High Precision for Machine, Fixture and Equipment Construction









AGATHON

Customer benefits
Why Agathon solutions?

What are standard parts?

Standard parts: Subject to one or more official organizations of standard(s) such as ISO, DIN, etc.
Standardized parts are standardized company- or market-specific parts that are not subject to any official standard (e.g. ISO, DIN, etc).
In addition to guide elements that are subject to the ISO standards, for example, we also produce standardized parts based on the standard specifications of official standards. To complete the offer, we produce high-precision guiding systems according to our own standards and also manufacture parts according to customer's requirements.
In the case of customized parts, the customer has full freedom of choice to adapt the parts optimally to his requirements. This has the following advantages, among others:

Advantages of an optimal guiding system from Agathon

- Selection of the optimal solution depending on the application area – what is the goal?
- Combination of standard parts and special solutions
- Easy installation
- Minimized maintenance
- Reduced number of components
- Combination of tasks
- Single parts to medium volumes
- Overall focus on TCO (Total Cost of Ownership)

What is the customer›s application?

The «typical» application does not exist. The requirements are as diverse as the customers and applications in the various market segments. They can be initial concepts, prototypes, new products, conversions/optimizations of existing applications in any kind of industries. New application without empirical values. In close cooperation and direct exchange with our customer, most challenges can be mastered.

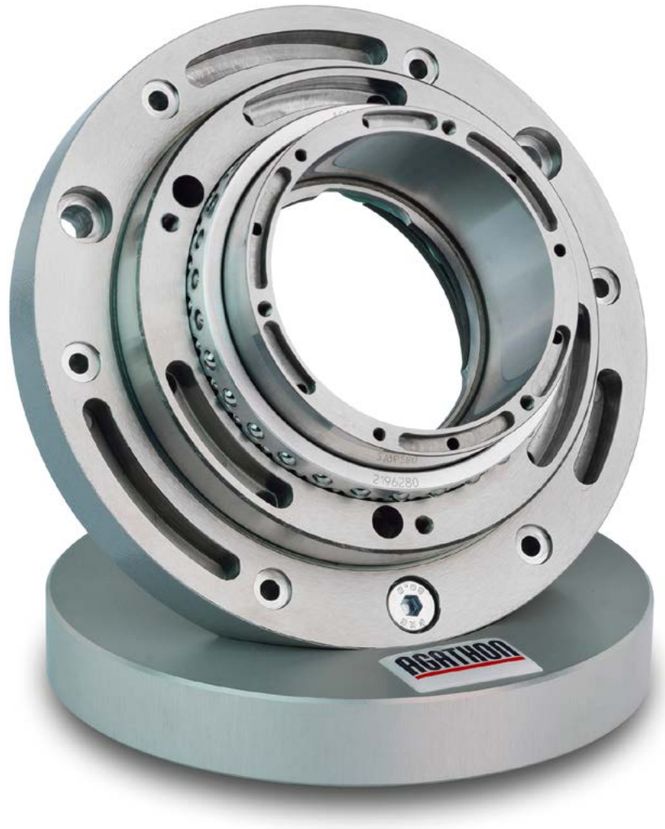


Typical challenges of the mechanical engineering

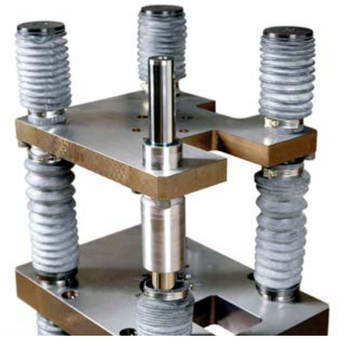
Many requests often contain requirements which cannot be met, or not completely satisfactorily met, with the current standard parts available on the market. This may be in terms of dimensions, as well as materials, combinations of tasks, achieved lifespan and precision, effort required for assembly, etc.

Guiding | Centering | Quick-change

As a specialist in the areas of Guiding | Centering | Quick-change, we support the customer with technical advice and discuss solutions from a different perspective. An open exchange with the customer is the basis for a successful project.
Are you planning to develop a new quick-change solution for your machine tool or do you desire to have a reliable, combined rotational and axial movement in an ultra-high vacuum? Are you currently faced with the task of finding an absolutely precise movement for an application in medical technology while still meeting the high standards of cleanliness? Are you faced with delivering a unit that is completely ready to be installed upon receipt? Also, are you losing a lot of time in aligning your parts and/or fixtures? If these are the problems that you face, then challenge us!!! We will be your partner when the need comes for more than what standard parts can handle.



Floating bearing for HF motor spindles with water cooling

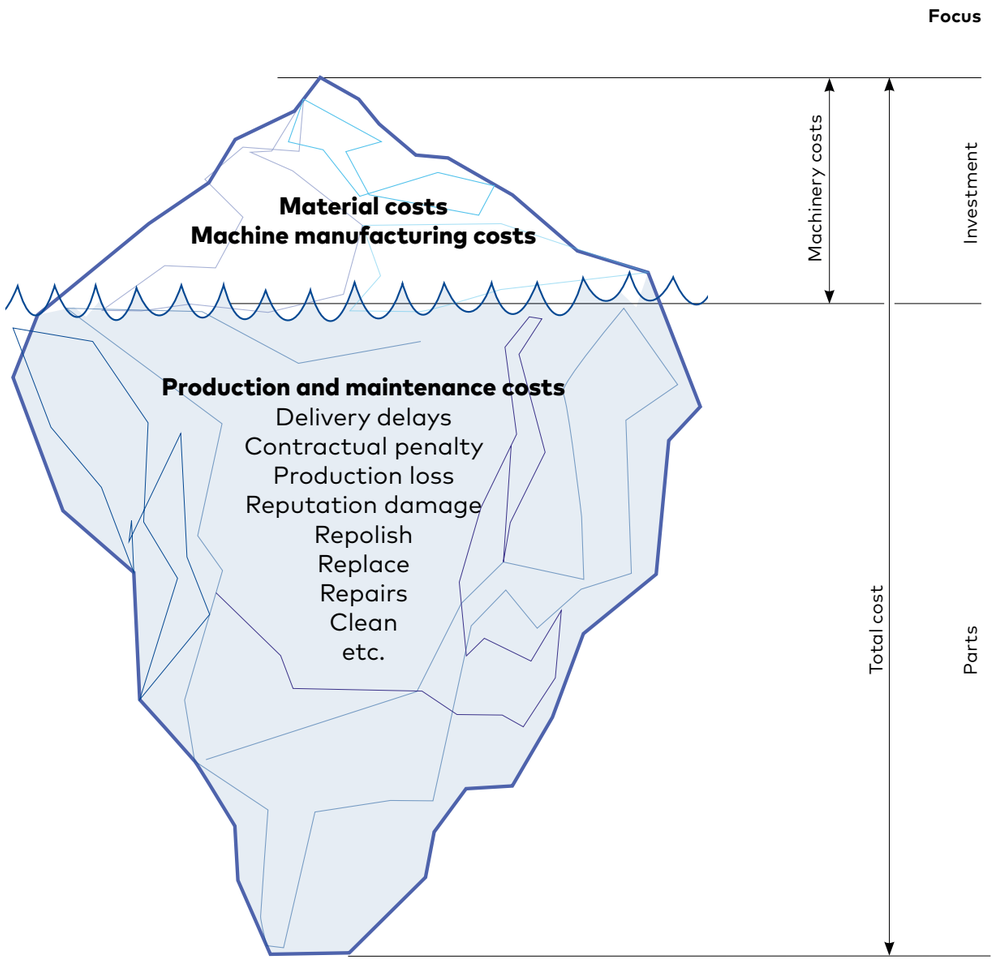


Sintering adapter with bellows to protect the guides from the sintering powder

Total cost consideration

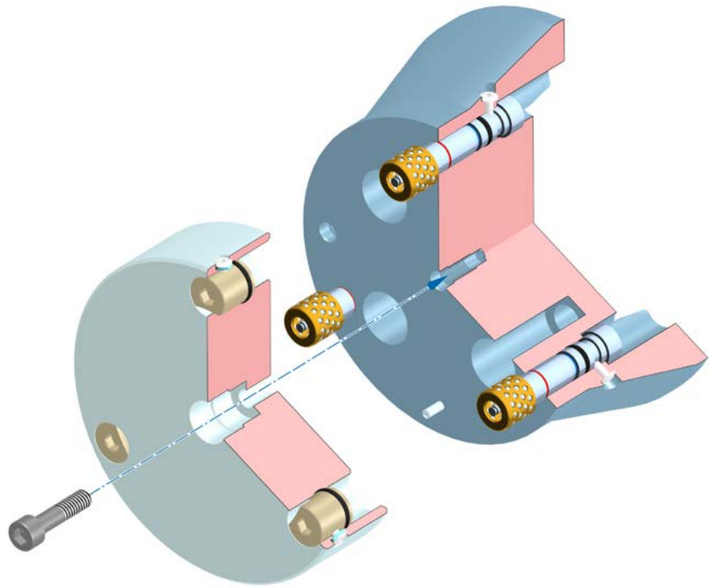
Price vs. Cost

Unless otherwise instructed by the customer, our focus is on the total cost consideration. This includes development, part price, customer requirements, production as well as maintenance costs. For this purpose, it is important to understand the application exactly and to respect the customer›s needs. Therefore, it is also recommended to include Agathon in the conceptual phase of your new development to avoid unattractive cost pitfalls in design or production.



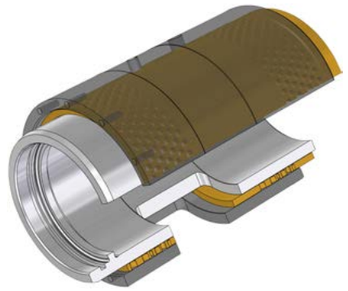
Supplied industries

Our customers come from the following industries, among others



Quick-change system for high precision requirements

- Aerospace and aviation
- Automation, robotics
- Component manufacture
- Electrics, Electronics
- Equipment construction
- Machine tools
- Mechanical enginnering
- Medicine and dental
- Nonwovens
- Optics
- Packaging
- Paper and textile
- Powder and punching presses
- Research, training centers
- Vacuum technology
- etc.



Automatic rotary transfer machines: Ball guide with window for media feed-through







Characteristics of the specific guiding systems

Recurring questions from mechanical engineering applications

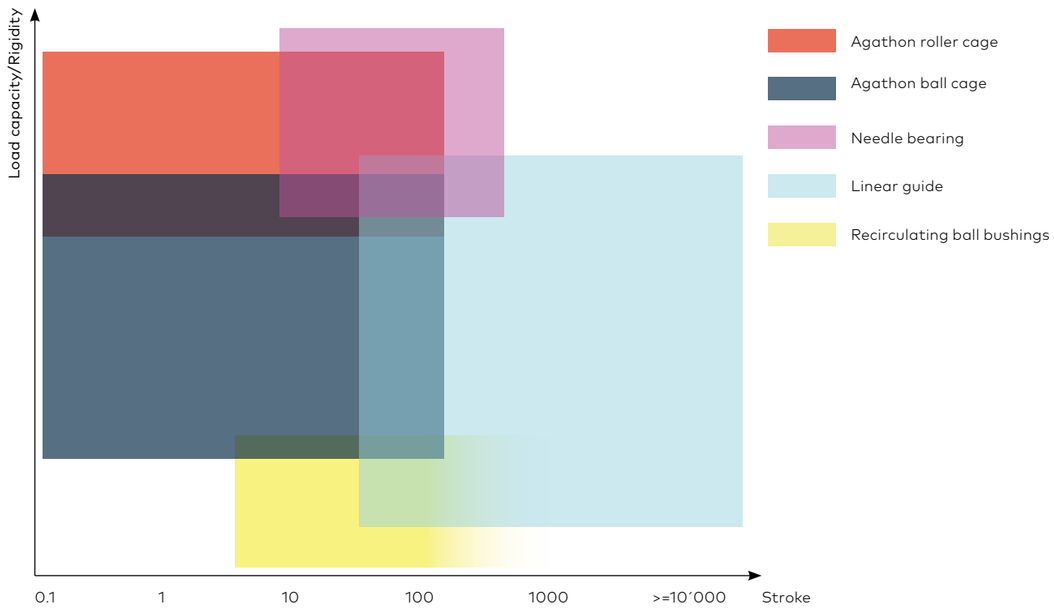
Although each project contains individual points, there are questions which are asked very often:

- What lifespan can be achieved with Agathon guiding systems?
- What construction sizes and dimensions are possible?
- Which accelerations, which repetition accuracies are possible?
- What rigidity / load capacity can be achieved?
- What is the maximum possible stroke?
- Are rotary and axial movements possible?

The following pages are intended to answer these questions. We will also be happy to answer your individual questions about the guiding systems.

Selection of suitable guiding systems

Each type of guiding system has its credentials and is unrivaled in certain areas. The art is to match the specific application with the optimum guiding system. The following points, among others, play an important role here: load capacity, rigidity, stroke.
While the load capacity and rigidity are determined, among other things, by the number and type of preloaded rolling elements and the selected preload, the maximum possible stroke depends on the combination of the lengths of the guiding pillar, rolling element cage and guide bushing.



Rolling elements

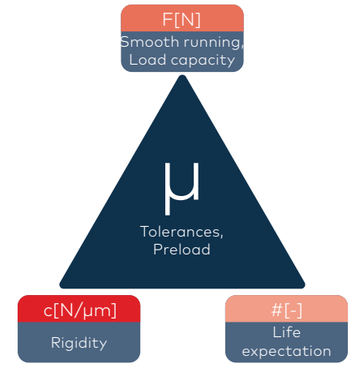
Matching load capacity/smooth running, rigidity and life expectancy of contact surfaces



Speed/Flexibility — Load capacity/Sensitivity

Increased preload — Reduced preload

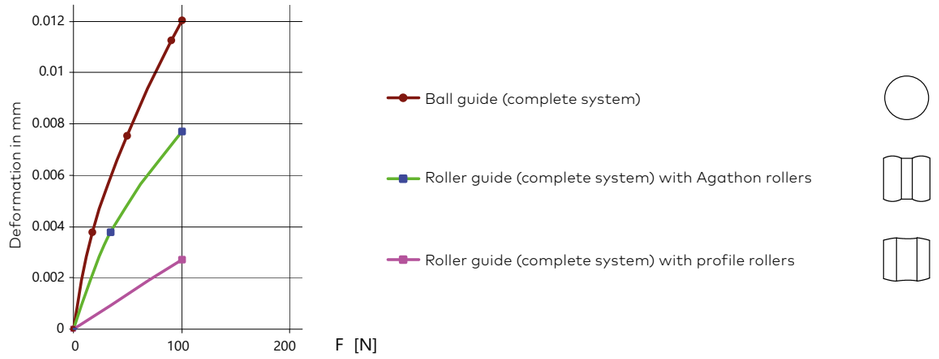
Point — Contact surface — Linear



Changes to the preload or tolerances have a direct influence on rigidity, life expectancy, as well as load capacity and smooth running.

Rigidity of the rolling elements

Rigidity diagram



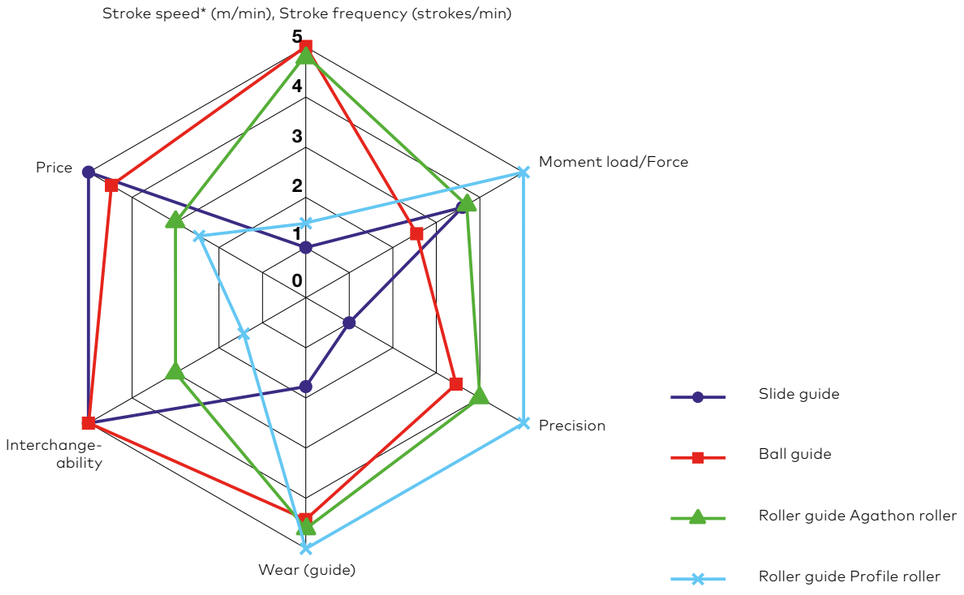
Rigidity of the guide

The rigidity of the guide is determined to a large extent by the rolling elements. Cages can be adapted to your application in terms of rolling element type, number of rows and number of rolling elements per row. On request, the values can be made available to you.

Diameter	Quantity			Load capacity		Rigidity	
d1 [mm]	Balls per row	Rows	Total balls	Per row [N]	Total [N]	Per row [N/µm]	Total [N/µm]
12	12	6	72	58.3	349.8	33.5	201

Example of load based on a cage with guide pillar diameter d1= 12 mm

Selection tool for guidance type



Criterion / Pt	1 (-)	2	3	4	5 (+)
Stroke speed* (m/min), Stroke frequency (strokes/min)	< 30m/min, ~ 300H/min	~ 60m/min, ~ 600H/min	~ 90m/min, ~ 900H/min	~120m/min, ~ 1'200H/min	< 150m/min, > 1'500H/min
Moment load/Force	none		average		high
Precision	poor (play)				high
Wear (guide)	much				little
Interchangeability	great effort				small effort
Price	expensive				fair

* When calculating the stroke speed it is important to note that with the roller guide, the cage only travels half the stroke/way!

Detailed explanations of the various guide types can be found in the main catalog, Chapter 2. www.agathon.ch

Maximum accelerations

For the correct function of the guiding system, the maximum acceleration must be observed. Usual values in the field of punching technology are up to 40g. In the field of mechanical engineering, these values are only reached in exceptional situations. Often mentioned values are in the range of 5-15g. Absolutely waterproof values, however, can only be proven with great effort. The maximum acceleration values depend, among other things, on the type of rolling element, the preload and the acceleration curve (step acceleration, constant acceleration, sinusoidal acceleration, etc.).
In mechanical engineering, the movement is often initiated by cylinders or other drives.
Particularly in dynamic systems with high stroke rates and accelerations, it is important to ensure that the system force is significantly higher than the specific push-through force, otherwise there is a risk of the system stopping.

$F_{DSK} < F_{system}$

- F_{DSK}: The push-through force is the force that must be applied to move one of the involved rolling partners against the two other, stationary rolling partners.
- F_{system}: Maximum system force available for the guides

For maximum lifespan and function of the guide, the acceleration should only be selected so high that the rolling elements do not slip. The push-through force and thus also the maximum possible acceleration is therefore directly dependent on:

- Surface quality
- Hardness of the rolling partners
- Expected lifespan
- Lubrication
- Preload
- Drive shape
- Number of rolling elements

Max. values		Balls	AAG rollers	Profile rollers
Speed	m/min	150	135	40
Acceleration	g	10-15	k.A	k.A

For roller guides, slightly higher values can be assumed for the acceleration

Position and repetition accuracy

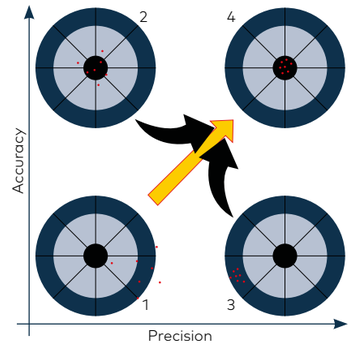
Maximum positioning accuracy is only achieved with optimum interaction between the interfaces manufactured by the customer and the high-precision guiding systems from Agathon. To successfully master demanding positioning and centering tasks, as well as high-precision guiding and movements in mechanical engineering, preloaded guiding systems are essential.
With centering systems of the 7981 and 7980 series, the following values can be achieved:

Definition:

- Repeatability: repeated movements in the preload
- Positioning accuracy: positioning accuracy achievable in space when moving into the preload

Values when using 4 centering systems:

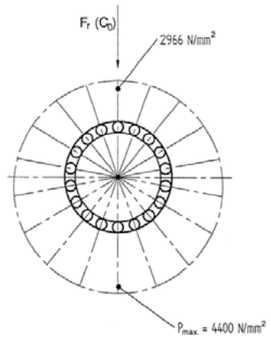
- Repetition accuracy: 0.16µm 2σ
- Positioning accuracy: 0.3µm 2σ
- Measurement inaccuracy of the measuring machine: 0.13µm

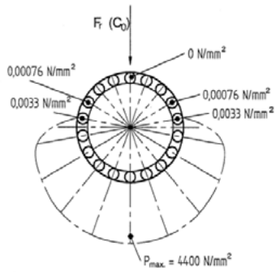


1 Current status
2 **Customer contribution:** Improvement of interfaces
3 **Contribution of centering systems:** Maximizing precision
4 **Customer requirement:** Repeatable positioning accuracy

Parameters

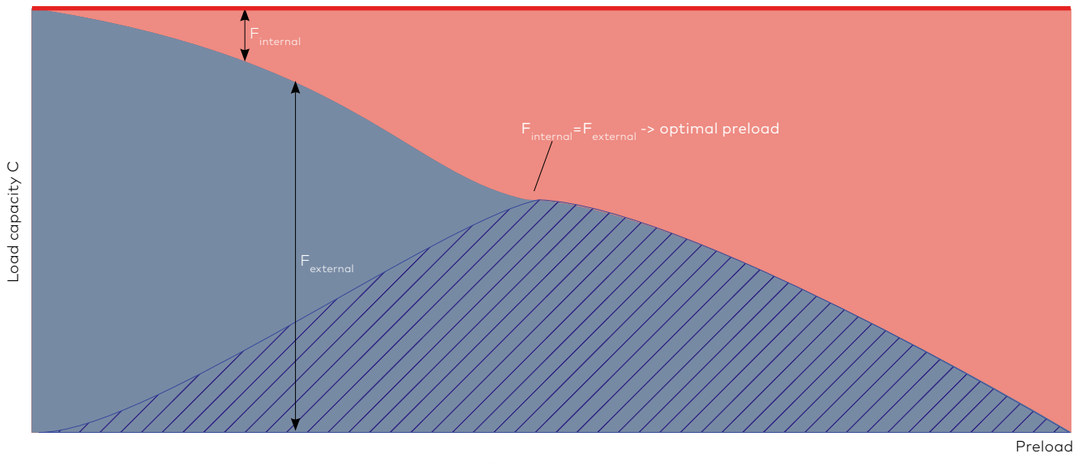
The best solution for specific applications depends on various parameters:





- Long stroke, short stroke
- Linear, rotating, combined movements
- Static (± 0 Movements/s), dynamic
- Different preload setups, arrangement of rolling elements: according to push-through force, according to lifespan, according to rigidity, according to smooth running, etc.

Relationship Preload - Load Capacity



Max. Hertzian Pressure is the result of all acting forces F_{total} per surface:
F_{total}: [max. Hertzian Pressure]=$F_{internal}$+$F_{external}$

The acting forces are:
$F_{internal}$: Forces acting due to preload, different temperature of the rolling partners
$F_{external}$: Effective forces due to radial loads, moment loads, etc.

That is, the maximum possible external load «Load capacity» is:
$F_{external}$ = F_{total}[max. Hertzian Pressure]- $F_{internal}$

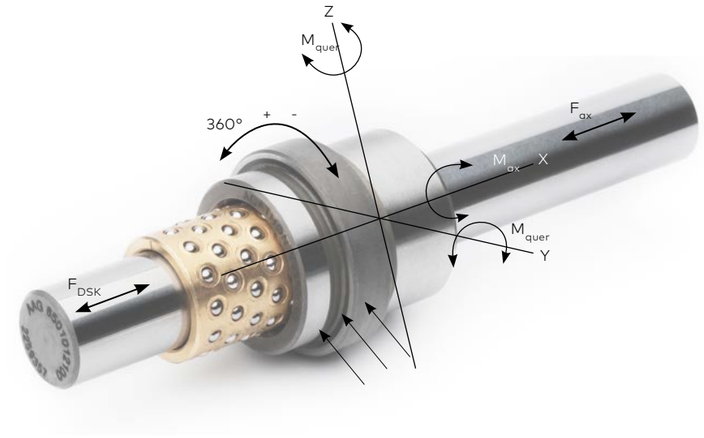
- Special case striped surface: maximum acceptable load under the condition that all balls are always preloaded (no clearance, i.e. elastic deformation of all rolling partners < half preload)
- Red line: maximum load at max. Hertzian Pressure

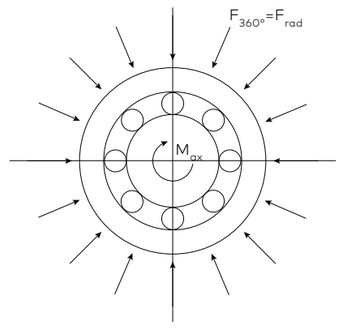
Effects of higher preload

+	–
Higher rigidity	Load capacity decreases
Less compression	Faster running-in – Reduced life expectancy
Resonance limit increases	Travel forces increase, smooth running decreases
Less risk of slipping during high accelerations	More sensitive to temperature changes

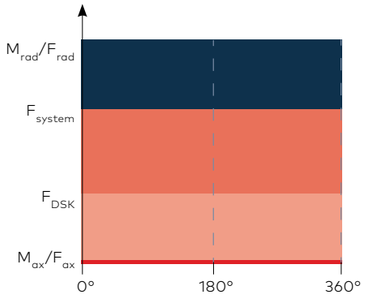
Force and moment diagrams

Possible forces and moments



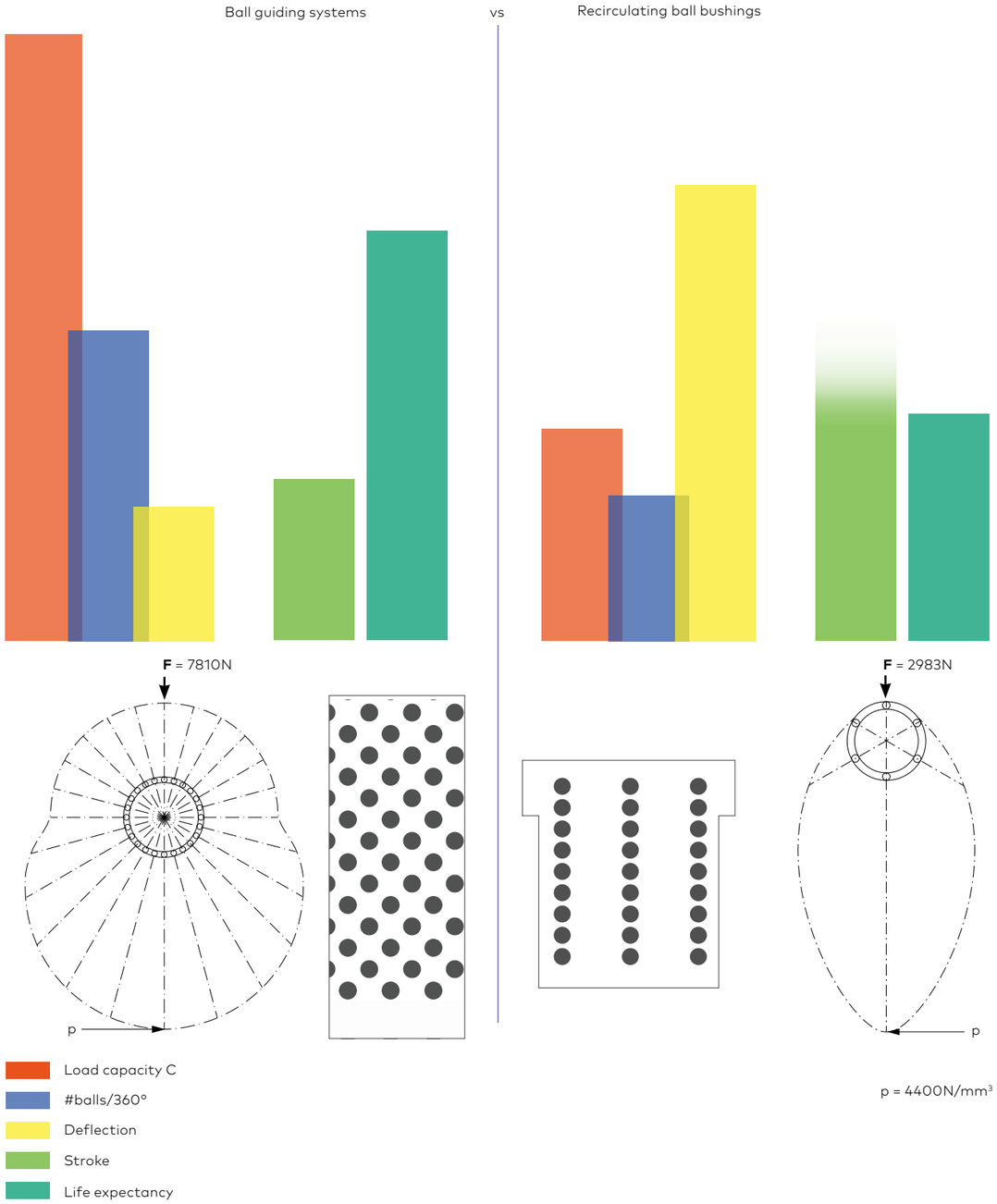


F_{DSK}	Push-through force (sliding force)
F_{rad}	Radial force (also called $F_{360°}$ on sketch)
F_{system}	Maximum system force available for the guides
F_{ax}	Transmittable axial force / movement force
M_{rad} = M_{quer}	Radial load moment
M_{ax}	Axial transmittable/absorbable torque

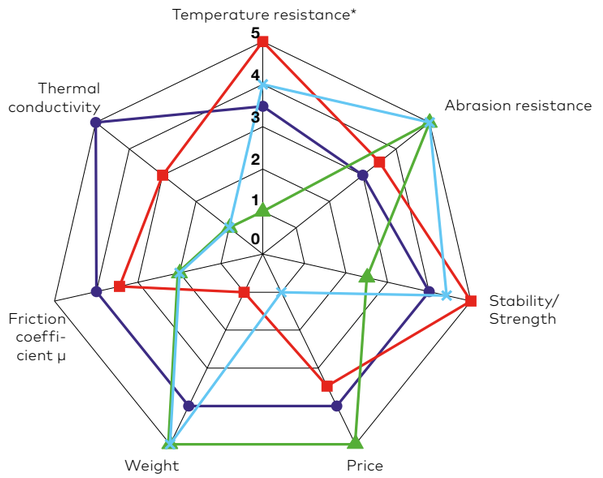


Force and moment (aptitude)	X axis		Y and Z axes	
System	Radial force	Moment load	Radial force	Moment load
Profile rollers	0	0	5	5
Agathon rollers	0	0	3.5	3.5
Ball cage	0	0	3.5	3.5
Ball cage double spiral	0	0	3	1.5

Comparison of Agathon ball guiding systems with recirculating ball bushings



Properties of the cage materials



Ball cages plastic PEEK , POM (ball arrangements, double spiral, rows, etc.)

- POM: Attention Reduce preload slightly to avoid overheating
- PEEK for medical and high temperature, expensive

Ball cages aluminum / brass

- Alu: light, economic
- Brass: heavy, self-lubricating, temperature resistant up to 170 °C (338 °F), can be cleaned in an ultrasonic bath

Criterion / Pt	1 (-)	2	3	4	5 (+)
Temperature resistance*	80 °C (176 °F)	100 °C (212 °F)	120 °C (248 °F)	200 °C (392 °F)	> 200 °C (> 392 °F)
Abrasion resistance	normal wear				suitable for clean room
Stability/Strength	low				high
Price	expensive				fair
Weight	heavy				light
Friction coefficient µ (Sliding property)	0.42		0.2		0.1
Thermal conductivity	bad				good

* Only valid for cage material (impact strength)! Rolling elements, pillars and bushings only up to 120 °C (248 °F) (mold construction up to 150 °C (302 °F), limited load, lifespan).

Design Options Overview

Sealing systems

- Scraper rings
- Bellows made of different materials, also customized

Lubrication

- Lifetime lubrication
- Application specific
- Completely without lubricant
- Automatic lubrication systems for reduced maintenance

Corrosion protection

- Chemical treatments or materials after consulting

Possible materials

Pillars and bushings	Rolling bearing and case-hardening steel, stainless steel		
Balls	Rolling bearing steel stain-less steel, ceramics	**Ball cages**	Aluminum, brass, POM/PEEK
Rollers	Rolling bearing steel	**Roller cages**	Aluminum, brass



Technical specifications for guide elements

*** to be completed by Agathon LTD.**

Checked (date/visa): ..... Offer No: .....

Released (date/visa): ..... Date of release: .....

Agency:

Official in charge (date/visa):

Customer

1. Company / Name: ..... Enquiry No: .....
2. Address: .....
3. Techn. official in charge: ..... Dept.: ..... Tel.: .....
4. kauf. Bearbeiter: ..... Dept.: ..... Tel.: .....

Application

10. Application in:
- ☐ Machine construction in general
- ☐ Press-tool
- ☐ Formenbau
- ☐ Mold construction
- ☐ Packing machine
- ☐ other ind. sectors: .....
- ☐ Textile machine
- ☐ Appliance manufacture
- ☐ Precision mechanics/optics
- ☐ Measuring technology
- ☐ Operating material construction

Requirements

20. Material to processed: ..... Thickness: .....
21. Stroke movement: Strokes/min: ..... Stroke length mm: .....
22. Min. lifespan: Strokes ..... Actuation of press .....
23. Quantity to be produced: Pieces .....
24. Turning movement: Revolutions/min: .....
25. Load: Radial N: ..... Moment Nm: .....
26. Tolerance of the guide: µm: .....
27. Mobility: ☐ normal ☐ easy ☐ extremely easy
28. Environmental factors: Temperature °C: ..... Type of dirt: ..... Aggressive material: ..... Others: .....
29. Sealing: ☐ by the customer ☐ by Agathon AG
30. Special requirements: .....

Info reg. manufacture

40. Quotation per piece: .....
41. Submission dead line: .....
42. Price basis: .....
43. Yearly requirement (estimated): .....
44. New construction: ☐ yes ☐ no
45. Competitors: .....
46. Enclosure: ☐ Drawings ☐ Samples ☐ Sketch ☐ Description

Evaluation*

50. Standard types according to the catalog: Guide pillar type: ..... Article No.: ..... Guide pillar type: ..... Article No.: ..... Guide bush type: ..... Article No.: .....
51. Special execution: ☐ according to customer's drawing No.: ..... ☐ according to Agathon drawing No.: .....
52. Calculation of: ☐ Load capacity ☐ Excursion ☐ Acceleration ☐ Others: .....

This form is available on the website under https://www.agathon.ch/en/download/ [Downloads Standard Parts EN] {Form: Guide elements customer specific}

AGATHON

STRIVE FOR THE BEST.

standardparts@agathon.ch | www.agathon.ch | F0120900EN | October 2021 | Subject to technical modifications