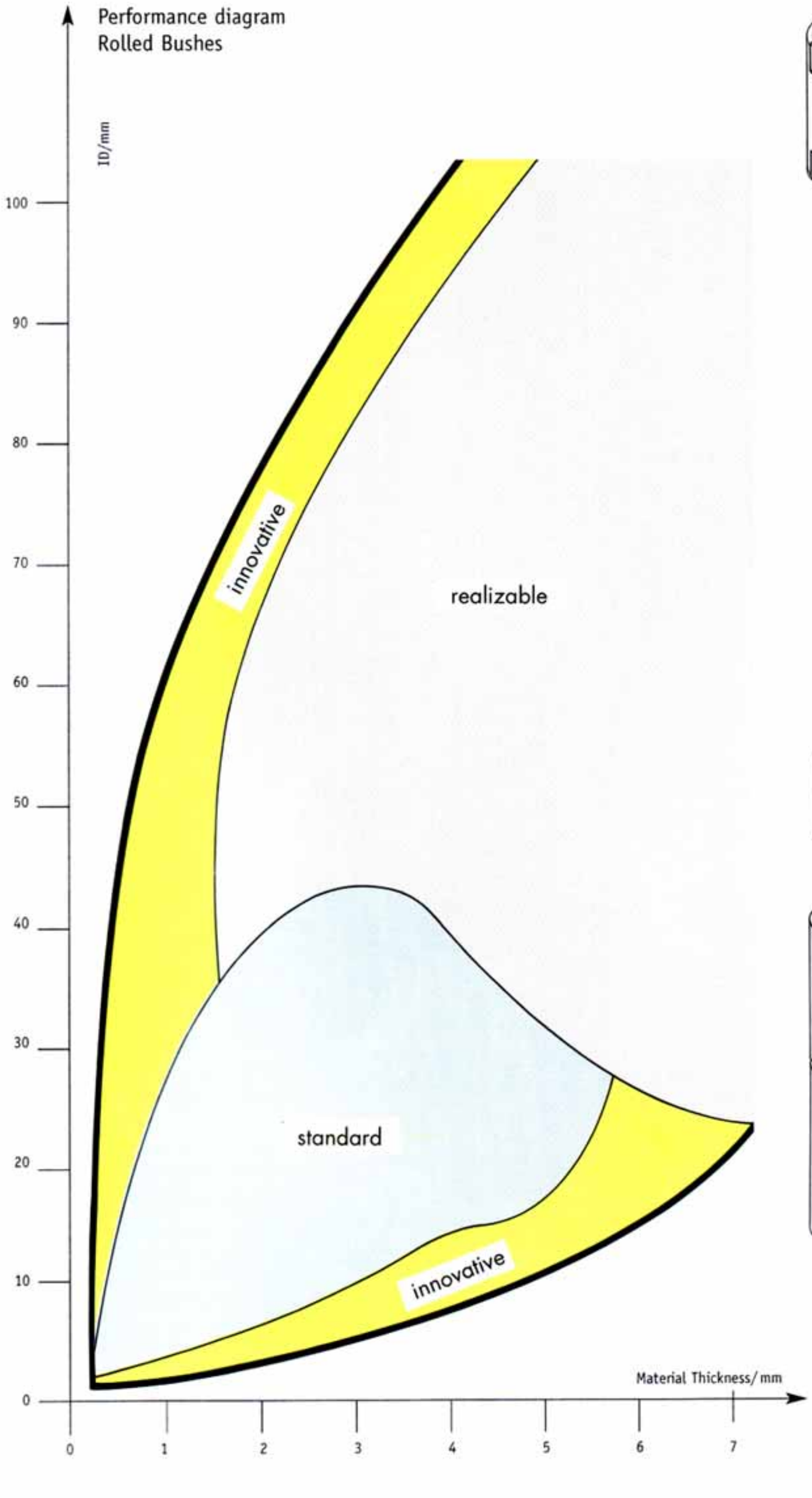
Internal Tension Bush (EG)
with rounded edge

Internal Tension Bush (EW)
with wavy slot for use on
dynamic applications
designed to distribute peak
loads in the area of the slot

Internal Tension Bush
with straight slot and
one outside chamfer -
the conventional solution
to static bearing
load problems

Internal Tension Bush (EG)
with outside chamfers at both
ends to facilitate automated assembly

Performance Diagram - Rolled Bushes



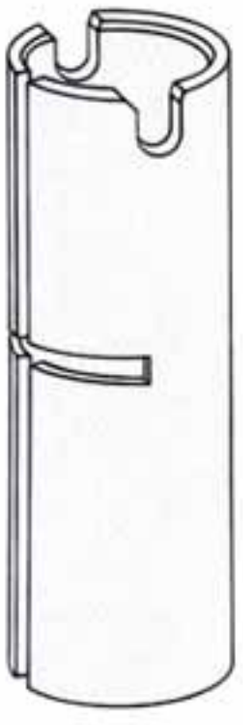
Special Purpose Carburized Bush
twist proof chain link pin for load transfer and positioning

radial hole for lubrication

Bush for Door Hinges
with one tangential end as a guard against twisting

Tension Bush
with cross hatch pattern as lubrication reservoirs

Special Configuration Tension Bush
with perpendicular locking flange



Special Configuration Tension Bush
with notches on one end to permit thrust transfer pin engagement

radial tension characteristics are influenced by means of the radial slot

Internal Tension Bush

Internal Tension Bushes, manufactured from rolled spring steel an through hardened (i.a.w. DIN 1498), offer a cost effective solution to protecting machine parts subjected to harsh an abriasive, low lubrication enviroments.

They provide the ideal bearing surface for parts subject to high loading but low speed rotational or oscillating motions where the working conditions do not permit adequate lubrication.

Characteristics:

in the free state their outside diameter is larger, by a predetermined amount, than the bore into which they are to be pressed to assure a snug and secure fit

external chamfers facilitate installation

various slot designs for specific applications:

straight

arrow and

wavy

accurate internal diameter

Tolerances tighter than those specified by DIN 1498 can be achieved through internal grinding when needed.

Advantages

Internal Tension Bushes, because of their inherent elastic qualities, maintain their fit and do not become loose, especially when used in dynamic environment, in the event the housing becomes enlarged.

Tension Bushes require a lower insertion force than solid bushes, thus avoiding damage to the housing and bush. This feature may also permit the use of smaller housing.

Lower manufacturing costs for bushes, spindles and housing.

Especially suited for pivot points with high bearing loads.

Simple assembly and un-complicated replacement - tension bushes are easily inserted or extracted with a hammer and drift.

Geomety

Tolerances of the housing bores for Internal Tension Bushes (DIN 1498) when the ID of the bore, after insertion of the bush, is desired to be as set forth in table #2

Nominal diameter of the housing bore	> 3 to 6	> 6 to 10	> 10 to 18	> 18 to 30	> 30 to 50	> 50 to 80	> 80 to 120	> 120 to 180	> 180 to 250
ISO-Tolerance h8	+ 0,018 0	+ 0,022 0	+ 0,027 0	+ 0,033 0	+ 0,039 0	+ 0,046 0	+ 0,054 0	+ 0,063 0	+ 0,072 0

ID tolerance of Internal Tension Bushes (DIN 1498)

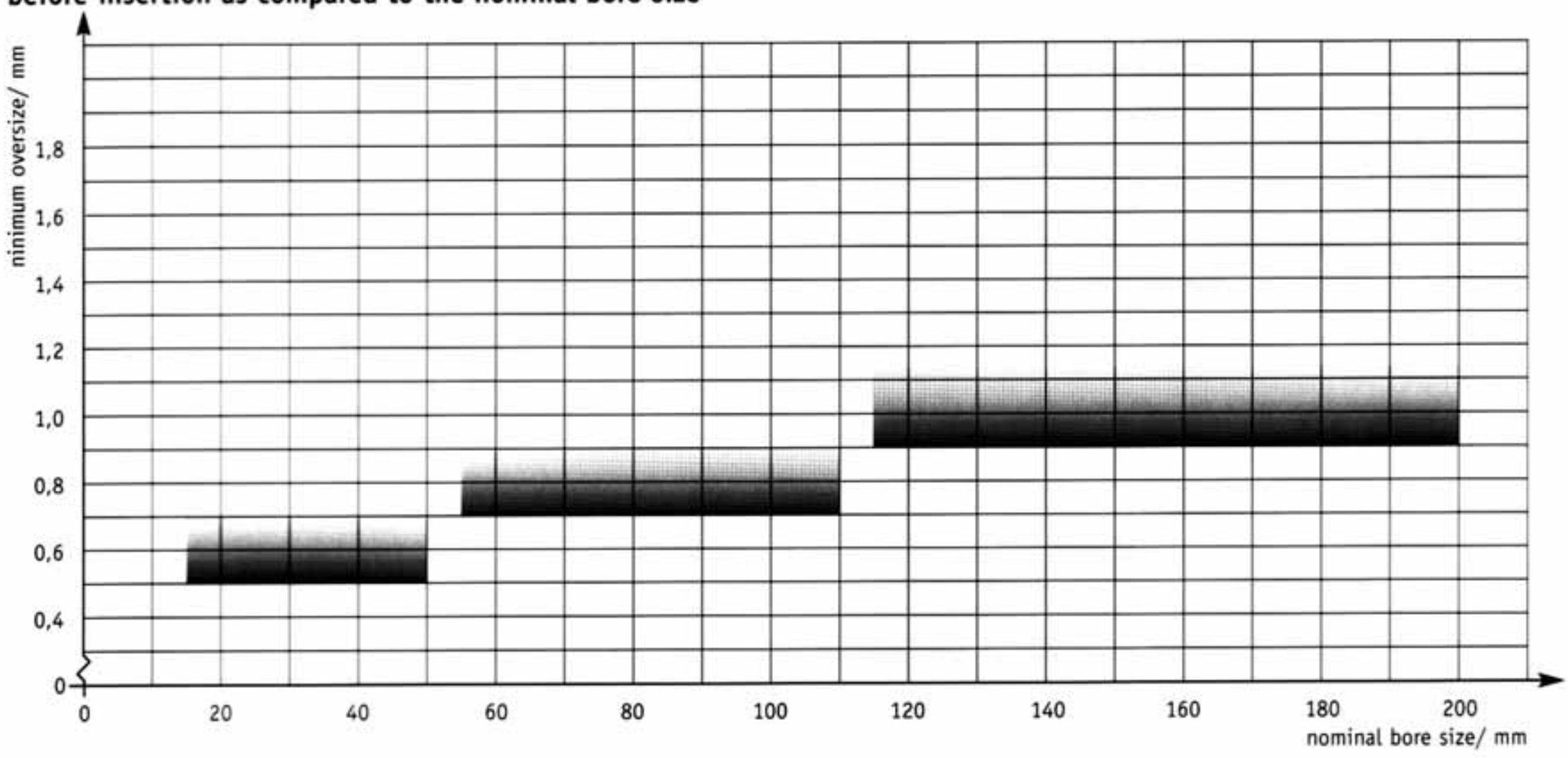
with ISO h8 tolerance housing bores

Nominal ID of Bush after installation		>6 to 10	>10 to 18	>18 to 30		>30 to 50			>50 to 80			>80 to 100			>100 to 120		>120 to 180	
Bushlength		to 50	to 50	to 50	>50 to 100	to 50	>50 to 100	>100 to 200	to 50	>50 to 100	>100 to 200	to 50	>50 to 100	>100 to 200	to 100	>100 to 200	to 100	>100 to 200
ISO-tolerance of the ID after installation	D 10	+ 0,098 + 0,040	+ 0,120 + 0,050	+ 0,149 + 0,065		+ 0,180 + 0,080												
	11				+ 0,195 + 0,065		+ 0,240 + 0,080		+ 0,290 + 0,100			+ 0,340 + 0,120						
	12							+ 0,330 + 0,080		+ 0,400 + 0,100			+ 0,470 + 0,120		+ 0,470 + 0,120		+ 0,545 + 0,145	
	13										+ 0,560 + 0,100			+ 0,660 + 0,120		+ 0,660 + 0,120		+ 0,775 + 0,145

Random tolerance of tolerance zone

Minimum Outside Diameter

before insertion as compared to the nominal bore size



External Tension Bushes

External Tension Bushes (DIN 1499) are used as an easily replaceable wear component an shafts and spindles subject to high bearing loads and marginal lubrication. Through their use, designers can provide economical operation of equipment in hostile enviroments.

Theit ID is smaller than the OD of the shaft onto which they are to be fitted, by a predetermined amount, to assure a tight fit.

The minimum pretension, as specified by DIN 1499, can be found on the next chart. To facilitate installation, External Tension Bushes have at least one inner chamfer. External Tension Bushes, like Internal Tension Bushes, can be supplied with various slot configurations.

Upon request, External Tension Bushes can be ground to obtain tighter tolerances than called for by DIN 1499.

Advantages

because of their inherent elastic qualities, External Tension Bushes require lower press-on forces than conventional tubular steel bushes

reduced cost of bearing point components

long life

ability to withstand high bearing point loads

resistant to shock loads because of their high elasticity.

Shaft tolerances for External Tension Bushes (DIN 1499)

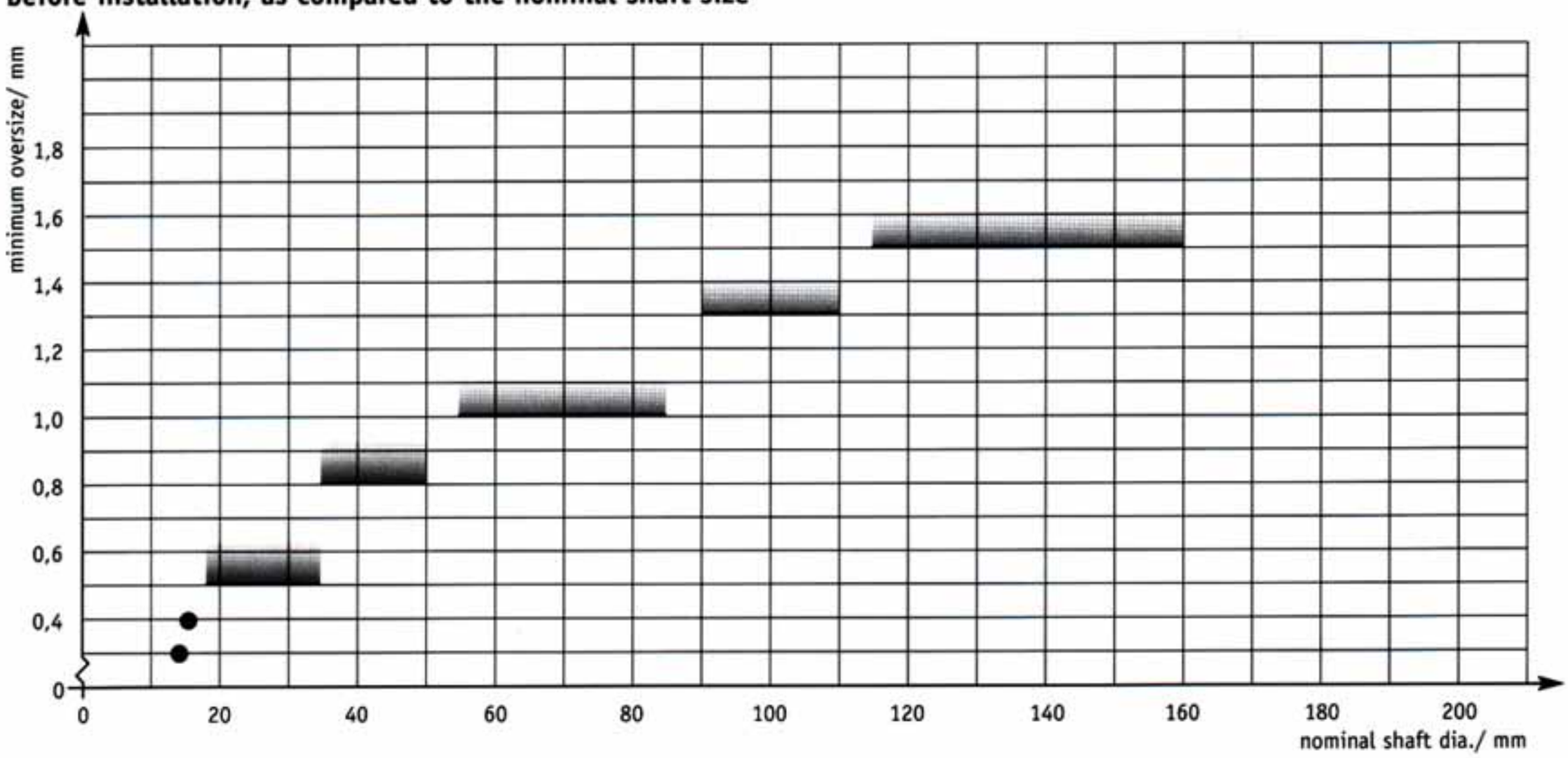
Nominal diameter of the shaft	> 3 to 6	> 6 to 10	> 10 to 18	> 18 to 30	> 30 to 50	> 50 to 80	> 80 to 120	> 120 to 180
ISO-Tolerance h8	0 - 0,018	0 - 0,022	0 - 0,027	0 - 0,033	0 - 0,039	0 - 0,046	0 - 0,054	0 - 0,063

OD tolerances of External Tension Bushes (DIN 1499)/ with ISO h8 shaft tolerances

Nominal OD of Bush after installation	>6 to 10	>10 to 18	>18 to 30	>30 to 40	>40 to 50	>50 to 65	>65 to 80	>80 to 100	>100 to 120	>120 to 140	>140 to 160	>160 to 180
ISO-Tolerance a 12	-280 -430	-290 -470	-300 -510	-310 -560	-320 -570	-340 -640	-360 -660	-380 -730	-410 -760	-460 -860	-520 -920	-580 -980
			No change in tolerance due to bush length									

Random position of tolerance zone

Minimum ID Pre-Tension, before installation, as compared to the nominal shaft size



Bearing Bush (highly wear - resistant)

Special requirements calling for an interference fit similar to those of tubular solid steel bush can be accommodated through control of the gap. For such applications, the user may specify the press-in force, i.e. the interference fit desired.

An enlargement of the housing bore into which such bushes are pressed does not lead to an immediate looseness of fit, since the inherent elastic qualities of the split bushes allow them to remain tight by compensating for the enlargement.

With the use of bearing bushes, designers can achieve the characteristics of a tubular bearing with the benefits of a Tension Bush.

Carburized Bushes

In the event design constraints preclude the use of a tension bush, Vogelsang's carburized bushes with a closed slot offer another solution to difficult bearing point problems. Such bushes due to their surface hardness of over 700 HV, provide excellent wear resistance.

Bearing Bush with slot shown as installed

Carburized Bearing Bushes

In addition to producting Tension Bushes within the standard DIN range, Vogelsang manufactures a large number of fractional sized bushes as well as custom and special purpose bushes to meet the exact form, fit and material requirements of its customer.

Some examples of variations available from Vogelsang are:

Tension Bushes with internal, external, or internal and external lubrication grooves

Tension Bushes with grease holes and open or closed end "X" style grooves

Tension Bushes with locking flanges perpendicular to the circumference of the bush

Tension Bush with cross hatch pattern as lubrication reservoirs

"Hat" style Tension Bush

Eccentric Tension Bushes

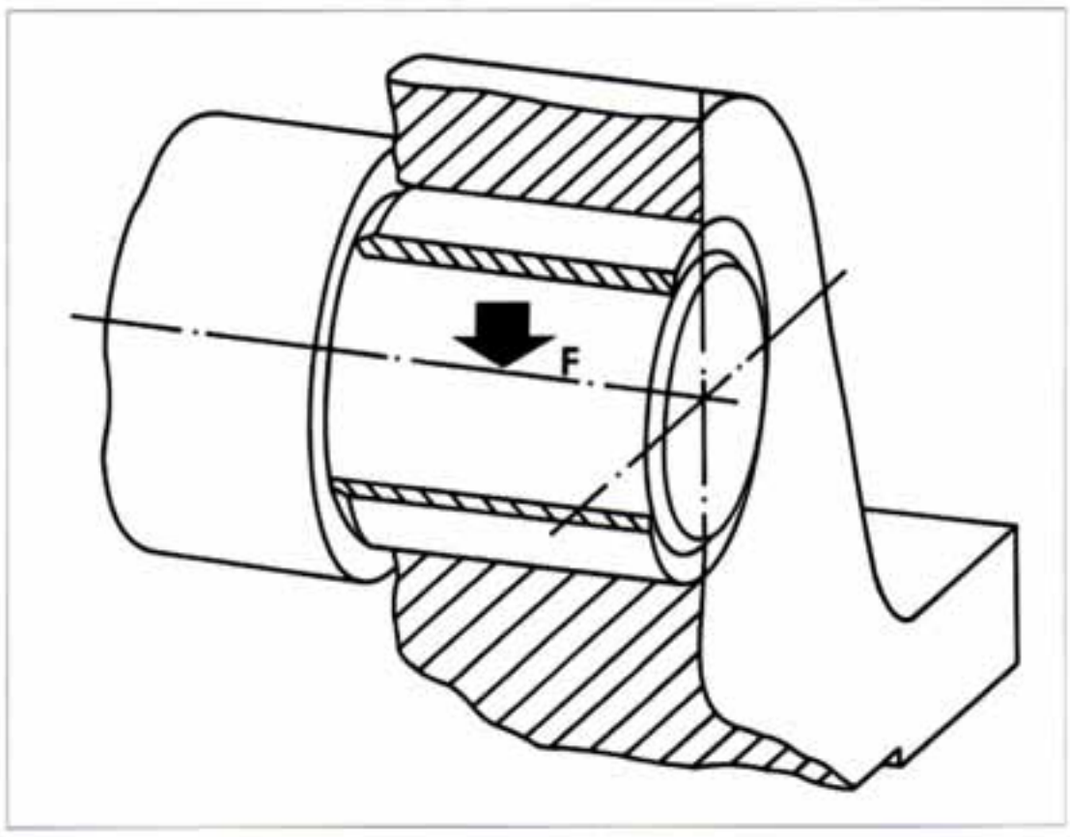
Basic Load

The load carrying capability of a bearing is determined by calculation of the bearing pressure (σ_L), a force exerts on the surface area of the bearing point. Due to the complex force distribution involved, see force distribution diagram to the right, it is normally convenient to calculate the forces under the assumption that they are at rest and that the radial force (F) is acting on a bearing point which has a surface area equal to the bush ID times the bush length.

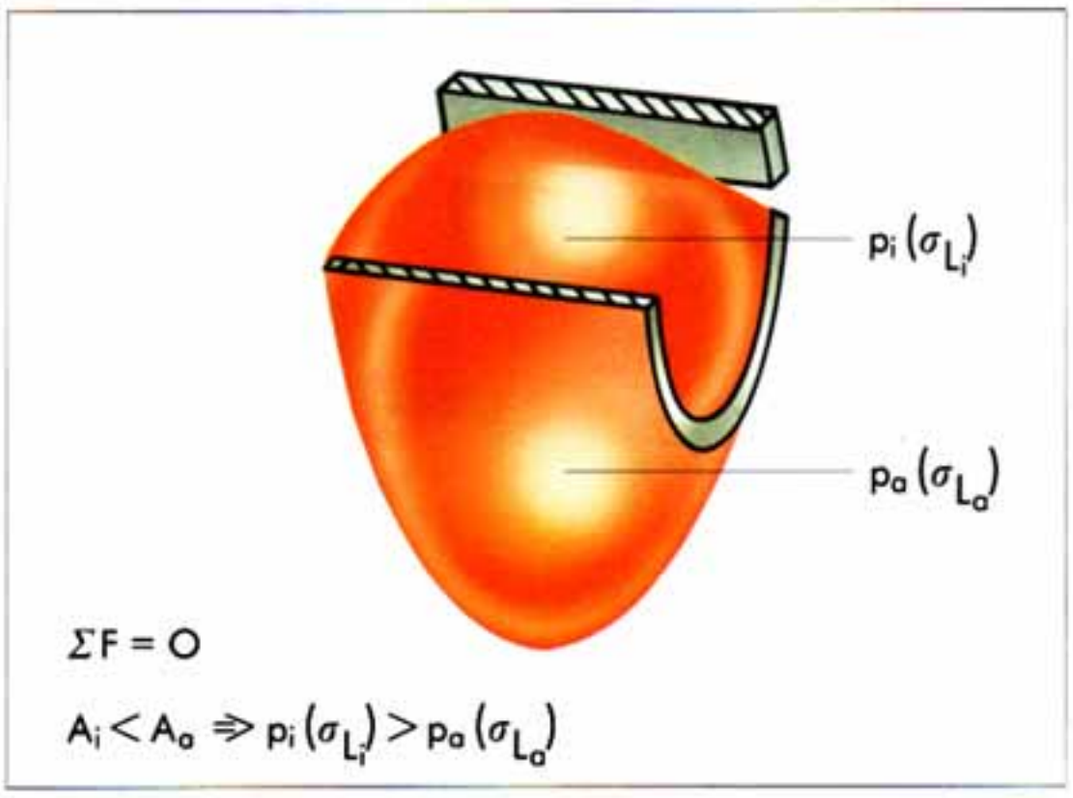
With a force (F), a supported bearing length (l-f) and a tension bush ID (d_i), the average surface pressure may be calculated as follows:

d $$\sigma_{L_m}(p_m) = \frac{F}{(l\text{-}f)\ d_i}$$

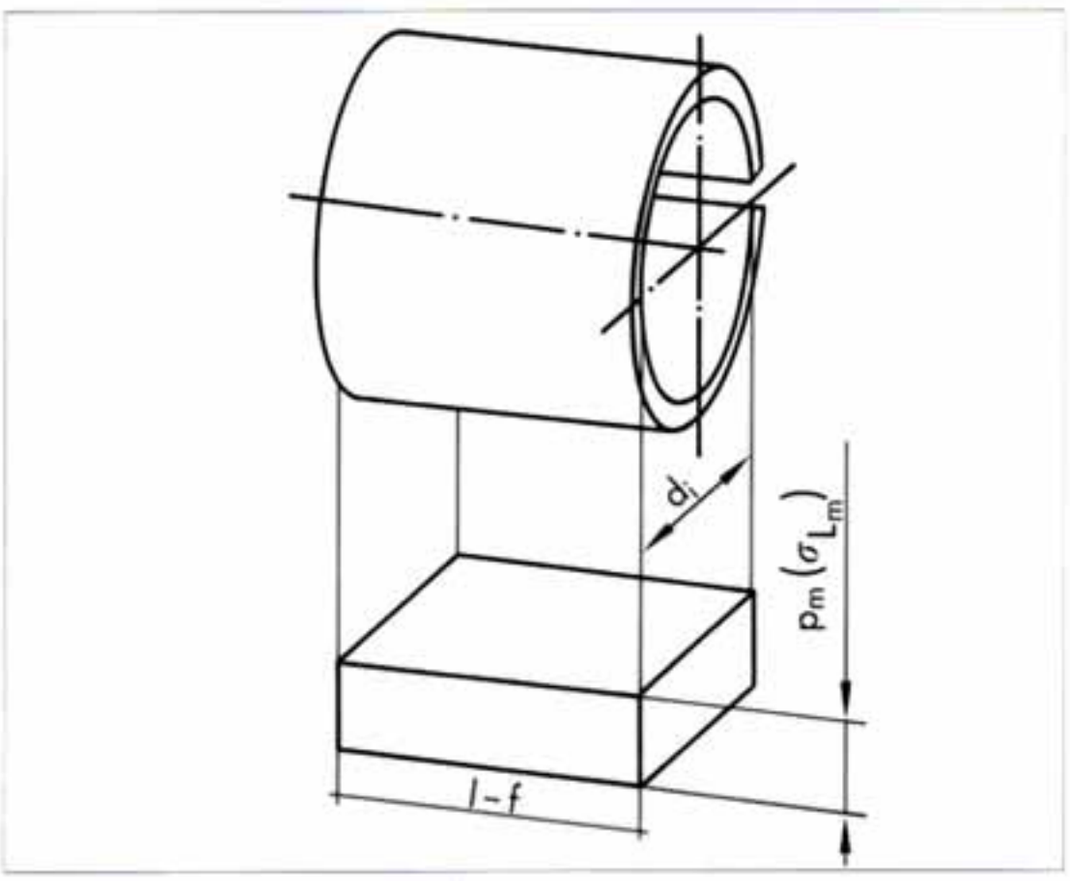
The results calculated as set forth above must be compared to allowable loads for the system. For a system at rest, designers must assure a sufficient safety margin as compared to the compression yield point of the bearing material. Under dynamic loads, validation of the safety margin must include consideration of the material's fatigue limits as well as stress boundaries.



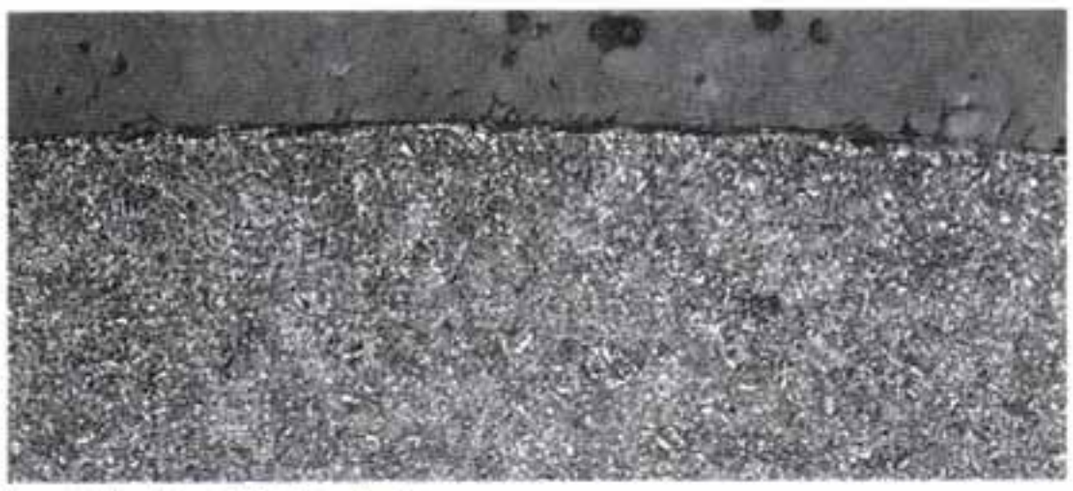
Radially loaded bearing point



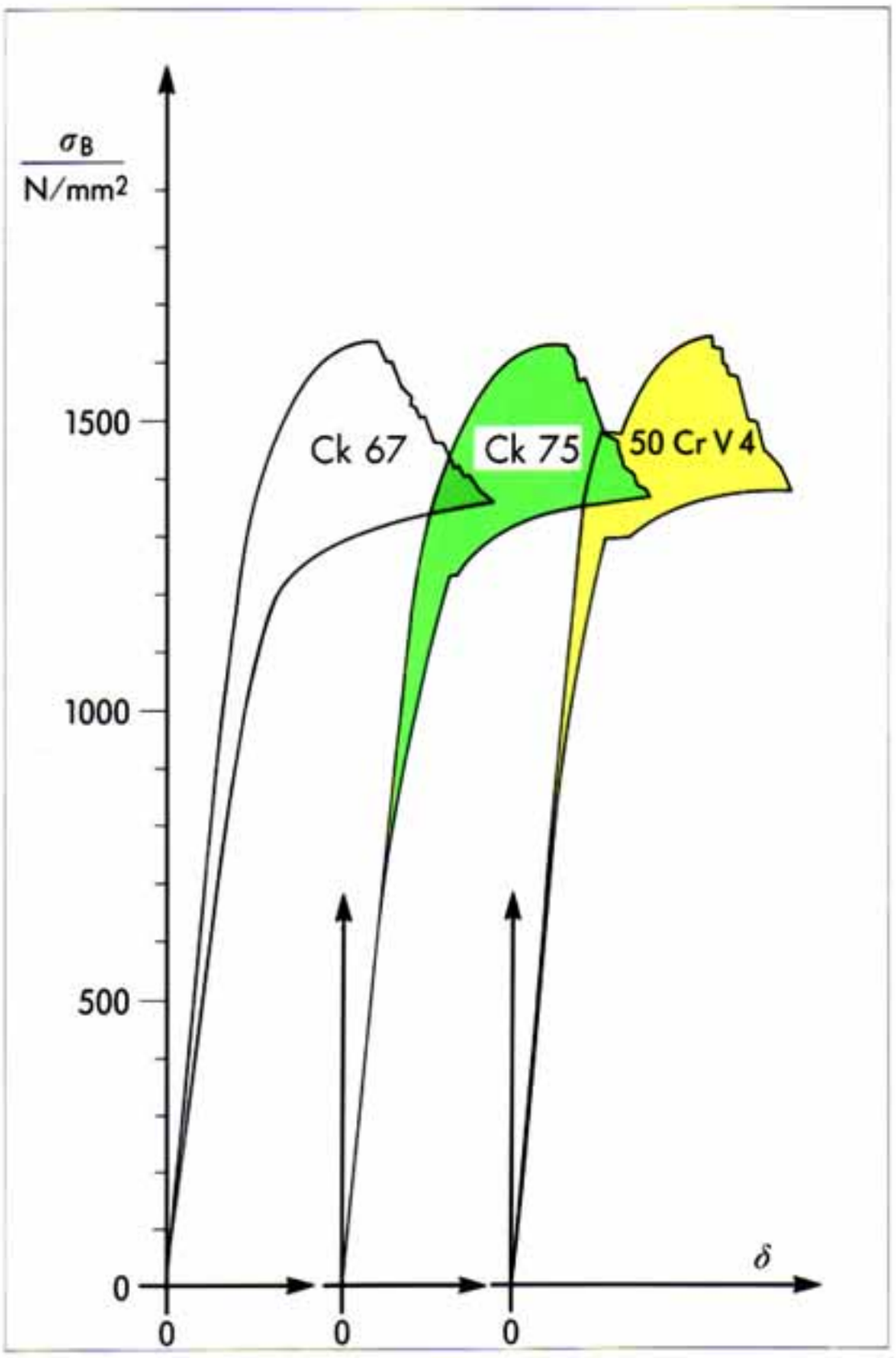
Actual bearing point load distribution for a bush in force equilibrium



Simplified bearing point load assumption



Through hardened Tension Bush



Carburized Bearing Bush

The top quality of Vogelsang Tension Bushes is guaranteed through use of only the highest quality of materials such as Ck 67 Spring Steel, DIN 17222, Material No. 1.0603.

Vigelsangs Tension Bushes are manufactured on state-of-the-art equipment and heat treated and tempered in a protective atmosphere. The resultant, through hardened martensite micro structure, Tension Bushes are able to withstand edge loadings caused by axial misalignments up to the material's plastic deformation limit. Tension Bushes are therefore especially suitable for use in areas where design constrains and or cost preclude precision bearing alignment.

Tension Bushes, with a standard hardness range of 420 - 500 HV and a tensile strength of 1350 - 1630 $\frac{N}{mm^2}$ provide protection against premature wear.

We also manufacture Bushes from the following materials upon request:

C 75 Spring Steel, DIN 17222, Material No. 1.0773

50 Cr V 4 Spring Steel, DIN 17224, Material No. 1.8159

Stainless Steel Type X 12 Cr Ni 177, DIN 17224, Material No. 1.4310 - work hardened to 1150 - 1350 $\frac{N}{mm^2}$

Carburized Rolled Bushes manufactured from the following materials are also available:

C 10, DIN 17210, Material No. 1.0301

C 15, DIN 17210, Material No. 1.0401

Dc 01...DC 04, Material No. 1.0330 ... 1.0338

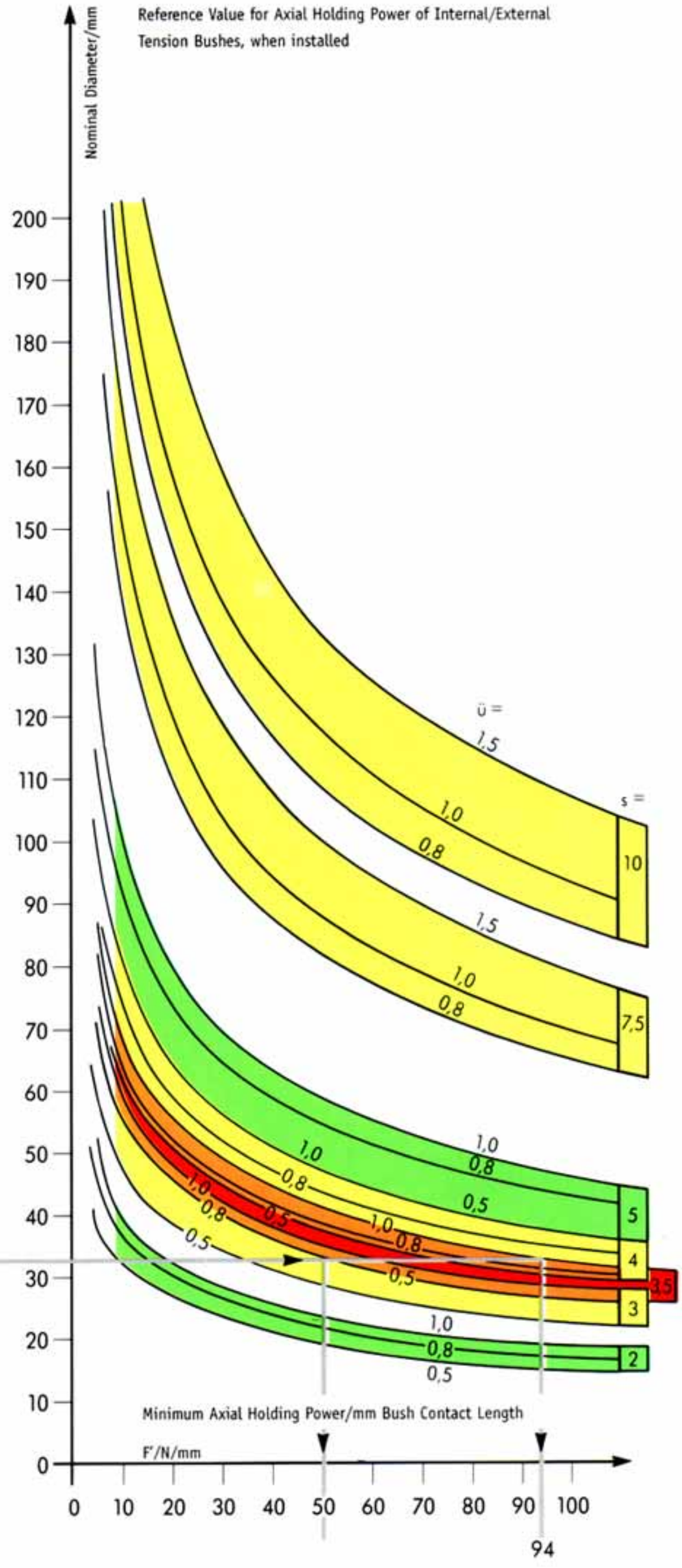
These bushes feature an extremely hard surface finish.

Holding Power of Tension Bushes

A bush resistance to axial rotation (holding power) when such bush is subjected to a combination of radial and axial load can be an important design criteria. While such information is readily available in technical reference manuals for solid tubular bushes, information concerning the holding power of tension bushes is typically obtained through field testing or test stand trials of the particular application.

Designers, by referring to the information presented on the accompanying Vogelsang diagram, can establish theoretical dimensioning criteria for a tension bush, thereby greatly reduce the time and effort needed to verify the bvushes holding power on test stand trials.

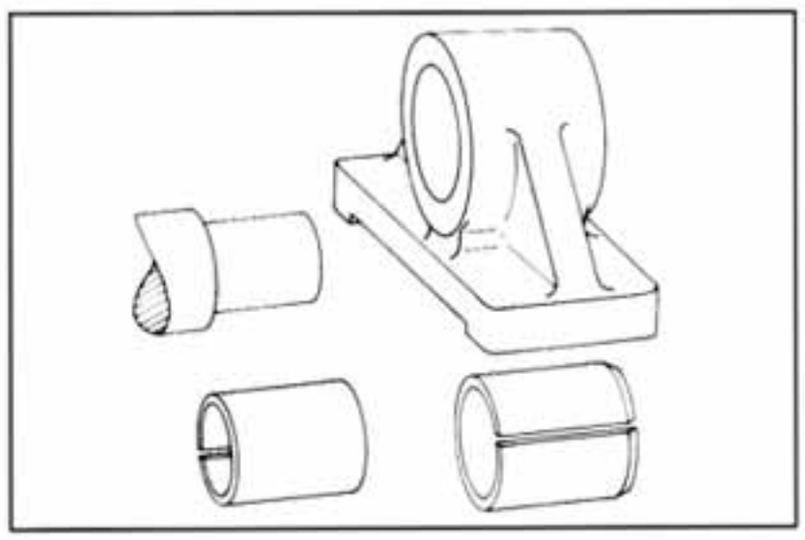
The theoretical minimum axial holding power of a tension bush can be read off the diagram by reference to the nominal ID/OD of the bore/bush, material (wall) thickness, pre-tensioning gap and bush contact length (F')

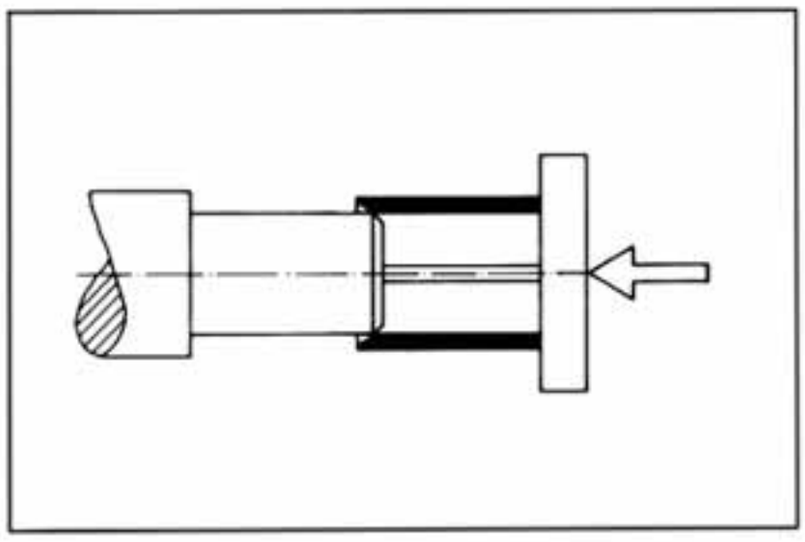


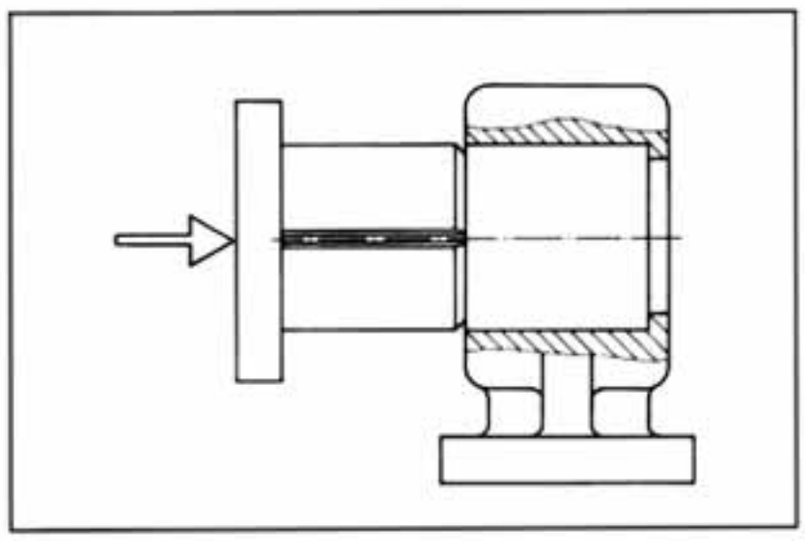
Example: Internal Tension Bush
EG 25/32x40 DIN 1498

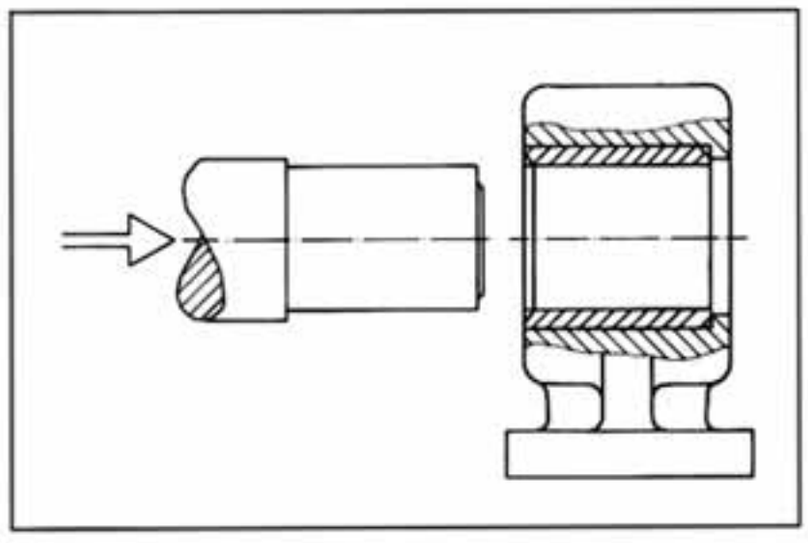
Specifications:

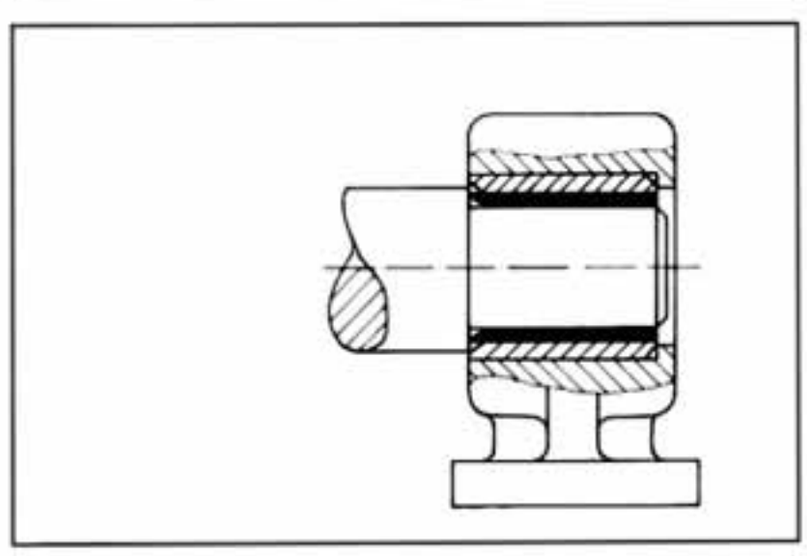
Nominal OD	d_2 =	32 mm
Pretension	ü =	0,5 mm...1,0 mm
Material Thickness	s =	3,5 mm
Nominal Length	l =	40 mm
Chamfer Length	f_1 =	2 mm
Bush Contanct Length	= Nominal Length / Chamfer Length = $l - f_1$ = (40 - 2) mm = 38 mm	
Theoretical Minimum axial holding power	$F = F' (l - f_1)$ = (50...94) $\frac{N}{mm}$ x 38 mm ≈ (1900...3570) N	

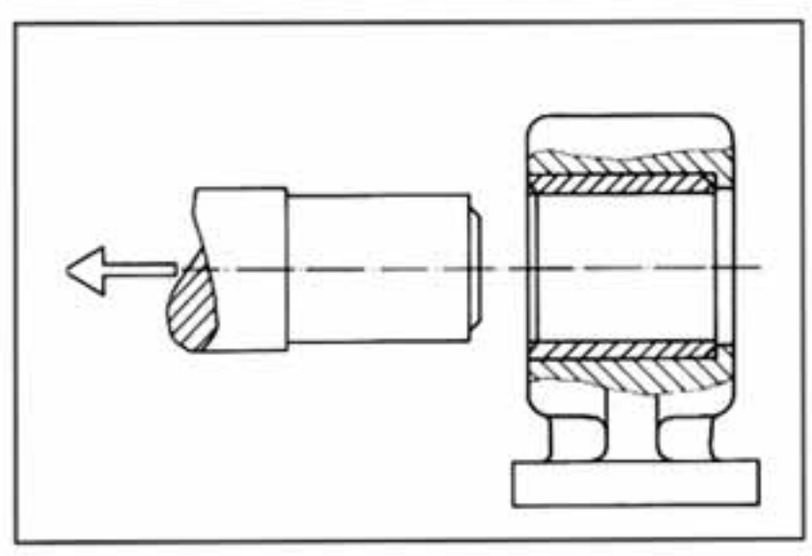


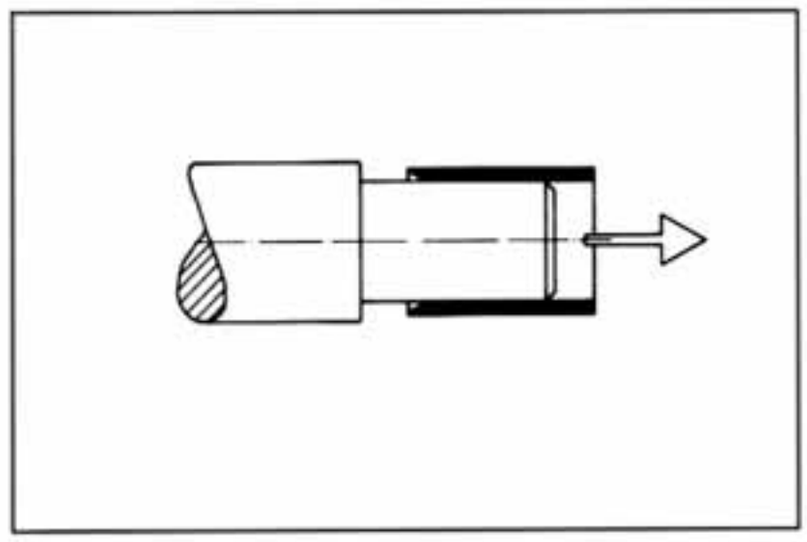


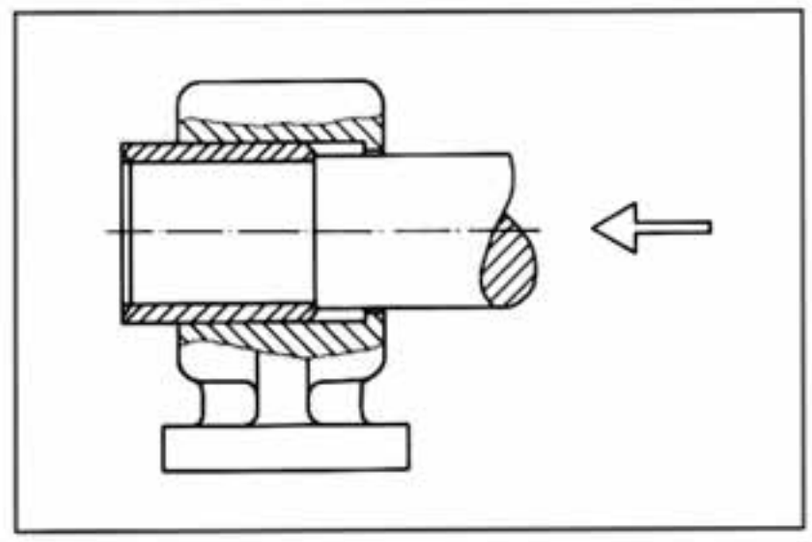












Due to the inherent elastic qualities, full lenght slit and chamfered end, tension bushes are easy to install with minimal tools. A wide range of sizes can be installed using a hammer and drift or hydraulic hand press. Because their design permits compression and expansion, they can be installed without causing damage to the surface of the bore or shaft to which they are fitted.

Jörg Vogelsang Metal Forming Technology
Manufacturing Program

Vogelsang is an international company which specializes in metal forming technology. We produce highly complex products from steel and non-ferrous metals to the highest precision and quality.

Our name is synonymous with innovative technology and consistent high quality precision products. Our problem solving capability and adeptness at finding economical and customer oriented solutions to complex manufacturing problems is founded in our highly qualified associates, capable suppliers and goal oriented investments.

Designers, engineers and end users from all branches of industry recognize our high level of metal forming technology and collaborate with us and our suppliers to develop superior products and production concepts.

Tension Bushes

The cost effective solution for bearing applications that are subject to high wear or in enviroments where proper lubrication can not be assured or is not practical.

Tension Pins and Coiled Spring Pins

Non-threaded metal fasteners which can be used to join two or more parts made from a wide variety of materials. Tension Pins, also known as ROLLPINS®, are hollow cylinders slit longitudinally over their entire pression during insertion, so that they "lock" themselves into the hole into which they are inserted, while Coiled Pins utilize a 2¼ coil wrap.

JÖRG VOGELSANG
UMFORMTECHNOLOGIE

Jörg Vogelsang is one of the world´s leading manufacturers of formed metal parts.
Our precision products made from steel and non-ferrous metal are of the highest quality.

Manufacturing Program
- Tension Pins
- Coiled Spring Pins
- Tension Bushes
- Chassis Components
- Safety Belt Components
- compression limiter®

TÜV CERT

TÜV

CERTIFICATE

The TÜV CERT Certification Body
of TÜV Anlagentechnik GmbH

certifies in accordance with
TÜV CERT procedures that

Jörg Vogelsang GmbH & Co.
Spannstiftstraße 2
D – 58119 Hagen

has established and applies a quality management system for

Manufacturing process design, construction, production and sale of formed metal parts, in particular: spring pins, coiled pins, tension bushes, rolled bushes, rolled sleeves and flat springs - without product design and development -

The audit was conducted as per the "Certification Guideline of the Automotive Industry for ISO/TS 16949:2002 1st edition".
Proof has been furnished through an audit, Report No. 5215
that the requirements according to

ISO/TS 16949:2002

have been fulfilled
The certificate is valid until 2006-11-26.
Certificate Registration No. 00 111 5215
IATF Certificate No. 0017186

TÜV Rheinland / Berlin-Brandenburg

TÜV

CERTIFICATE

The Certification Body for Environmental Management Systems
of TÜV Anlagentechnik GmbH

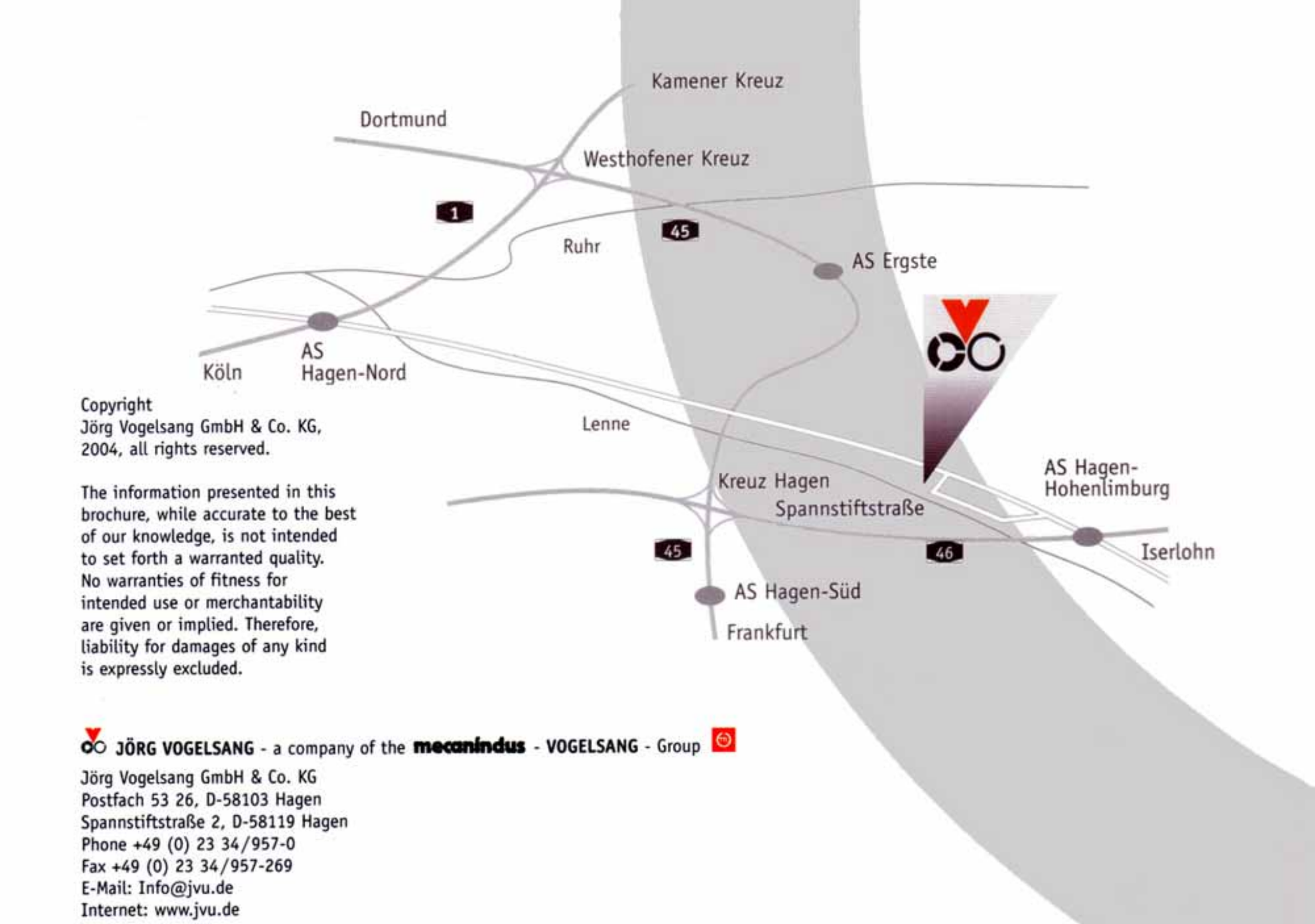
hereby certifies that the enterprise

Jörg Vogelsang GmbH & Co.
Spannstiftstraße
D – 58119 Hagen

has established and applies an environmental management system for

Producer of formed metals parts, in particular, spring pins, coiled pins, tension bushes, rolled bushes, rolled sleeves, stamping parts and flat springs

The audit was performed.
Report No: 010815
Proof has been furnished, that the requirements according to
DIN EN ISO 14001 : 1996
are fulfilled.
The certificate is valid until: May 2004
Certification Registration No.: 01 104 010815



JÖRG VOGELSANG - a company of the **mecanindus** - **VOGELSANG** - Group

Jörg Vogelsang GmbH & Co. KG
Postfach 53 26, D-58103 Hagen
Spannstiftstraße 2, D-58119 Hagen
Phone +49 (0) 23 34/957-0
Fax +49 (0) 23 34/957-269
E-Mail: Info@jvu.de
Internet: www.jvu.de