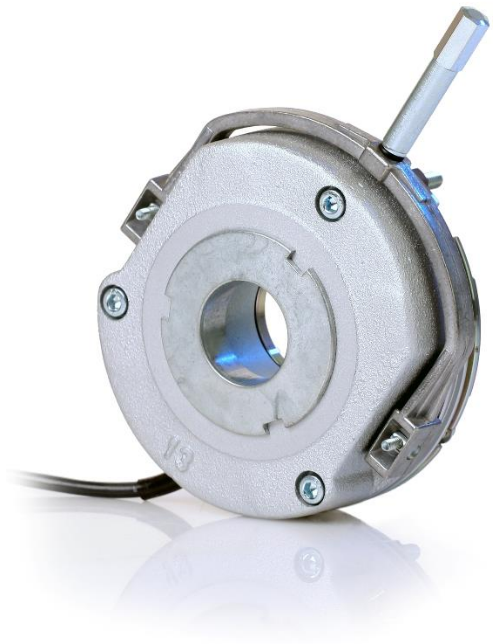
General Introduction

to the

Operating and Assembly Instructions

for electromagnetically released

PRECIMA Spring-Applied Brakes



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1. Information on the Operating and Assembly Instructions

1.1 Validity

The **operating and assembly instructions** are only valid for the **electromagnetically released spring-applied brake(s)** (as known in their respective title) from PRECIMA Magnettechnik GmbH. Furthermore, they represent a necessary component of every brake delivery and are generally only valid for simultaneously delivered brakes. The operating and assembly instructions will remain valid for such brakes even though a newer version of the instructions exists, unless PRECIMA expressly declares to the customer that the newer version has replaced the older one.

In individual cases, the above mentioned principles may be deviated from (e.g. in case of special designs or repeated deliveries). In any case, an advisory or supplementary notification from PRECIMA is required.

1.2 Purpose and use

The operating and assembly instructions are intended to ensure a safe and proper installation and operation of the spring-applied brake.

In order to meet this purpose and complete this task, all persons involved in the assembly and operation of the brake (qualified in accordance with 2.1.2) have to read these instructions **carefully and thoroughly before** carrying out their respective activities (assembly, commissioning, operation, maintenance, etc.). In addition, such persons have of course to **observe and implement the instructions given** in their respective activity. The instructions themselves must be accessible at any time and at short notice (even after the end of the respective activity) in a clean, complete and well legible state.

Despite conscientious and careful elaboration of these instructions, errors, defects and incompleteness in the operating and assembly instructions cannot be excluded. Therefore, please consult PRECIMA in case of doubt. Other technical questions, notes and suggestions for improvement can also be sent to the following address:

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1.3 Terms and notices

Important information regarding technical safety as well as operational protection in the chapters on **assembly**, **operation** and **disassembly/ replacement** of this instruction manual are given particular emphasis through the following **signal words**:

➔**Danger!** stands for work and operating procedures that are to be observed exactly in order to avoid **endangerment of people**.

➔**Attention!** indicates safety measures that must be adhered to in order to **avoid brake failures**.

➔**Stop!** refers to other instructions that must be **absolutely observed** when carrying out the work.

To simplify the text of the operating and assembly instructions, certain longer and more complicated terms are replaced by shorter ones, which have the following meanings in the context of these instructions:

Instructions = operating and assembly instructions

Working brake = brake that implements friction work in regular operation, i.e. performs a braking function. The nominal braking torque for a working brake corresponds to the nominal value of the **dynamic torque** at 1 m/s friction velocity ➔ see also chapter 5

Brake = spring-applied brake = electromagnetically released spring-applied brake

Data sheet = technical data sheet

Holding brake = brake that does not implement any friction work in regular operation, but only serves to secure a reached position. However, it may perform a braking function in case of emergency (= emergency stop). The nominal braking torque for a holding brake corresponds to the nominal value of the static holding torque (= tearing off torque) ➔ see also chapter 5

End shield = motor end shield = end shield of an electric motor

Dimension sheet = dimension drawing

PRECIMA = PRECIMA Company = PRECIMA Magnettechnik GmbH, Bückeburg

Shaft = motor shaft = shaft of an electric motor

In the context of the operating and assembly instructions, the spring-applied brake is usually assumed to be a machine element to be attached to an electric motor, since this combination represent the most common variant. Therefore certain designations also refer to it (motor shaft, motor end shield ➔ see above). However, this does not mean that the validity of a manual is limited in principle to such combinations - nor does it mean that the use of the spring-applied brake is restricted in any comparable way.

2. Conditions for Assembly and Operation

2.1 Persons

2.1.1 Operator

The operator is any natural or legal person who uses the spring-applied brake or on whose behalf the brake is used. The operator or a person commissioned by him must ensure **proper use in accordance with 2.3** and compliance with relevant standards and provisions, regulations and laws. In particular, he must ensure that only **qualified personnel in accordance with 2.1.2** is entrusted with work on the brake.

2.1.2 Personnel

Personnel to work the brake must be exclusively qualified and authorized by the person responsible for security on the basis of their training, experience, instruction as well as knowledge of the relevant standards and provisions, accident prevention regulations and operating conditions, who are able to perform the activities described in these instructions and, when doing so, are in a position to recognize and avoid possible dangers at an early stage.

2.2 Product

2.2.1 Area of application

The area of application of the brake is limited to systems and machines and is defined by the **general conditions of operation** described in section **2.2.4** as well as by the boundary conditions, performance data and dimensions specified in the **dimension drawing** and in the **lettering of the brake** (see respective operating and assembly instructions). Any deviation from these directives requires a special agreement with PRECIMA. Particular attention must be paid to the distinction between usage as a **working brake** and as a **holding brake** (definition: see 1.3).

2.2.2 Operating environment

The environment in which the spring-applied brake is used must be designed in such a way that the brake can perform its function properly when correctly installed and does not pose a risk to people or property. Changes to the operating environment (e.g. on the machine or system to which the brake is attached) may only be carried out if they have no influence on the first-mentioned condition.

2.2.3 State of application

The permissible state of application of the brake includes the functionally perfect condition of all components (in the case of wearing parts: timely replacement) and compliance with the operating and assembly guidelines specified in the instructions as well as the omission of any retrofitting, changes or modifications of the brake, unless approved by PRECIMA. The latter also includes the use of non-original spare and replacement parts.

➔Attention!

Friction surfaces and friction lining must not come into contact with oil or grease under any circumstances, since even small amounts of them will reduce the braking torque considerably!

2.2.4 General conditions of operation

The general conditions of operation include **duty cycle**, **ambient temperature** and **humidity.** Information on this can be found in the *Overview table of the PRECIMA spring-applied brakes* (Figure 4.2) in this introduction, as well as in the operating and assembly instructions for each series. In general, the following applies: **If the ambient temperature deviates from the general specifications, either the brake must be adapted or supplemented in terms of design or the conditions of use must be restricted. Should this not be mentioned in the individual instructions, a special agreement with PRECIMA is required in any case.**

2.3 Proper use

At the time of delivery, the spring-applied brake corresponds to the state of the art and is generally considered safe to operate. Only use it **properly** in order to avoid any danger to people or property!

The spring-applied brake is used correctly if the valid operating and assembly instructions (according to 1.1 and 1.2) are used by qualified personnel (according to 2.1.2) to **create and maintain** an admissible state of application (according to 2.2.3) in an admissible operating environment (according to 2.2.2) within the permissible area of application (according to 2.2.1).

The improper (incorrect) use involves risks which could not be taken into account in their entirety in the design and construction of the brake and are therefore incalculable.

2.4 Legal aspects

2.4.1 Liability

On the basis of the information, data and notes given in this introduction and in the operating and assembly instructions, and on the basis of the illustrations and descriptions contained therein, no claims can be made for brakes outside the scope of these documents (see 1.1) .

Improper use of the brake (see 2.3) excludes any liability of the PRECIMA company.

2.4.2 Warranty

Warranty conditions can be found in General Terms for Sale and Delivery of PRECIMA (www.precima.de AGB). Warranty claims must in any case be reported to PRECIMA immediately after the defect or fault has been identified. The exclusion of any liability according to 2.4.1 also means that no warranty claim exists.

2.4.3 Directives and standards

The spring-applied brake was built in accordance with the following guidelines and standards:

- EC Machinery Directive (2006/42/EG)
- EN ISO 12100: Safety of Machinery
- EU Directive on Electromagnetic Compatibility (2014/30/EU) compliance with this directive must be ensured by the user with the appropriate switchgear.

The spring-applied brake is not an independently functioning machine and is intended for installation on another machine. Commissioning is prohibited until it has been established that the machines comply with the provisions of the EC directive .

2.5 Delivery scope and state

The delivery scope and state must be checked **immediately upon receipt of a brake**.

Precima will not assume any warranty for subsequently claimed defects (cf. 2.4.2).

Transport damage must be reported immediately to the deliverer, as well as the incompleteness of the delivery and recognizable defects to the manufacturer.

➔Attention!

Should any ambiguities or contradictions be revealed during the inspection or should the delivery be incomplete or defective, the brake must not be installed and put into operation without consulting PRECIMA.

2.6 Safety guidelines in the event of spring fracture

The springs used in PRECIMA spring-applied brakes are characterized by the fact that when the installed brake is under tension, their wire diameter is always greater than half their pitch. This ensures that if a spring breaks, the two parts cannot turn into each other. The theoretical extreme case analysis of such a scenario results in a spring force reduction of approx. 5%; **however, under no circumstances the total failure of a spring is possible.**

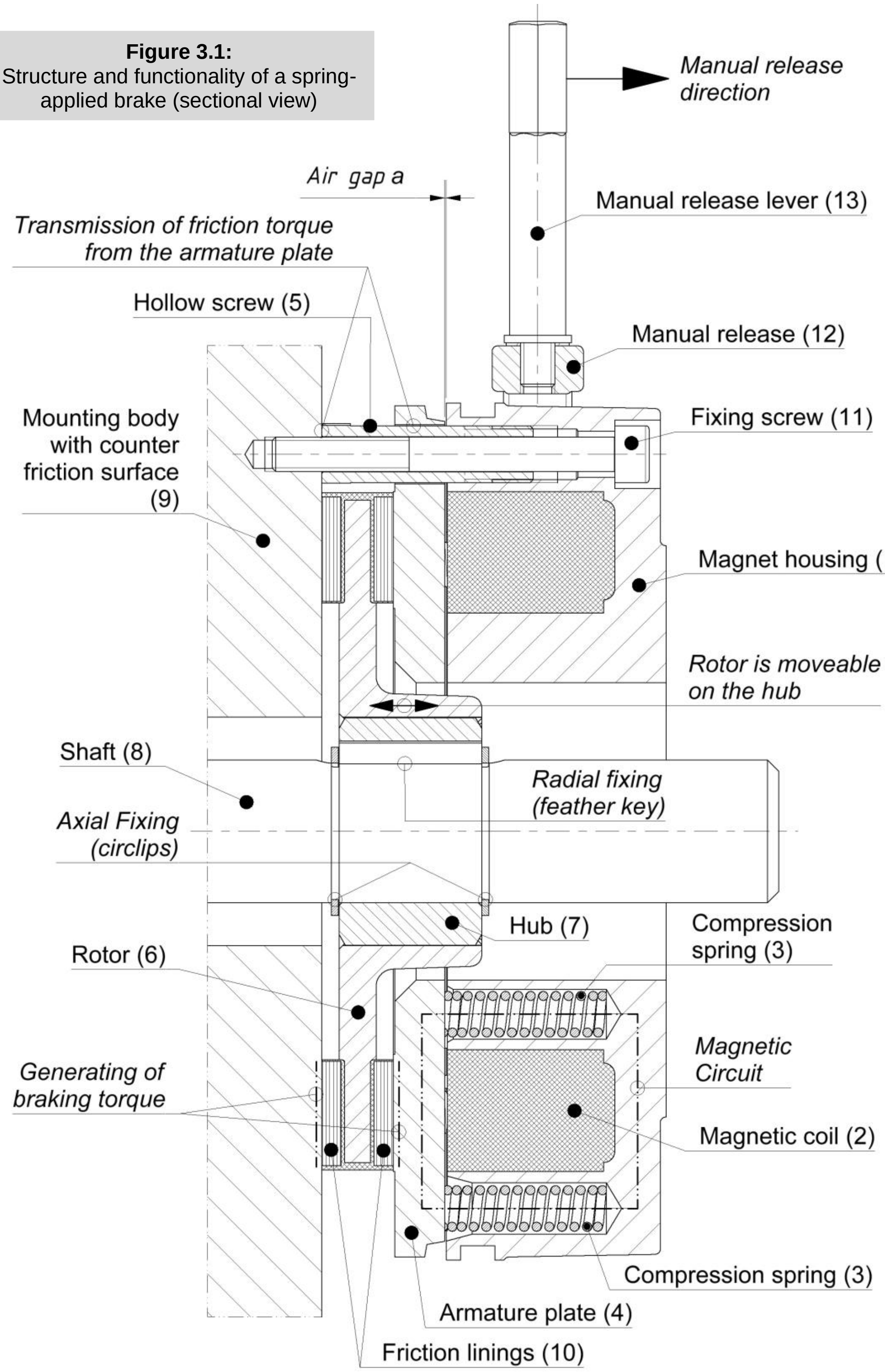
Nevertheless, a spring that is found to be broken or even only damaged, for example during maintenance work, must always be replaced as a precaution!

2.7 Control of the brake

- From **BR100** *(Precima size 20)* / series FDB, FDW, FDD, FDR the use of a fast-acting rectifier is **recommended**
- For **BR1000** / *(Precima size 40)* / series FDB, FDD, FDT the use of a fast-acting rectifier is **mandatory**
- In the case of PWM (pulse width modulation) control, consultation with PRECIMA is required

3. Structure and Functionality

Figure 3.1:
Structure and functionality of a spring-applied brake (sectional view)



3.1 General structure of a spring-applied brake (see Figure 3.1)

The electromagnetically released PRECIMA spring-applied brakes are fail-safe brakes, i.e. the braking torque in regular operation is generated by spring force and cancelled by magnetic force.

The core of a brake is the **magnetic body**, consisting of a cast-iron or steel **magnet housing (1)** with an embedded **magnetic coil (2)**. **Compression springs (3)** are inserted into the magnetic body; the **armature plate (4)** is arranged directly behind them. In addition, going through the armature plate (4) and screwed into the magnet housing (1), there are the **hollow screws (5)**. Independently of this, the rotating parts of the spring-applied brake, **rotor (6)** and **hub (7)**, are attached to the **shaft (8)** to be braked.

In the open brake shown here as an example, the hollow screws (5) are screwed into the magnet housing (1) until the distance between the latter and the **mounting body (9)** minus the thickness of the rotor (6) (measured via the **friction linings (10)**) and the armature plate (4) gives the necessary **air gap**.

The connection of the magnetic part to the mounting body (9) takes place via the **fixing screws (11)** which are guided through the magnet housing (1) and the hollow screws (5). The hub (7) is fixed radially via a **feather key** and axially via **circlips** on the shaft (8). **Gear teeth** (in smaller brakes it can also be a **hexagonal outline**) between the rotor and hub serve for the radial transmission of the braking torque and at the same time enable an axial movability of the rotor.

3.2 Braking process

During the braking process, the compression springs (3) arranged in the magnet housing (1) press against the rotor (6) via the armature plate (4) sliding on the hollow screws (5) and push it onto the mounting body with the counter friction surface (9). The braking torque is generated by the friction between the friction linings (10) of the rotor (6) on the one hand and the armature plate (4) as well as the counter friction surface on the other.

The rotor (6) and the hub (7) transmit the braking torque to the shaft to be braked. The frictional torque acting on the armature plate (4) is transmitted into the mounting body (9) via the hollow screws (5).

3.3 Electrical release process

When the brake is released electrically, the magnetic coil (2) inserted in the magnet housing (1) is energized and a **magnetic circuit** flowing through the magnet housing (1) and the armature plate (4) is set up. The magnetic force at the junction points pulls the armature plate (4) onto the magnet housing (1) and releases the rotor (6).

3.4 Manual release process

Optionally, the release process triggered in normal operation by energizing the magnetic coil (2) can also be carried out manually. When the **manual release lever (13)** is pulled or swivelled, the corresponding mechanism of a **manual release (12)** ensures that the armature plate (4) is placed on the magnet housing (1) and releases the rotor (6) as in the case of electrical release. This means that the brake can still be released very easily even when the power supply is interrupted. Please note:

The setting of a manual release must not be changed for safety reasons!

4. PRECIMA Spring-Applied Brakes

4.1 Genealogy

The following graphic (Figure 4.1) shows the various PRECIMA spring-applied brakes in a schematic form. Starting from the basic type FDB as an adjustable, open brake with a rotor and various options, the changes pertaining to the other series or to special designs of a series are then described. This does not take into account the fact that the individual series do not cover the entire range of braking torques of all brakes.

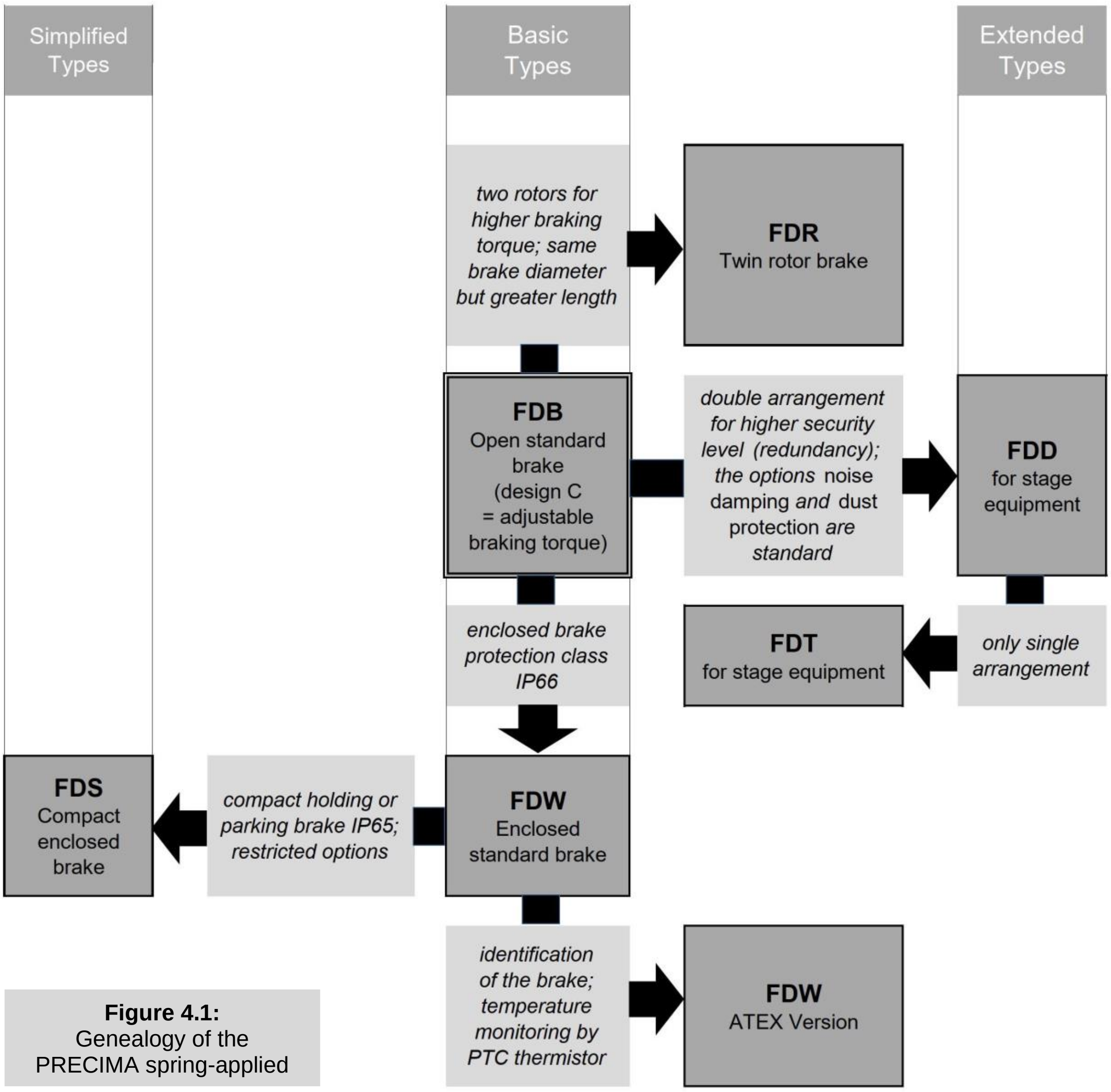


Figure 4.1:
Genealogy of the PRECIMA spring-applied

4.2 Overview table

The following table (Figure 4.2) summarizes essential information on the individual series, which - based on Figure 4.1 - shows their strengths, the useful areas of application and optional additions and variations (see also Figure 4.3, Figure 4.4). Deviating from these standard designs, special solutions are of course also possible (within the framework of the main technical and economic possibilities).

Brake type		FDB Design N/T	FDB Design C	FDW	FDD / FDT (2x) = FDD	FDR	FDS
Construction form		open		enclosed	open		enclosed
Friction surfaces	Number of pairs	2			(2x) 2	4	2
Size NORD Precima	Minimum	BR5 08	BR5 08	BR5 08	BR5 08	BR150 23	BR5 08
	Maximum	BR1000 40	BR150 23	BR400 30	BR1000 40	BR400 30	BR20 13
Nominal braking / holding torque	Minimum	2 Nm	0,8 Nm	2 Nm	(2x) 3,5 Nm	125 Nm	—
	Maximum	1000 Nm	150 Nm	400 Nm	(2x) 1000 Nm	800 Nm	—
	Variability	Spring arrangement	Spring arrangement and adjusting ring	Spring arrangement	Spring arrangement		Spring arrangement
Readjusting the air gap		possible		not possible	possible		not possible
Armature plate	sandwich	Standard		—	Standard	—	Standard
	solid	at high switching frequency; brake with lateral micro switch		Standard	at high switching frequency; brake with lateral micro switch	Standard	—
Operating conditions	Environmental conditions	Protected area		Outdoor area	Protected area		Outdoor area
	Operating temperature	-20°C…+40°C			-20°C…+40°C		-20°C...+40°C
	permitted humidity	0 … 80%		0 … 100%	0 … 80%		0 … 100%
	Power on time	100%			100%		100%
	IP Protection class	depending on installation		IP66	depending on installation		IP65
Rotor/hub systems	Hexagon	Standard from size BR20 on Standard from size 13 on			—	—	on request
	PRECIMA Toothing	up to size BR20 up to size 13			Standard for size BR5 Standard for size 08 / up to size BR20 up to size 13	—	Standard
	DIN Toothing (Splined profile)	from size BR10 on from size 10 on / Standard from size BR40 on Standard from size 15 on			Standard from size BR10 on Standard from size 10 on	Standard	—
Additional elements – Handling	Manual release	Option			Standard	Option	Option
Handling	Fixing	Special		Option	Special		—
Attachm.	Tapped bores	Option			Standard	Option	—
Friction elements	Friction plate	Option			Option (not size BR1000) Option (not size 40)	Sonder	—
	Flange	Option			Option		Option
Protection / Enclosing	Dust protection	Option		—	Standard	Option	—
	non through-going shaft	—	—	Sealing cap	—	—	Sealing cap
	through-going shaft	—	—	SKF Sealing rib + V-ring (by customer)	—	—	Sealing lamella + Gamma ring
Noise damping	Switching noise	Option		—	Standard	Option	—
	Running noise	Option			Standard	Option	Standard
Monitoring / Micro switch	M8	Function and Wear from size BR10 on Function and Wear from size 10 on			—	like FDB	—
	M12	Function *or* / and Wear from size *BR40* / BR150 on Function *or* / and Wear from size *15* / 23 on			—		—
	lateral	Function *or* Wear		—	Function *or* Wear		—
Monitoring / Sensor	M8	Function from size BR10 on Function from size 10 on			—		—
	M12	Function from size BR150 on Function from size 23 on			—		—
	lateral	Function		—	Function		—
Monitor. Temp.	PTC Thermistor	—	—	ATEX version	—		—
Heating	Heating tape	Option from size BR10 on Option from size 10 on			Special		—

Figure 4.2: Overview table of PRECIMA spring-applied brakes

4.3 Additional elements / options

The two pictures below show an example of a FDB brake (Figure 4.3) or a FDW brake (Figure 4.4) and, in addition to *the Overview table of PRECIMA spring-applied brakes* (Figure 4.2), the essential additional elements and/or options. The heating cable (HEATING option) and the PTC thermistor (MONITORING TEMPERATURE option), located inside the magnetic body, are excluded.

The pictures are for illustration purposes only and make no statement as to whether the respective additional element or option is useful or applicable in a specific brake. The *Overview table of PRECIMA spring-applied brakes (Figure 4.2)* for standard brakes provides basic information on this point. With a brake other than that shown, the additional element or option can also take a different shape.

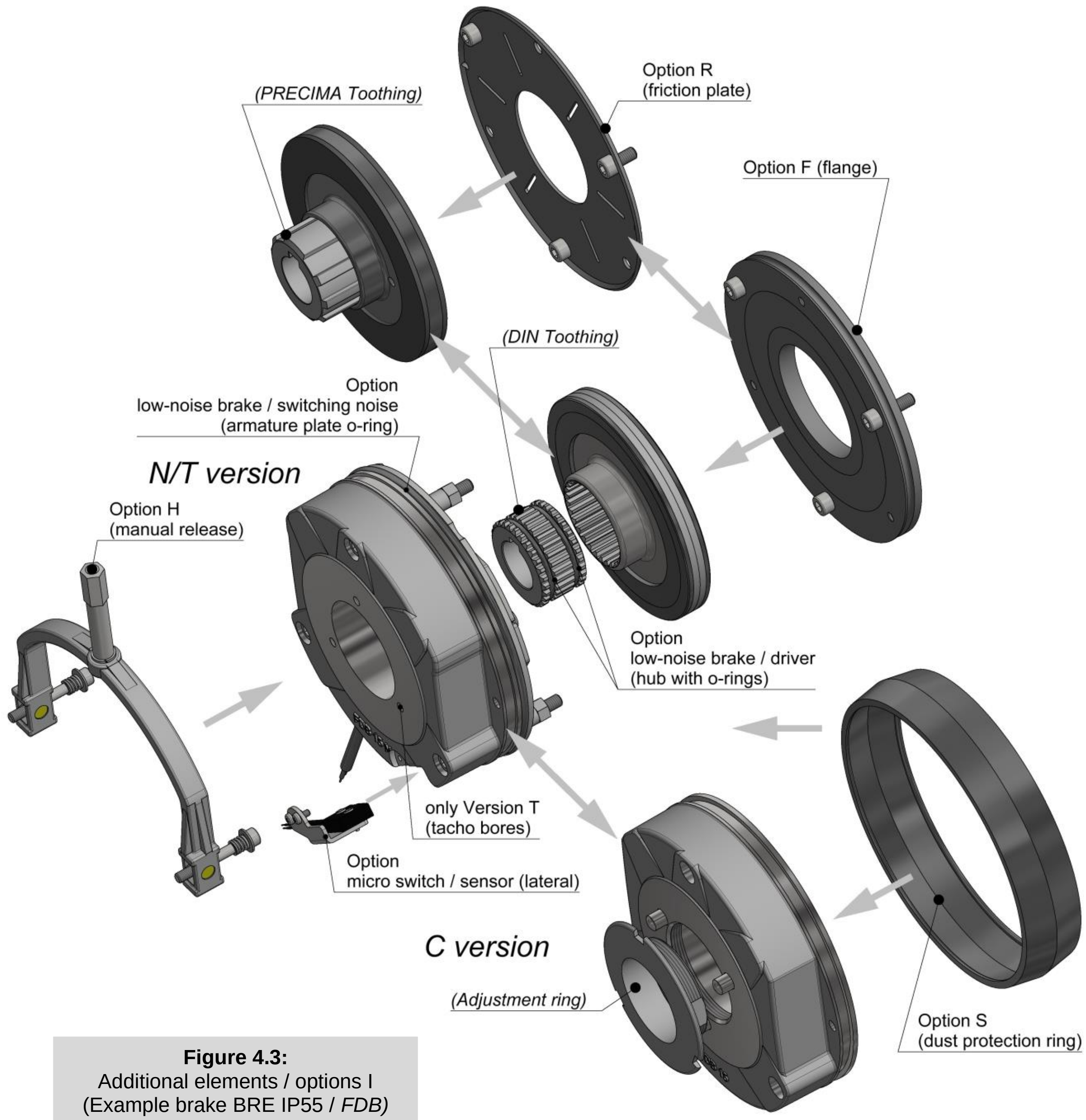


Figure 4.3:
Additional elements / options I
(Example brake BRE IP55 / *FDB)*

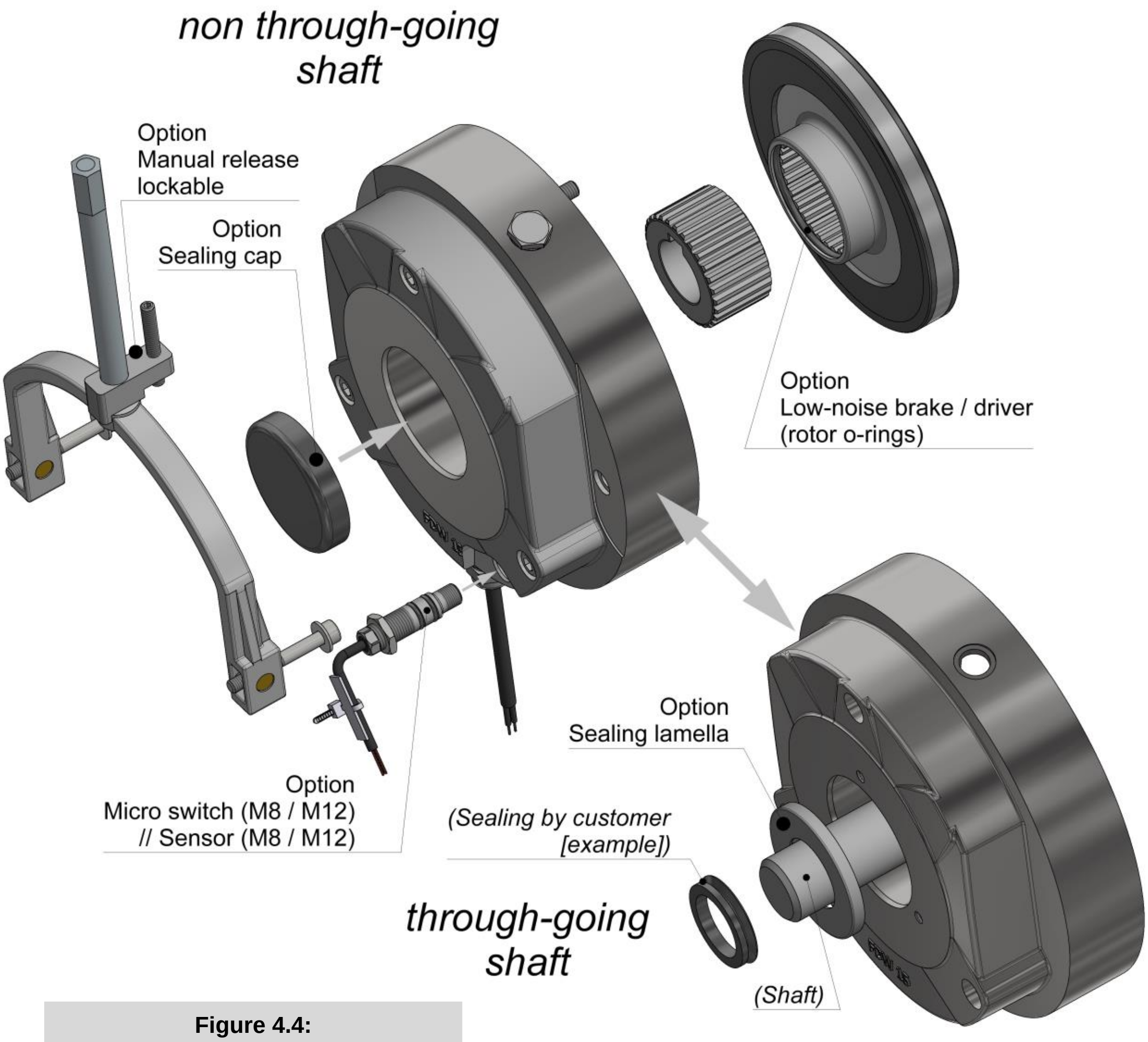


Figure 4.4:
Additional elements / options II
(Example brake BRE IP66 / *FDW)*

5. Application

5.1 Braking tasks

The general description of working and holding brake already given in the definition under 1.3 will be further elaborated in the following and integrated into the overall complex of the technical function of a spring-applied brake.

Independent of the terms working brake and holding brake, the two clearly distinguishable tasks "**braking a load**" and "**holding a load**" are relevant for practically all spring-applied brakes. In this context, braking a load always means **braking to a standstill** (➔ Transition to holding a load), since with a brake that is uncontrolled in the braking process, e.g. a controlled reduction in speed or similar is not possible. Which of the two tasks "braking" and "holding" predominates or is considered to have priority in the overall system determines the classification of the brake used as a holding or working brake.

5.1.1 Working brake

A spring-applied brake to be classified as a working brake is characterised by the basic operating condition that the **braking** of a load takes place **frequently and regularly** and not only as an occasional special case:

- Since braking leads to progressive **wear** on the friction linings of the brake rotor, it makes sense to use a correspondingly **wear-resistant lining**, which can be referred to as a **working brake liner** without hesitation.
- The design of the brake is **primarily** based on the **braking performance**, i.e. is a desired braking distance or a specified braking time maintained, can the friction work generated as heat be easily absorbed by the friction lining, how high is the wear or how long is the service life of the rotor, etc.?
- Only **secondarily** is the **holding function** to be considered, which, however, does not mean that this is completely meaningless in every case. Only in the case of a system without a static load moment, i.e. without a movement-inducing load, does the latter apply
- In general, the **lower coefficient of static friction** of the working brake liner compared to a holding brake liner (➔ 5.1.2) should also be sufficient to ensure the safe holding of the load. This is helped by the constant renewal of the lining surface due to the friction processes during braking.
- In principle, a rotor with a **holding brake liner** can also be used for a working brake, if the **disadvantages in the braking function** (higher wear, lower permissible friction work) are taken into account or do not play a major role.

5.1.2 Holding brake

A spring-applied brake to be classified as a holding brake is characterised by the basic operating condition that the **braking** of a load does **not take place regularly** and only as an occasional special case (usually referred to as an "emergency stop"). From this follows directly and inversely the priority of the holding function:

- The usefulness of a special **holding brake liner** results from the lack of renewal of the liner surface due to braking processes, which take place sporadically at best. Even **without friction work**, the **holding capacity** of the holding brake liner must not drop significantly. In addition, its **coefficient of static friction is generally higher** than that of a working brake liner

- The design of the brake is **primarily** oriented towards the **safety of holding**, i.e. the approached position of a system remains unchanged against the urge to move of a static load torque. The system is typically braked by an inverter-controlled electric motor, and the brake is only applied when the motor comes to a standstill
- **Secondly**, the **braking function** is important. Even in the case of rarely occurring dynamic braking processes, the desired **boundary conditions** (braking distance, braking time) and/or **technical limits** (maximum friction work) must of course not be disregarded. Such a case would only exist if the task of an emergency stop were actually excluded
- In principle, a rotor with a **working brake liner** can also be used for a holding brake. It may be necessary to accept its **disadvantages** with regard to the **static friction coefficient** and the **constancy of the holding torque** if, for example, the holding brake liner has too low a permissible friction work

5.2 Torques and tolerances

In the following diagram (**Figure 5.2**), the various torque designations are defined and inserted in the context between the functional states of the applied (i.e. braking or holding) brake and the nominal values of the braking torques in the tables of the individual operating and assembly instructions. The purpose of this presentation is to distinguish more clearly between the often confusing designations, to relate them to each other in a meaningful way and to supplement them with information on testing and brake design. The brake design itself (braking torque, braking time, braking distance, friction work, safeties, etc.), however, is not the subject of the presentation.

Values of the friction velocity factor f_R are listed for all sizes and for important speeds in the table following Figure 5.2. The values in parentheses apply to speeds that are not reached in continuous operation, but only for a maximum of 5 seconds.

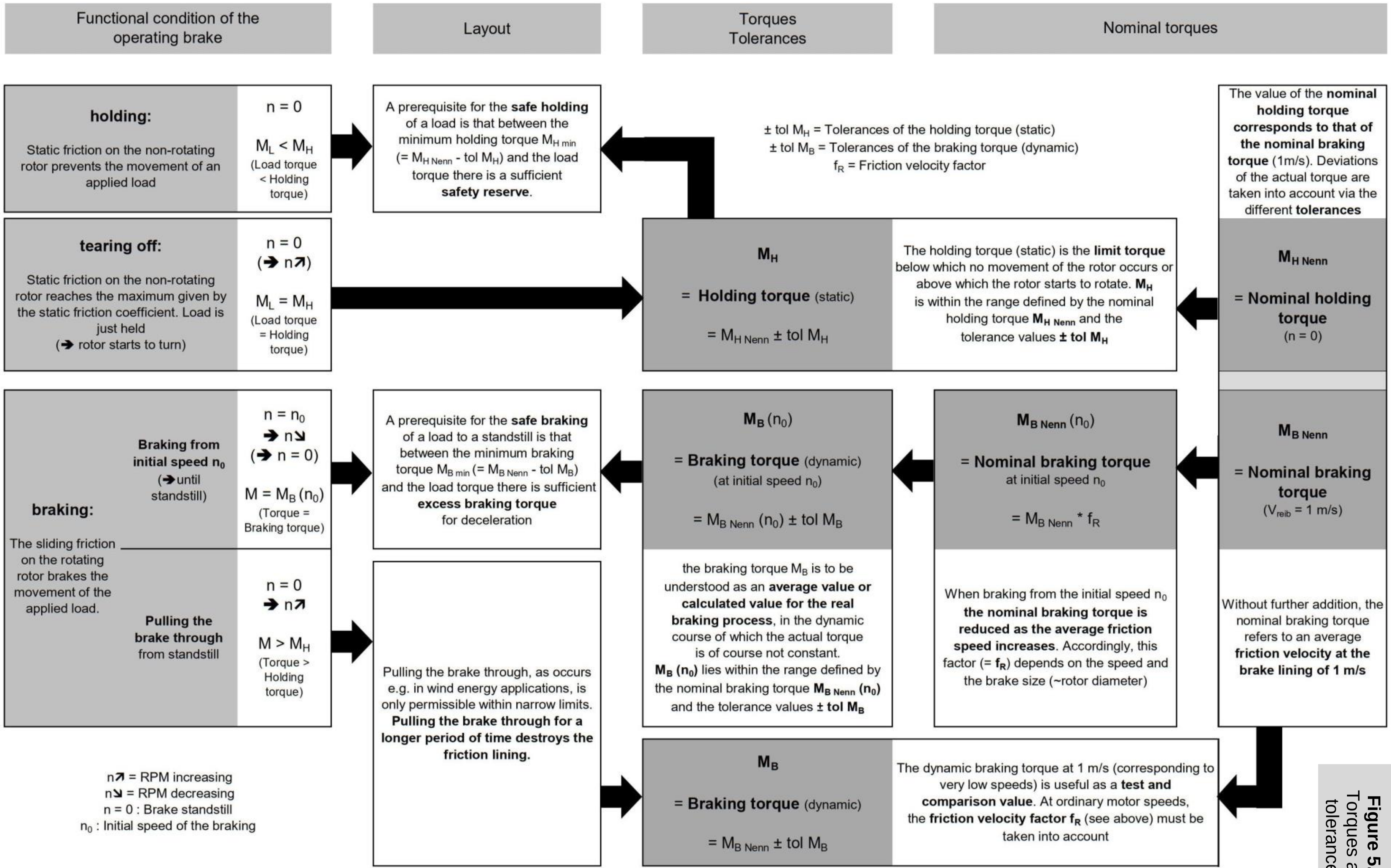


Figure 5.2: Torques and tolerances

Friction velocity factor f_R		Rotational speed [RPM]					
		1500	1800	3000	3600	4500	6000
Brake size	BR5 / Size 08	**0,88**	**0,86**	**0,81**	**0,79**	**0,77**	**0,74**
	BR10 / Size 10	**0,85**	**0,83**	**0,78**	**0,76**	**0,74**	**0,71**
	BR20 / Size 13	**0,83**	**0,81**	**0,76**	**0,74**	**0,72**	**0,69**
	BR40 / Size 15	**0,81**	**0,79**	**0,74**	**0,72**	**0,70**	**0,67**
	BR60 / Size 17	**0,80**	**0,78**	**0,73**	**0,71**	**0,69**	(0,66)
	BR100 / Size 20	**0,79**	**0,77**	**0,72**	**0,70**	**0,68**	(0,65)
	BR150 / Size 23	**0,77**	**0,75**	**0,70**	**0,68**	**0,66**	(0,63)
	BR250 / Size 26	**0,76**	**0,74**	**0,69**	(0,67)	(0,64)	
	BR400 / Size 30	**0,73**	**0,71**	**0,66**	(0,64)	(0,62)	
	BR1000 / Size 40	**0,70**	**0,68**	**0,63**	(0,61)	(0,59)	

Table: Values for friction velocity factor f_R

5.3 Friction linings and tolerances

The following table (**Figure 5.3**) shows the values for the tolerances of the braking and holding torque mentioned in Figure 5.2 for the different combinations of applications and friction lining types (cf. 5.1) as well as for the different states of the friction lining (new, conditioned, etc.).

Application		Working brake				Holding brake				*Remarks*
Friction lining		Working brake liner		Holding brake liner		Working brake liner		Holding brake liner		*see for this 5.1*
Tolerance		tol M_B	tol M_H	tol M_B	tol M_H	tol M_B	tol M_H	tol M_B	tol M_H	*see for this 5.2*
Friction lining condition	NEW	+30% -20%	+20% -40%	+30% -20%	+50% -10%	Special application! Please consult PRECIMA		+30% -20%	+50% -10%	*Friction lining on unused rotor*
	conditioned	not applicable		not applicable				+30% -20%	+40% -10%	*5...10 x switching cycle (release/braking) without friction work*
	run in	±20%	+30% -20%	+30% -20%	+40% -10%			no change		*Wear at rotor approx. 0.05 mm*
	after braking	no change		no change				up to +60% *)	up to +80% *)	*Holding brake: Change after emergency stop*

*) Carry out reconditioning if necessary

Figure 5.3: Friction linings and tolerances

Document history

Issue	Version	Description
05.2020	*0.0*	*Created*
11.2021	*1.0*	*Addition of Chapter 5:* Application