POTAIN®

FFB brake
Service Guide

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GS-2022-001-2

Manitowoc®

Legal information

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Contents

1. Foreword

Accessing the brake, which is detailed in this document, involves removing the brake cover (loosening the 4 mounting screws + removing the levers).
Dismantling and refitting the cover are not indicated in the various procedures, but are implied.

Removing the brake cover allows access to moving parts. Maintenance operations must be carried out taking the necessary safety measures.

Some of the representations in this document may differ from the reality.

2. Introduction

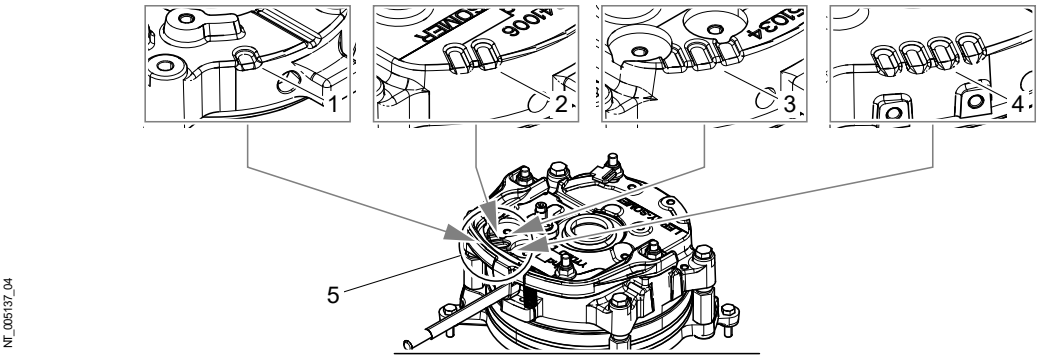
The FFB brake is a new brake. The initials FFB stand for Flexible Failsafe Brake.

The FFB brake is available in 5 different sizes:

- FFB1
- FFB2
- FFB3
- FFB4
- FFB5 (not used)

The FFB brake type can be determined by marking on the yoke of the brake **(5)**.

(1)	FFB1	1 mark	**(2)**	FFB2	2 marks
(3)	FFB3	3 marks	**(4)**	FFB4	4 marks



The brake is adapted to the various motor sizes through the use of an adapter plate. The plate dimensions depend on the size of the motor and the size of the brake.

The static braking torque depends on the number of springs in the brake.

On Manitowoc applications, the brake is equipped with a brake release system by auto-return lever (DLRA).
Depending on the movements, the brake is also equipped with the following systems:

- Brake release lock off (DLM) – use case: manual slewing / weathervaning
- Removable brake release lock off (DLMA) – use case: trolleying movement / maintenance on winch
- Remote brake release lock off (DMD) – use case: electrical slewing / weathervaning

The DLM and DLMA systems use the same working principle. The differences are described in chapter 4.4

At the same time, the motor can be equipped, or not, with an encoder on the end of the second motor shaft. If no encoder is fitted, the length of the second shaft end is reduced in order to optimize the motor space requirements.

An electrical contact to monitor the brake condition can also be installed.

An inductive sensor to measure the speed of the motor shaft can be installed on the brake.

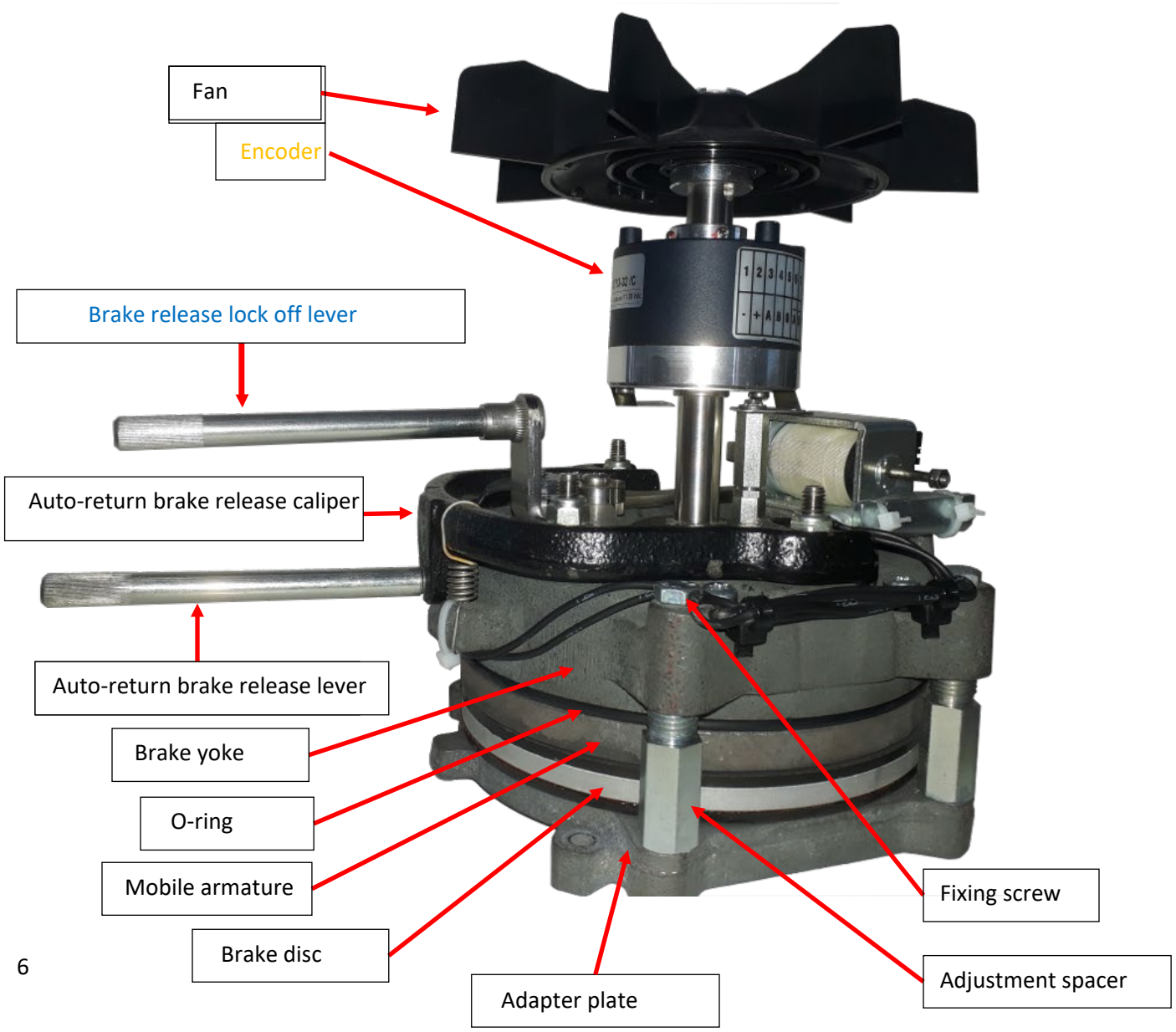
The fan installed on the second shaft end can be replaced by electric forced ventilation.

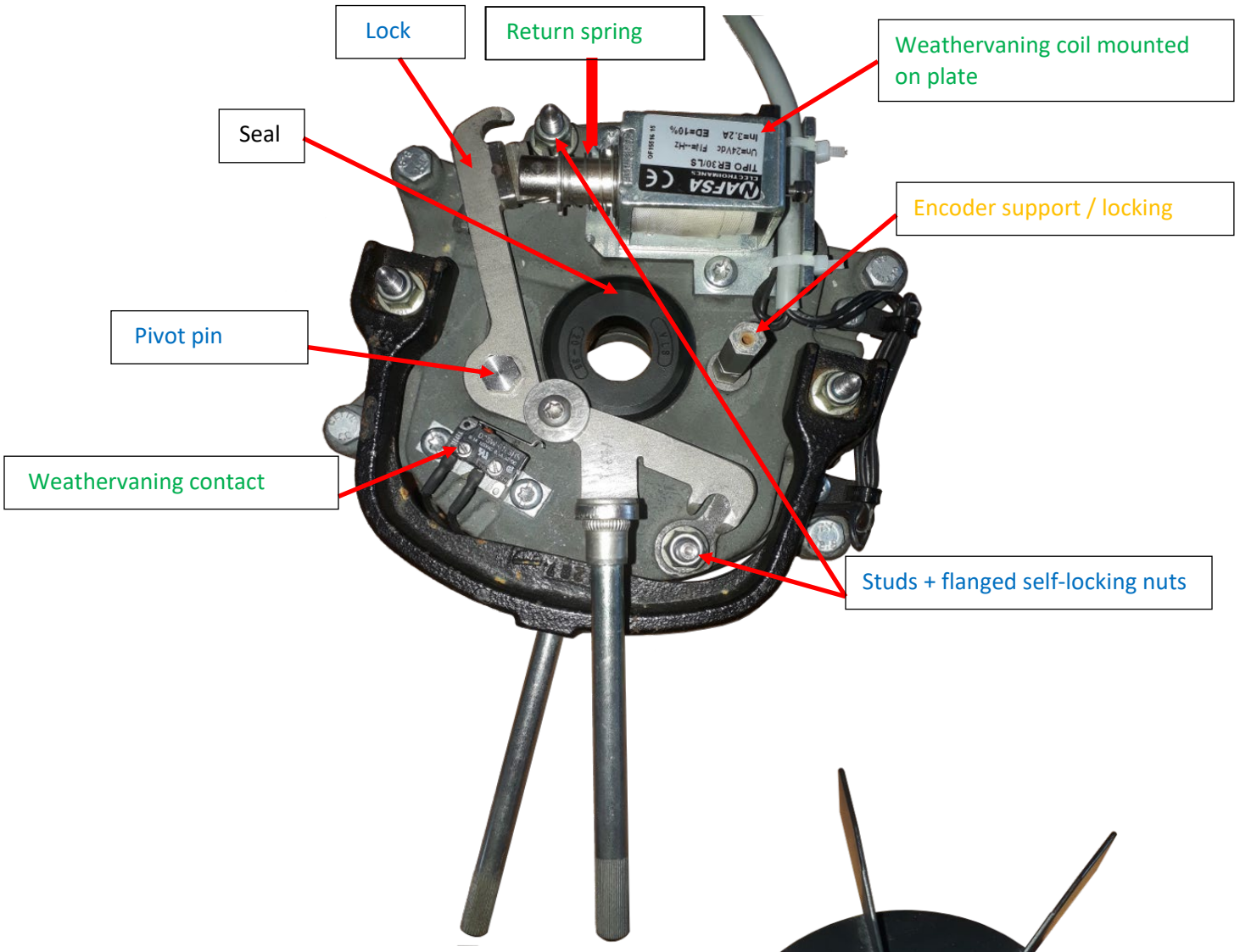
3. Component names

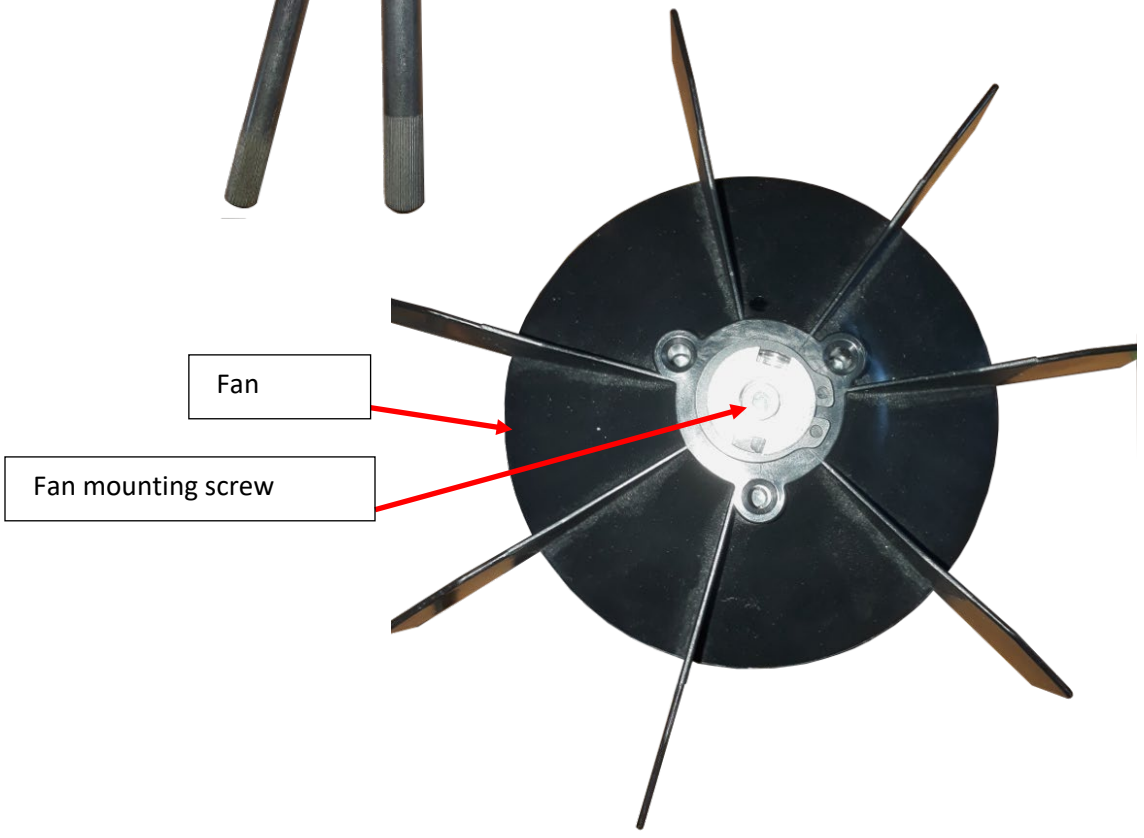
The basic components are described below in black characters.
The components used for the DLM and DLMA systems are described below in blue characters.
The components used for the DMD system are described below in green characters.

The components used when fitting an encoder are described below in orange characters. The

DMD system uses the components of the DLM system.

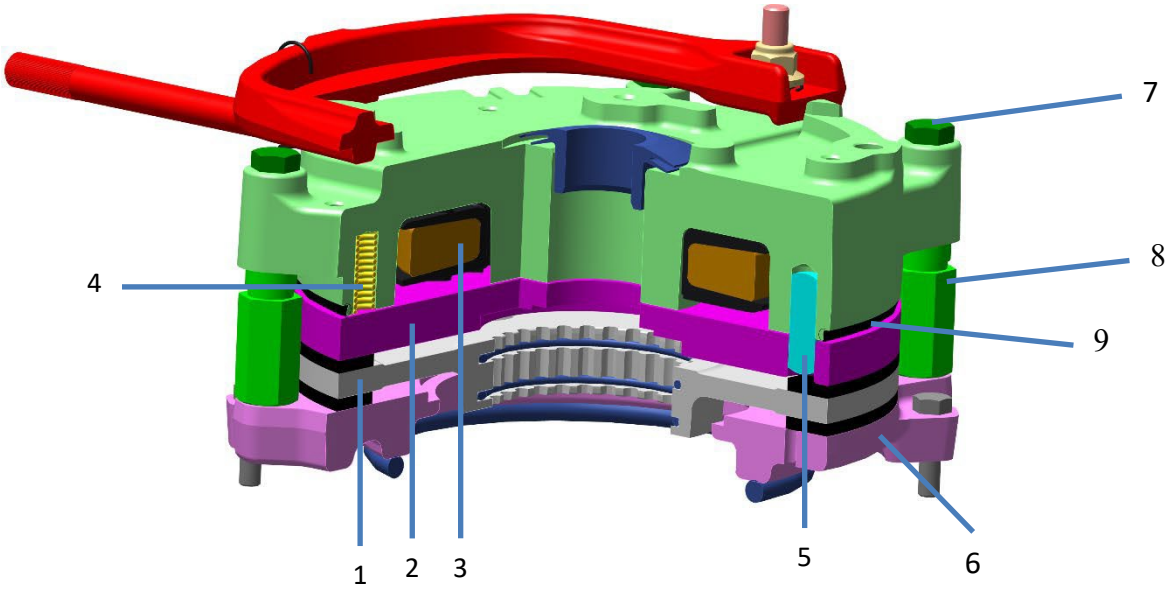



Lock
Return spring
Weathervaning coil mounted on plate
Seal
Encoder support / locking
Pivot pin
Weathervaning contact
Studs + flanged self-locking nuts


Fan
Fan mounting screw

4. Working principle

4.1. Standard



1 : Brake disc
2 : Mobile armature
3: Yoke
4: Spring
5 : Safety pin
6 : Adapter plate
7: Fixing screw
8: Adjustment spacer
9: O-ring

4.1.1. Principle:

The FFB brake is a spring failsafe brake.
The brake is opened and held open by electricity. The brake is closed and held closed by springs.
The safety pins (5) are fixed to the yoke (3), which is itself fixed to the adapter plate (6), via the fixing screws (7) and the adjustment spacers (8). The adapter plate (6) is fixed to the motor.
The brake disc (1) has two brake linings bonded to each side. The brake disc (1) is driven by the motor shaft via a ring (key connection between the shaft and the ring / spline connection between the ring and the brake disc).

4.1.2. Braking:

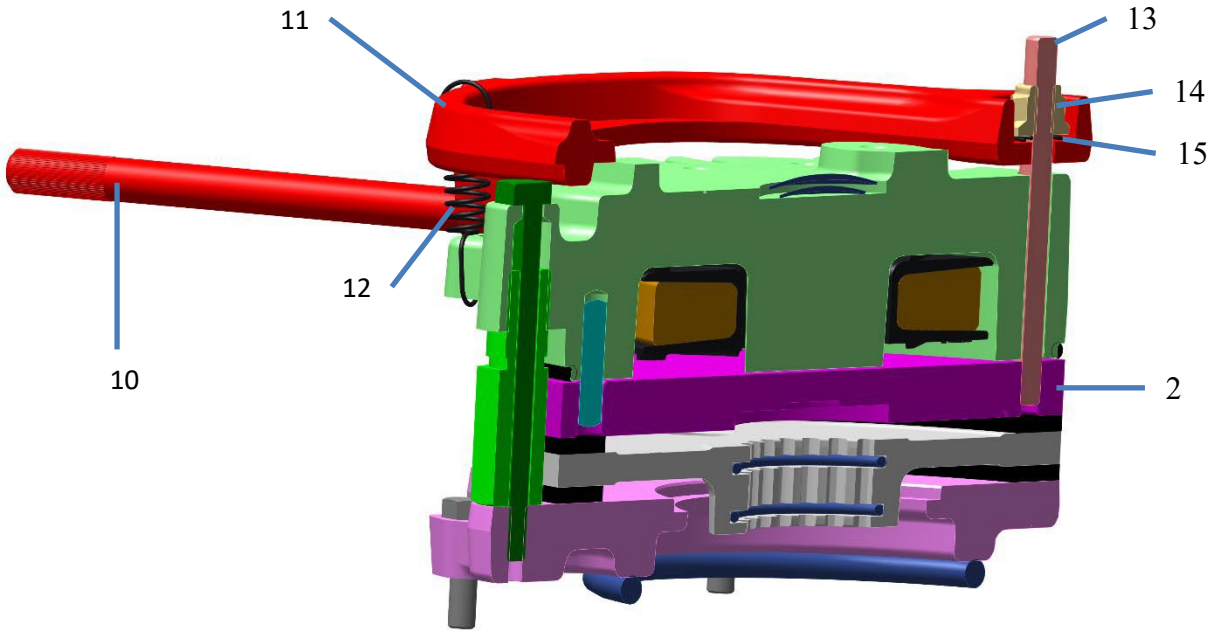
- The yoke (3) is not energized.
- The springs (4) push the mobile armature (2) against the brake disc lining (1). The air gap is between the yoke (3) and the mobile armature (2).
- The mobile armature (2) slides along the safety pins (5).
- The second brake disc lining (1) is pressed against the adapter plate (6).
- The brake disc (1) is locked.

4.1.3. Brake release:

- The yoke (3) is energized.

- The mobile armature (2) is attracted to the yoke (3).
- The mobile armature (2) slides along the safety pins (5).
- The springs (4) are compressed.
- The air gap is distributed on each side of the brake disc (1).
- The brake disc (1) is free to rotate.

4.2. DLRA brake release lever



10: Brake release lever
11: Brake release caliper
12 : DLRA Return spring
13 : DLRA Stud
14 : DLRA flanged self-locking nut
15: Coil spring under nut

4.2.1. Principle:

The DLRA system allows the brake to be temporarily opened by carrying out a manual action. Stopping the manual action causes the brake to close.

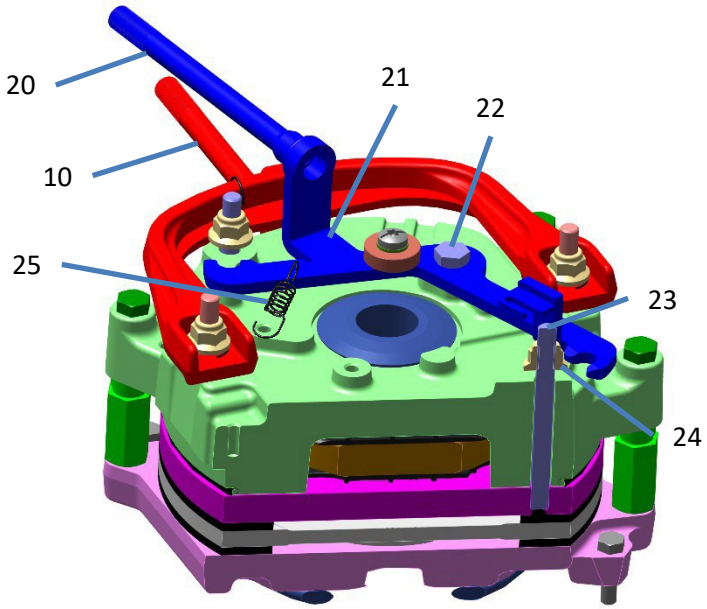
4.2.2. Brake release:

- Brake release is carried out manually using the brake release lever (10). The movement must be carried out in the direction opposite to that of the motor (upwards in the above representation).
- The coil springs under the nut (15) are compressed between the brake release caliper (11) and the DLRA flanged self-locking nuts (14).
- The DLRA studs (13) slide through the yoke (3). The DLRA studs (13) are connected to the mobile armature (2).
- The force applied to the brake release lever (10) is transmitted to the DLRA studs (13) via the DLRA flanged self-locking nuts (14). The force is then transmitted to the mobile armature (2) to compress the springs (4).
- The brake disc (1) is free to rotate.

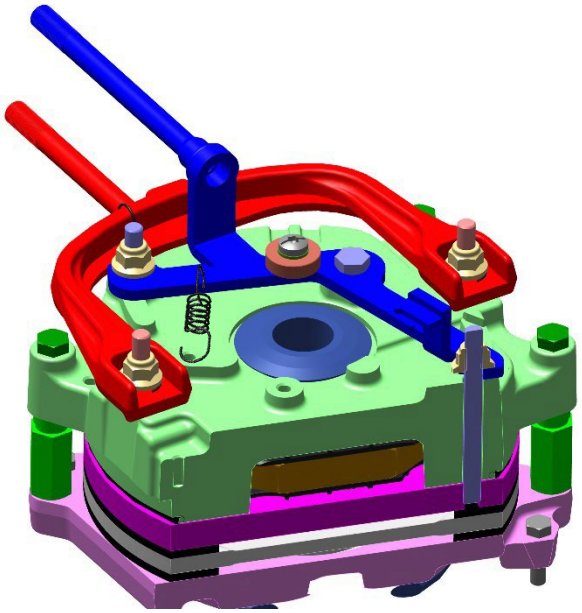
4.2.3. Braking:

- Braking occurs by releasing the force on the brake release lever (10) towards the motor (downwards in the above representation).
- The springs (4) apply a force on the mobile armature (2), locking the brake disc (1).
- The return spring (12) keeps the brake release caliper (11) in the rest position (without transmitting force to the mobile armature (2)).
- The coil springs under nut (15) keep the brake release caliper (11) in the rest position during the brake electrical maneuvers.

4.3. DLM brake release lever



DLM - Inactive position



DLM - Active position

20: DLM Brake release lock off lever
21 : Lock
22 : DLM pivot pin
23: DLM stud
24 : DLM flanged self-locking nut
25 : DLM Return spring

4.3.1. Principle:

The DLM brake release lever locks the brake in the open position using the lock (21). This brake is locked in the open position manually.
The brake is unlocked automatically by the DLM return spring (25) when the brake is energized or when using the DLRA system.
The position of the DLM brake release lever indicates the state of the system:

- Aligned with the DLRA lever: the brake is locked in the open position (brake off).
- Offset with respect to the DLRA lever: the brake is on.

4.3.2. Brake release lock off:

To lock the brake in the open position:

- Use the DLRA brake release lever (10) to release the brake (movement in the direction opposite to the motor).

- The mobile armature (2) moves towards the yoke. The movement of the mobile armature (2) causes the DLM flanged self-locking nuts (24) to move via the DLM studs (23) which slide inside the yoke (3).
- The air gap between the DLM flanged self-locking nuts (24) and the yoke (3) is sufficient to allow the lock (21) to pass.
- While maintaining the force on the DLRA brake release lever (10), apply a lateral movement to the DLM brake release lock off lever (20), to align it with the brake release lever (10) (to a stop).
- The lock (21) pivots about the DLM pivot pin (22), and is positioned between the yoke (3) and the DLM flanged self-locking nuts (24).
- Maintain the force on the DLM brake release lock off lever (20), while releasing the force on the DLRA brake release lever (10).
- The springs (4) apply a force on the lock (21) via the mobile armature (2), the DLM studs (23) and the DLM flanged self-locking nuts (24).
- Release the force on the DLM brake release lock off lever (20).
- The brake disc (1) is free to rotate.

4.3.3. Electrical unlocking:

The brake locking in the open position (unbraked) can be removed electrically. To do this:

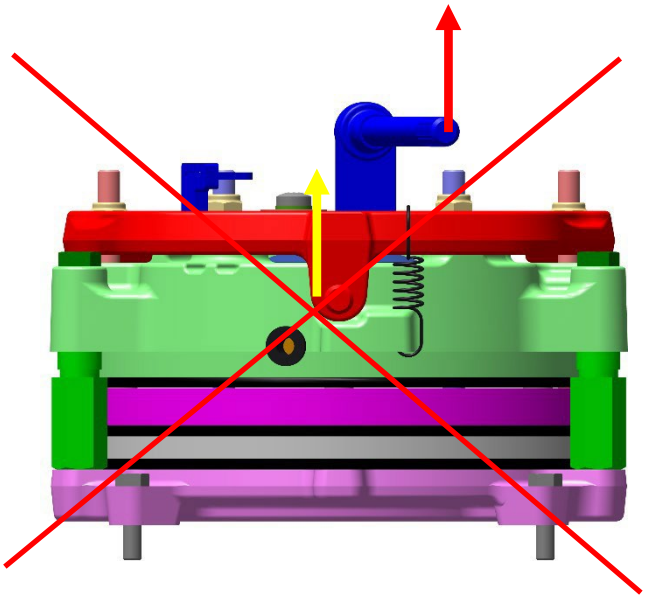
- Energize the yoke (3).
- The DLM return spring (25) returns the lock (21) to the inactive position and moves the DLM brake release lock off lever (20) to its initial position (not aligned with the DLRA brake release lever (10)).
- De-energize the yoke (3).
- The brake disc (1) is locked.

4.3.4. Manual unlocking:

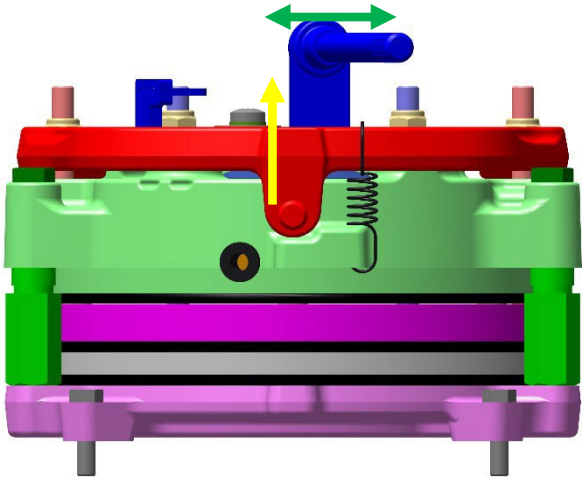
To manually remove the brake locking in the open position (unbraked),

- Use the DLRA brake release lever (10) to release the brake (movement in the direction opposite to the motor).
- The DLM return spring (25) returns the lock (21) to the inactive position and moves the DLM brake release lock off lever (20) to its initial position (not aligned with the DLRA brake release lever (10)).
- Release the force on the DLRA brake release lever (10).
- The brake disc (1) is locked.

 Risks of damaging the equipment: never apply a force to the DLM brake release lock off lever (20) in the same direction as the DLRA brake release lever (10): risk of deforming the lock, causing the DLM system to malfunction:

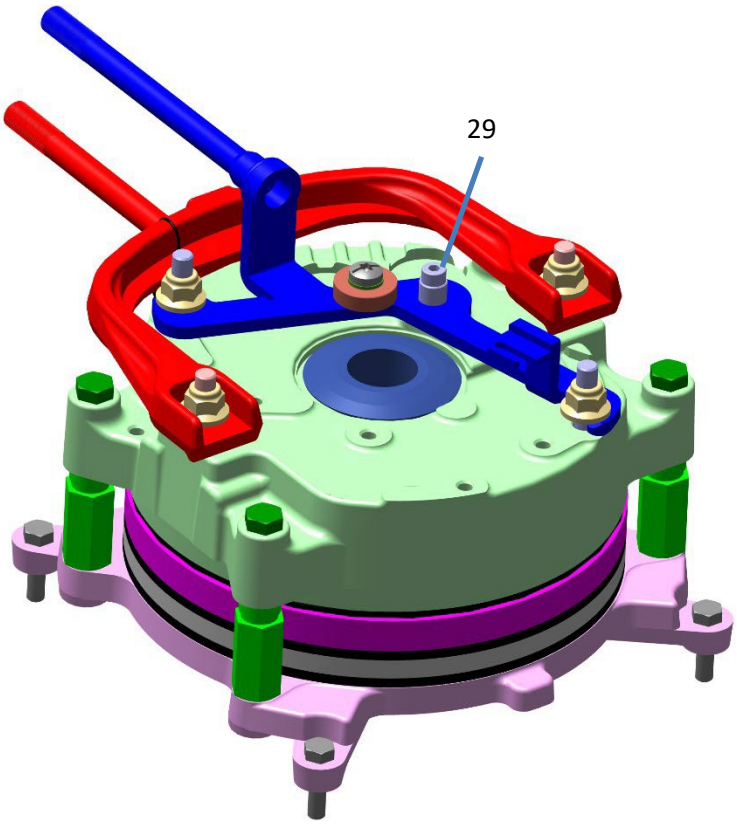


Movement prohibited



Movement authorized

4.4. DLMA brake release lever



29 : DLMA pivot pin

4.4.1. Principle:

The DLMA brake release lever is a variant of the DLM system. The lock is now removable, it can be removed from the brake to avoid any interference when operating the brake.

The pivot pin (22), consisting of a flanged hex head screw for the DLM, is replaced by a headless pivot pin for the DLMA (29).

To avoid leaving the lock installed on the brake in position (risk of accidental brake release), the brake release lever is connected to the lock (the lever is bonded to the lock on the thread). It is therefore impossible to refit the brake cover, as long as the lock is installed on the brake.

4.4.2. Brake release lock off:

To lock the brake in the open position:

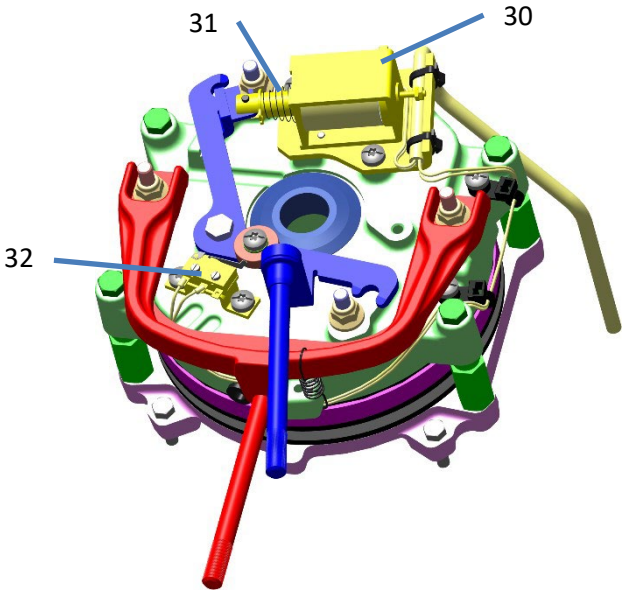
- Remove the brake cover.
- Install the lock (21) + DLM brake release lock off lever (20) assembly through the DLMA pivot pin (29) present on the yoke (3).
- Continue with the procedure described in chapter 4.3.2.

4.4.3. Manual unlocking:

To remove the lock (21) + DLM brake release lock off lever (20) assembly:

- Use the DLRA brake release lever (10) to release the brake (movement in the direction opposite to the motor).
- While maintaining the force on the DLRA brake release lever (10), apply a lateral movement to the DLM brake release lock off lever (20), so that the lock (21) is no longer under the DLM flanged self-locking nuts (24).
- Release the force on the DLRA brake release lever (10).
- To remove the lock (21) + DLM brake release lock off lever (20) assembly from the DLMA pivot pin (29).
- Install the brake cover.

4.5. DMD System



30 : DMD weathervaning coil
31: DMD return spring
32: Weathervaning contact

4.5.1. Principle:

The DMD system is a variant of the DLM system. It uses the same components as the DLM system, apart from the DLM return spring (25), which is replaced by the DMD return spring (31).

The DMD weathervaning coil (30) exerts the force to move the lock (21) instead of the manual force on the DLM brake release lock off lever (20).

The weathervaning contact (32) provides electrical information concerning the position of the lock (21). The NO electrical contact of the weathervaning contact (32) is used on Manitowoc applications. When the electrical contact is closed, the lock (21) keeps the brake in the released position. When the electrical contact is open, the lock (21) is not active and the brake is in the braked position.

The DMD system can also be used to release the brake manually in the same way as with the DLM system (§4.3). The representation of the system state is identical to that described for the DLM lever (§4.3).

4.5.2. Activation of electrically maintained brake release:

To lock the brake in the open position:

- Energize the yoke (3) and the weathervaning coil (30) at the same time. The lock activates the weathervaning contact (32), and is positioned under the flanged self-locking nuts (24).
- After about 2 seconds, de-energize the yoke (3), while leaving the weathervaning coil (30) energized. The springs (4) apply a force on the lock (21) via the mobile armature (2), the DLM studs (23) and the DLM flanged self-locking nuts (24).
- After about 1 second, de-energize the weathervaning coil (30).
- The brake disc (1) is free to rotate.

4.5.3. Activation of manually maintained brake release:

Same principle as that described in §4.3.2.

4.5.4. Electrical unlocking:

Same principle as that described in §4.3.3.

4.5.1. Manual unlocking:

Same principle as that described in §4.3.4.

5. Maintenance

5.1. Specifications

5.1.1. Yoke coils:

The nominal resistance of the FFB yoke coils, depending on the voltage, at 20 °C, is as follows:

Brake size	Voltage 180 Vdc	Voltage 20 Vdc
FFB1	776 ohms	10.1 ohms
FFB2	610 ohms	7.6 ohms
FFB3	522 ohms	7.2 ohms
FFB4	530 ohms	5.6 ohms
FFB5	329 ohms	4.8 ohms

These values are given with a tolerance of -5% / +5%.

5.1.2. DMD coil:

The nominal resistance of the DMD system coil at 20 °C is as follows:

Brake size	Voltage 24 Vdc
FFB1, FFB2, FFB3, FFB4, FFB5	7.5 ohms

5.1.3. Brake air gap:

The nominal brake air gap (measured between the brake yoke (3) and the mobile armature (2) at each adjustment spacer (8), after moving the O-ring), must be equal to the following values, depending on the brake release system fitted on the brake :

Brake size	DLRA (standard), DLMA lever	DLM, DMD lever
FFB1, FFB2, FFB3	0.3 mm	0.6 mm
FFB4, FFB5	0.4 mm	

Adjust the brake air gap (see procedure in chapter 5.1.6) in the following cases:

- the air gap measured is less than the above nominal values (**risk of operation with brake applied**)
- the air gap measured is greater than the above nominal values by up to 0.9 mm (possibility of operation in this case, but the air gap should be adjusted).
- the air gap is greater than or equal to 0.9 mm (adjustment **mandatory**)

5.1.4. Total thickness of the brake disc:

The total thickness of the disc is equal to the thickness of the two linings + the thickness of the disc. This total thickness must not be less than the following dimensions:

Brake size	Minimum total thickness of the disc
FFB1, FFB2, FFB3	10 mm
FFB4, FFB5	16.5 mm

If the total thickness measured is less than the minimum value, the brake disc must be replaced (see procedure in chapter5.9) (otherwise the braking torque would be decreased, possibly resulting in a total loss of torque without prior warning).

5.1.5. Residual clearance brake held open (DLM, DLMA, DMD):

When the DLM, DLMA or DMD systems are activated (DLM flanged self-locking nuts (24) against the lock (21)), the mobile armature (2) is held in an intermediate position. In this case, the brake is neither fully open nor fully closed. The brake air gap (adjusted in § 5.1.3) is distributed between the brake caliper (3) and the mobile armature (2), and on each side of the brake disc (1).

The residual clearance, measured between the brake caliper (3) and the mobile armature (2), after moving the O-ring, at the DLM studs (23), must be equal to the following value:

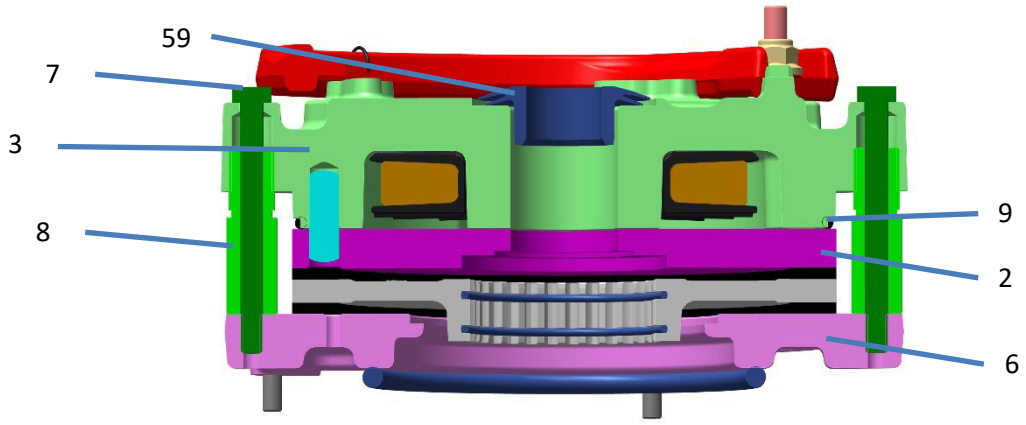
Brake size	Residual clearance with DLM, DMD activated	DLMA residual clearance
FFB1, FFB2, FFB3, FFB4, FFB5	0.3 mm	0.2 mm

5.1.6. Inductive sensor air gap:

The nominal air gap of the inductive sensor (measured between the head of the inductive sensor (80) and the pulse disc (86)) must be equal to the following value:

Brake size	Inductive sensor air gap
FFB1, FFB2, FFB3, FFB4, FFB5	0.5 mm

5.2. Adjusting the brake air gap



Before adjusting the brake air gap:

- Ensure that the brake is correctly closed **(no DLRA, DLM, DLMA, or DMD locking device is active)**.

Adjustment:

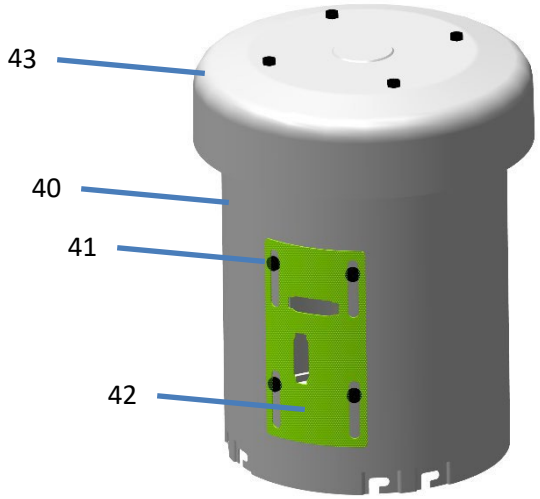
- Unlock the adjustment spacers (8), and move them closer to the yoke (3).
- Remove the O-ring (9) to access the air gap between the mobile armature (2) and the yoke (3).
- Screw the fixing screws (7) in (to reduce the air gap) or out (to increase the air gap).
- Check the air gap according to the values shown in the table of §5.1.3.
- Screw the adjustment spacers (8) to place them against the adapter plate (6) and tighten to a torque of 2 Nm (+/- 10%).
- Tighten the fixing screws (7) to torque, according to the following table:

Brake size	Tightening torque of the fixing screws (7)
FFB1	4.9 Nm (+/- 10%)
FFB2, FFB3	8.5 Nm (+/- 10%)
FFB4, FFB5	21 Nm (+/- 10%)

- Check the air gap again.
- Refit the O-ring (9).
- Press the seal (59) against the yoke (3).

Refit the brake cover and check that there is no interference with the brake release levers (10) and (20)

In case of interference, move the brake cover blanking plate (loosen the 4 fixing screws (41) to slide the blanking plate (42) then tighten the 4 screws (41) after adjustment).

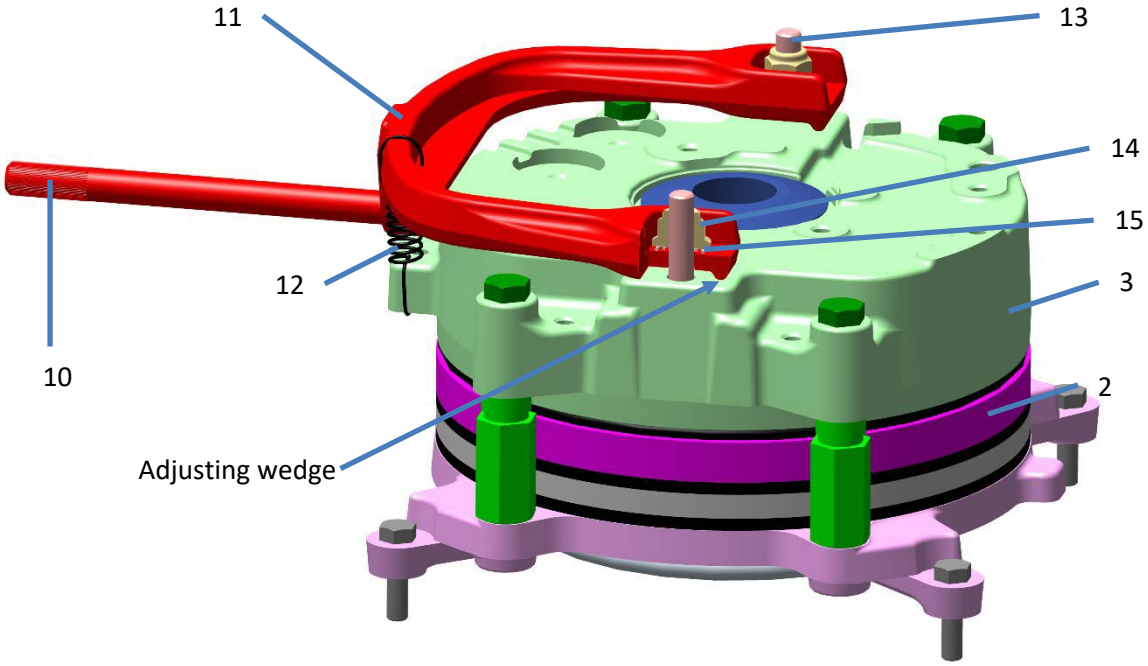


40: brake cover
41: fixing screw
42: cover blanking plate
43: umbrella plate

Important: After the air gap has been adjusted 3 times, the total thickness of the brake disc must be checked frequently.

5.3. DLRA brake release lever

5.3.1. Adjusting the DLRA brake release lever



Before adjusting the DLRA system, check that the brake air gap has been correctly adjusted (see §5.1.6).
The DLRA system is <u>adjusted</u> with the brake powered (brake air gap zero).

<u>Danger</u>: Take all the necessary precautions concerning the loads held by the brake.

Adjustment:

- Loosen the DLRA flanged self-locking nuts (14) to move the brake release caliper sufficiently away (11) from the yoke (3).
- Insert an adjusting wedge of thickness "j" between the brake release caliper (11), at the boss at the end of the caliper, and the yoke (3) on each side. Choose the adjusting wedge thickness "j" according to the following table:

Brake size	DLRA **adjusting** wedge thickness "j"
FFB1	1.9 mm
FFB2, FFB3	1.6 mm
FFB4, FFB5	2 mm

- Tighten the DLRA flanged self-locking nuts (14) until they touch the brake release caliper (11) (coil springs under nut (15) fully compressed).
- Remove the two adjusting wedges. If necessary, slightly loosen the DLRA flanged self-locking nuts (14) to remove the wedge, then tighten them to return to the same angular position as before loosening.
- Operate the brake release caliper (11) using the brake release lever (10), after switching off the brake power supply: the lever must have a slight angular movement before feeling actual resistance as the brake is unlocked.

After refitting the brake cover, check that there is no interference between the brake release lever (10) and the cover blanking plate (42), when:

- The lever is in the rest position
- The lever is operated to release the brake

In case of interference, adjust the cover blanking plate (42) as indicated in §5.1.6.

5.3.2. Checking the adjustment of the DLRA brake release lever

Due to various geometric variations across all of the FFB brake parts, the adjustment of the DLRA brake release lever is not checked with the same thickness wedge as that used for adjustment.

The DLRA system is <u>checked</u> with the brake powered (brake air gap zero).

⚠ <u>Danger</u>: Take all the necessary precautions concerning the loads held by the brake.

Check:

- Insert a checking wedge of thickness "k" between the brake release caliper (11), at the boss at the end of the caliper, and the yoke (3) on each side. Choose the wedge thickness "k" according to the following table:

Brake size	DLRA **checking** wedge thickness "k"
FFB1	1.5 mm
FFB2, FFB3	1.2 mm
FFB4, FFB5	1.6 mm

A tolerance of 0.05 mm can be applied to the wedge thickness.

If the checking wedge of thickness "k" goes between the brake release caliper (11) and the yoke (3):

➔ The DLRA brake release lever is correctly adjusted.

If the checking wedge of thickness "k" does not go between the brake release caliper (11) and the yoke (3):

➔ Check the position of the mobile armature (2) with respect to the yoke (3).
If the mobile armature (2) is correctly pressed against the yoke (3), readjust the DLRA brake release lever (§5.3.1).
Otherwise, check that no foreign bodies hinder the movement of the mobile armature (2).

5.3.3 Alternative if the brake cannot be energized

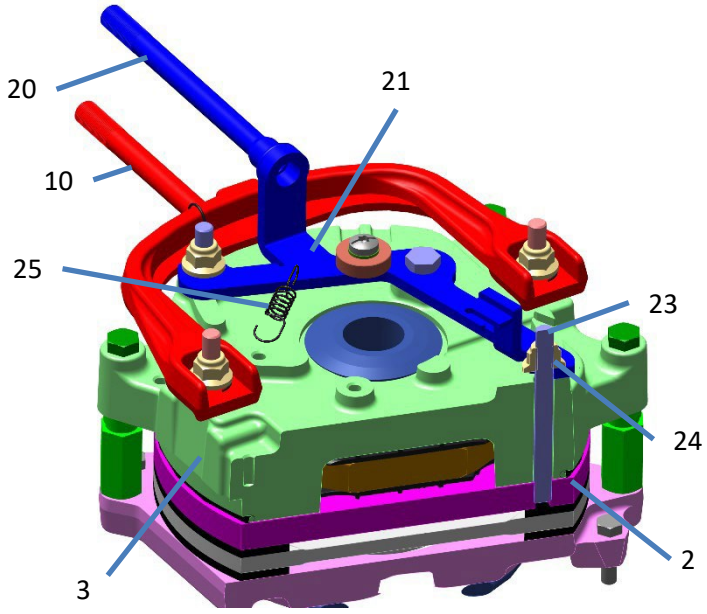
⚠ <u>Danger</u>: Take all the necessary precautions concerning the loads held by the brake.

- Check the air gap by following the procedure of § 5.1.3.
- Measure the actual brake air gap at the studs (13) of the DLRA by successively inserting several shims.
- Check the adjustment of the brake DLRA not energized at the two studs (13). The value of the non-energized brake check shim is equal to (the **<u>check value</u>** present in the table of §5.3.**2** – the air gap measured previously).

If the check shim cannot be inserted between the brake release caliper (11) and the yoke (3):

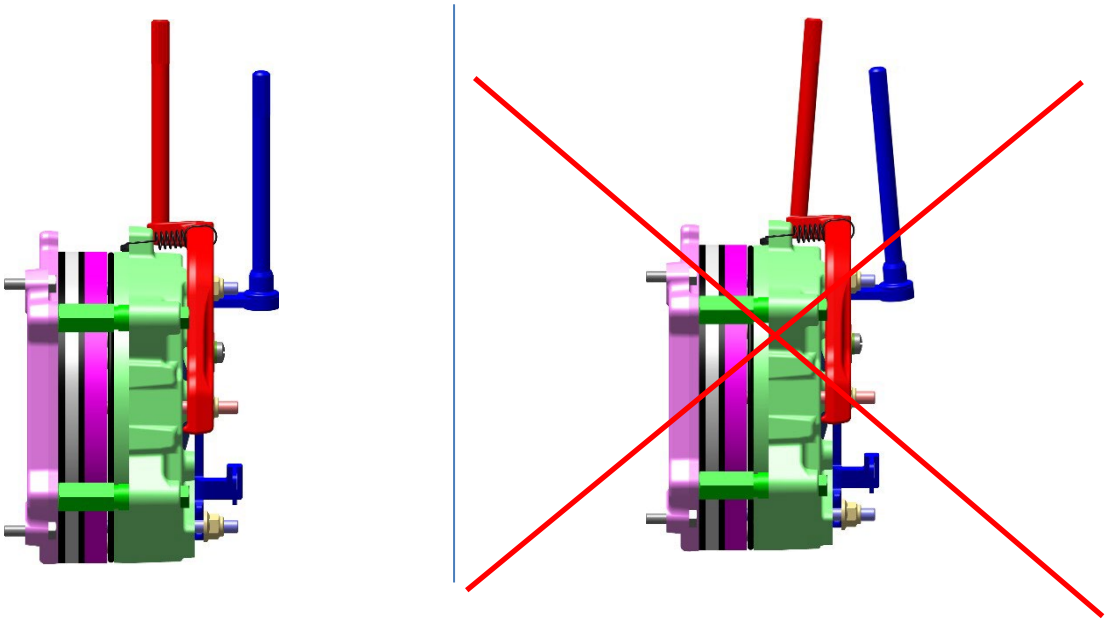
- Adjust at the two studs with a shim of (the **<u>adjustment value</u>** present in the table § 5.3.**1** – the air gap measured previously) mm
- Check the adjustment of the non-energized brake DLRA by following the previous procedure.

5.4. Adjusting the DLM / DLMA brake release lever



Before adjusting the DLM/DLMA system:

- Check that the brake air gap has been correctly adjusted (see §5.1.6).
- Visually check that the two levers (10) and (20) are in two parallel planes, and perpendicular to the motor axis:



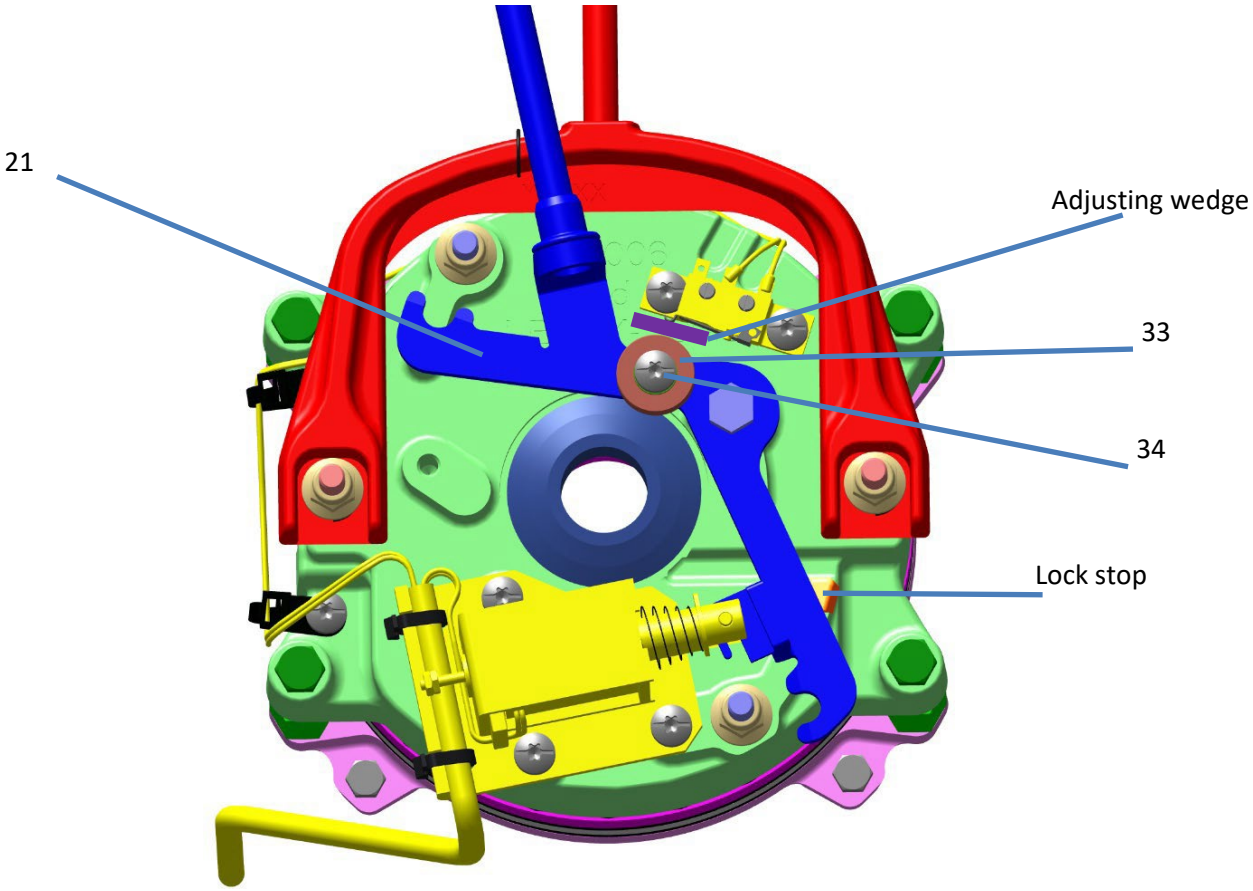
Otherwise, replace the lock (21) (see §5.10).

Adjustment:

- Activate the DLM/DLMA system according to the procedures described in §4.3.2 / 4.4.2.
- If the air gap is not sufficient to activate the system, unscrew the DLM flanged self-locking nuts (24) and repeat the activation procedure.
- As soon as the system is activated, insert an adjusting wedge of thickness as indicated in §5.1.5. between the yoke (3) and the mobile armature (2).

- Screw the flanged self-locking nuts (24) on the DLM studs (23) to trap the adjusting wedge.
- Unscrew the DLM flanged self-locking nuts (24) (1/8 of a turn) to release the adjusting wedge.
- Operate the brake release lever (10) to check that:
    - DLM: under the action of the DLM return spring (25), the lock (21) must resume its rest position (DLM system deactivated)
    - DLMA: the lock (21) can be pivoted to remove it from the brake.

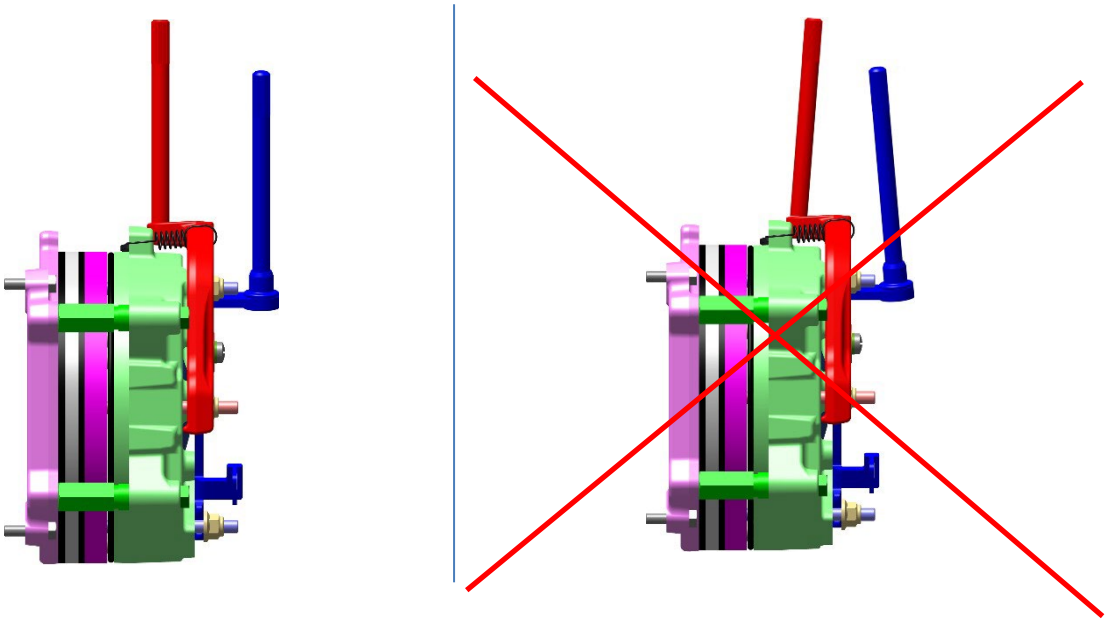
5.5. Adjusting the DMD contact



33: Contact adjustment washer
34: Contact adjustment screw

Before adjusting the DLM/DLMA system:

- Visually check that the two levers (10) and (20) are in two parallel planes, and perpendicular to the motor axis:



Otherwise, replace the lock (21) (see §5.10).

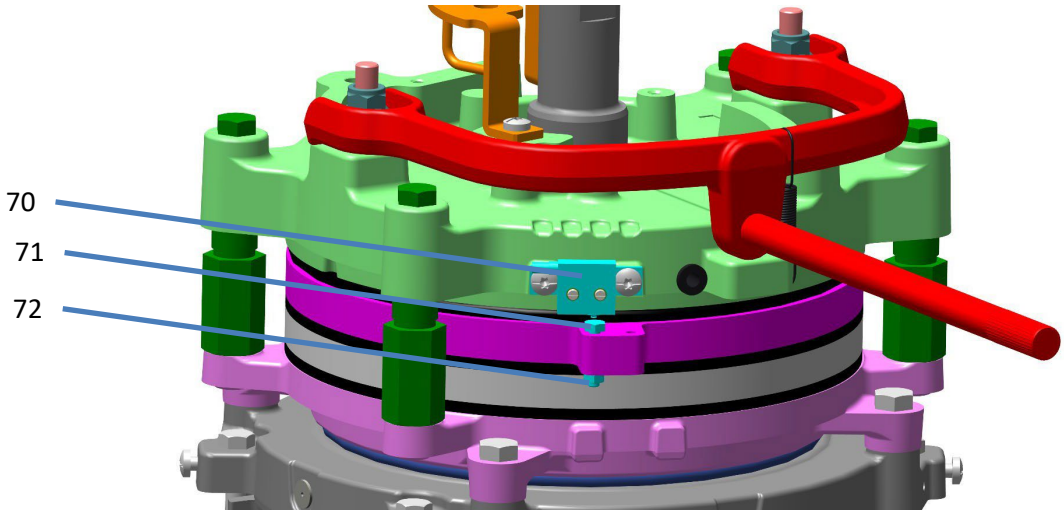
Adjustment:

- Position the lock (21) in the rest position (resting against the stop present on the yoke (3)).
- Loosen the contact adjustment screw (34).
- Insert an adjusting wedge between the weathervaning contact (32) and the contact adjustment washer (33). The adjusting wedge thickness must correspond to the following table:

Brake size	DMD contact air gap
FFB1, FFB2, FFB3, FFB4, FFB5	3.5 mm

- Tighten the contact adjustment screw (34).
- Remove the adjusting wedge and check that the contact is electrically activated (check with a multimeter) when the lock (21) is in the activated position (the contact must be activated when the lock can physically lock the brake in the intermediate position).

5.6. Adjusting the brake release contact



70: Brake release contact
71: Adjustment screw
72: Locking nut

Normally, there is no need to adjust the brake contact after adjusting the brake air gap. Before adjusting the brake release contact:

- Check that the brake air gap has been correctly adjusted (see §5.1.6).

Adjustment:

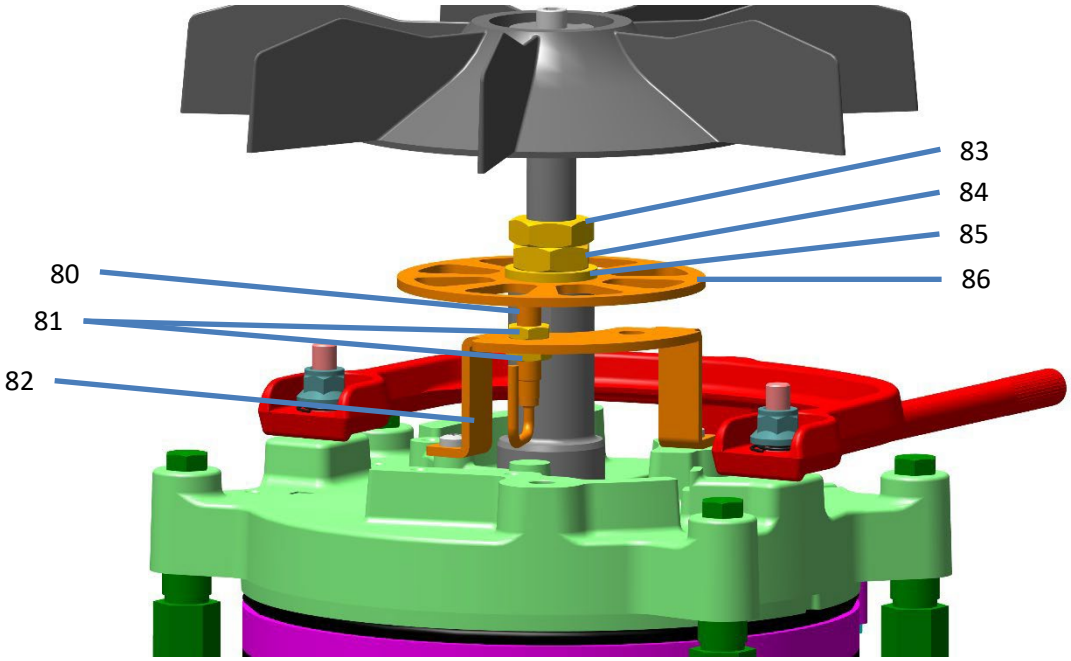
- Unlock the locking nut (72).
- Unscrew the adjustment screw (71).
- Insert an adjusting wedge between the head of the adjusting screw (71) and the brake release contact probe (70). The thickness of the adjusting wedge depends on the brake size:

Brake size	Thickness of brake contact adjusting wedge
FFB1, FFB2, FFB3	0.2 mm
FFB4, FFB5	0.3 mm

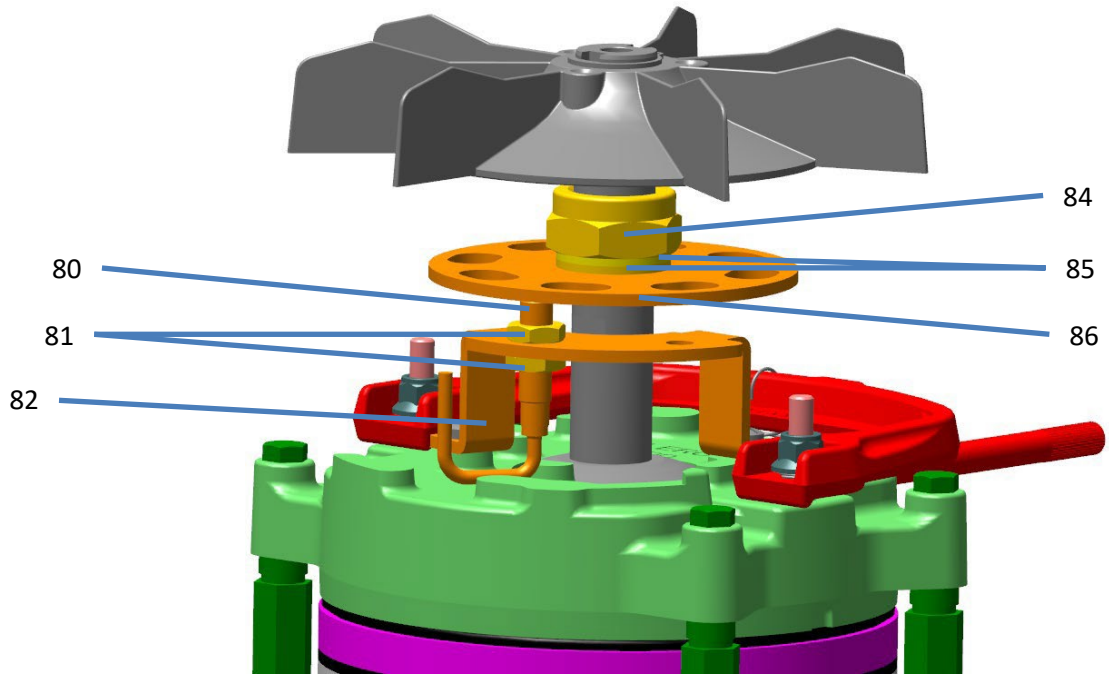
- Unscrew the screw until you hear the switch changing state (or by using a multimeter in the motor terminal box).
- Lock the locking nut (72) then remove the adjusting wedge.

5.7. Adjusting the inductive sensor

Version 1:



Version 2:



80 : inductive sensor

81 : nut / counternut locking the sensor

82: inductive sensor support

83 : counternut locking the pulse disc

84 : nut locking the pulse disc

85: pulse disc washer

86: Pulse disc

/!\: each time the brake air gap is adjusted, check, and if necessary adjust, the inductive sensor air gap.

Before adjusting the inductive sensor:

- Check that the brake air gap has been correctly adjusted (see §5.1.6).

- Check that the pulse disc (86) is connected to the motor shaft by the washer (85) + locking nut (84) + locking counternut (83) assembly. If necessary, lock the disc using the locking nut (84), then tighten the counternut (83).

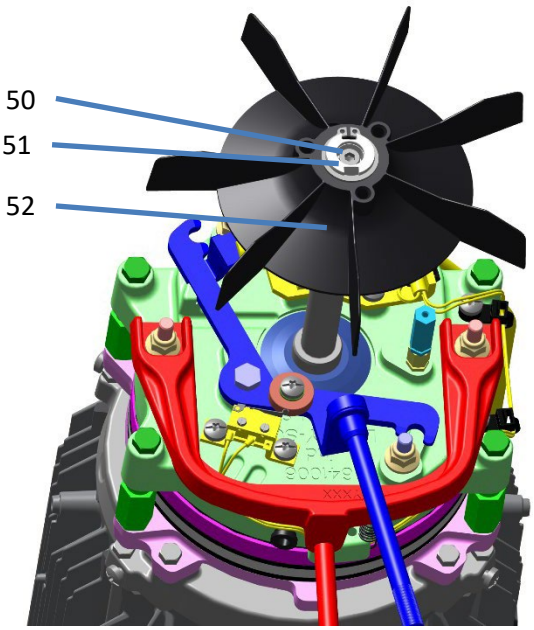
Adjustment:

- Unlock the nuts (81) of the inductive sensor (80).
- Insert a wedge, of thickness corresponding to the nominal value of the air gap indicated in §5.1.6, between the inductive sensor (80) and the pulse disc (86).
- Lock the nuts (81) with a maximum torque of 2 Nm.

5.8. Dismantling / refitting the fan

There are several ways of fitting the fan on a motor equipped with an FFB brake. There is a specific dismantling / refitting procedure for each type of fitting.

5.8.1. Fixing by axial screw:



50: mounting screw
51: sleeve
52: fan

Dismantling:

- Unscrew the fan mounting screw (50)
- Remove the fan (52) + sleeve (51) + mounting screw (50) assembly.

Refitting:

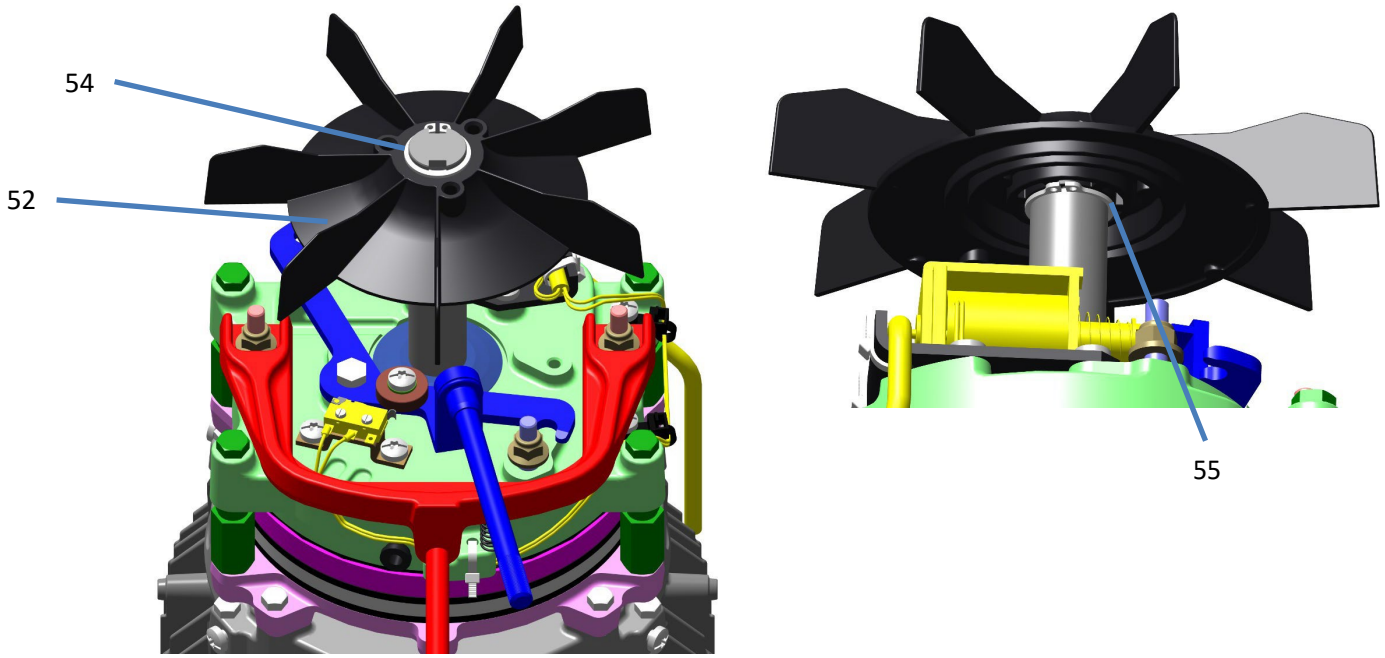
- Apply low strength threadlocker on the mounting screw (50)

Recommended threadlocker	Comment
LOXEAL 55-03	MTW code: J-01035-31 (55 mL bottle) G-12035-04 (250 mL bottle)

- Install the mounting screw (50) + sleeve (51) + fan (52) assembly on the motor shaft.
- Tighten the mounting screw (50) to torque according to the following table:

Brake size	Tightening torque of the mounting screw (50)
FFB1, FFB2, FFB3, FFB4, FFB5	3 Nm (+/- 10%)

5.8.2. Fixing by circlip:



52: fan

54 : Upper circlip

55 : Lower circlip

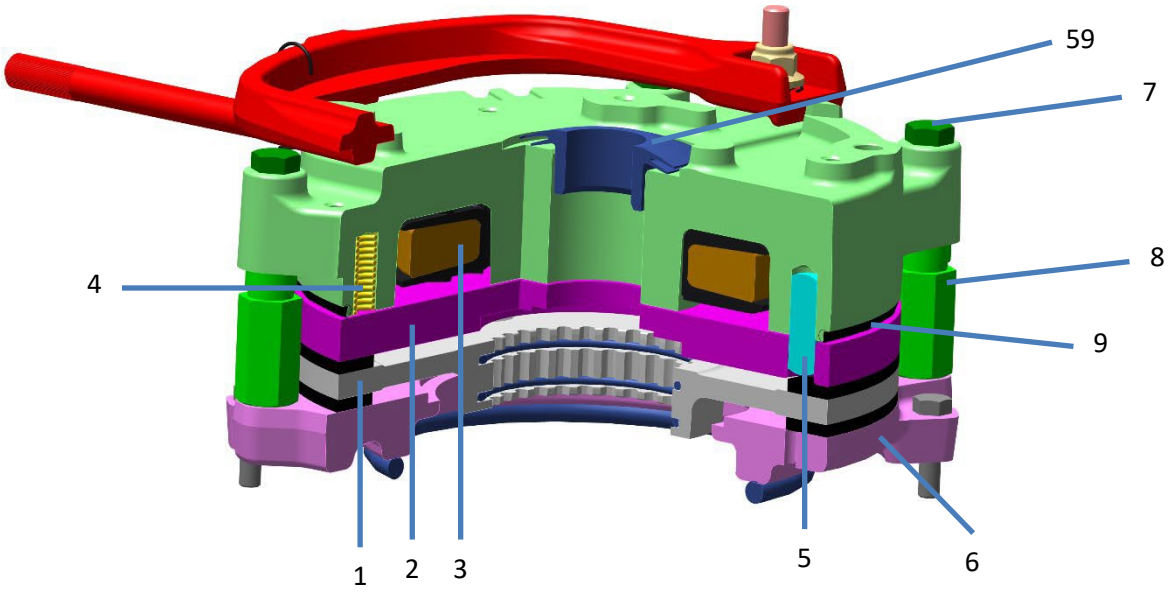
Dismantling:

- Remove the upper circlip (54) locking the fan (52) in the axial direction.
- Extract the fan (52), levering with two screwdrivers.
- Remove the lower circlip (55).

Refitting:

- Install the lower circlip (55).
- Install the fan (52).
- Install the upper circlip (54).

5.9. Replacing the brake disc

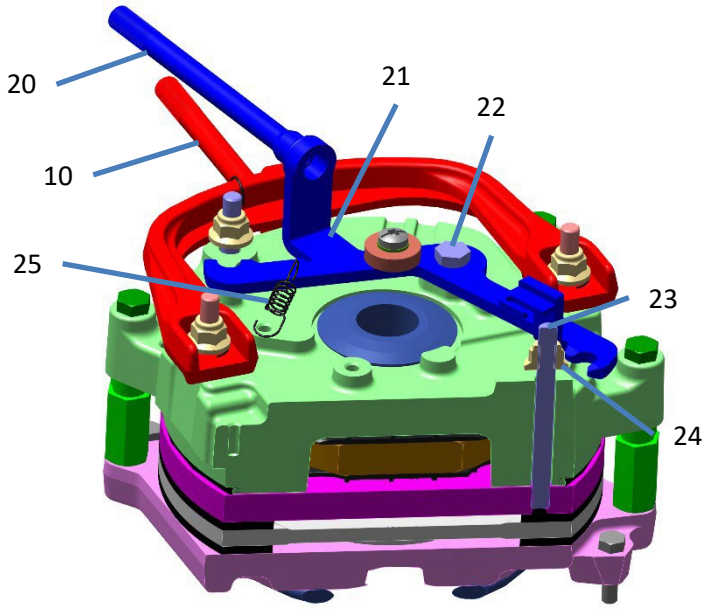


Danger: Take all the necessary precautions concerning the loads held by the brake.

Proceed as follows to replace the brake disc:

- Remove the fan. Follow the procedure of §5.8 depending on the way the fan is fixed.
- Remove the encoder (60) (if fitted), or the pulse disc (86) used by the inductive sensor (if fitted) to measure the speed.
- Remove the seal (59).
- Unlock the adjustment spacers (8), and move them closer to the yoke (3).
- Unscrew and remove the fixing screws (7).
- Remove the brake unit thus released and position it near the motor (pay attention to the length of the wires).
- Remove the brake disc (1).
- Clean the various brake parts to remove the excess dust.
- Install a new brake disc (1), with the large hub shoulder on the motor side.
- Position the brake unit, mobile armature (2) in contact with the brake disc (1), so as to return to the initial position (brake release lever direction).
- Install the fixing screws (7) and carry out the procedure for adjusting the brake air gap (§5.1.6).
- Position the seal (59).
- Reinstall the encoder (if necessary), or the pulse disc (86) used by the inductive sensor (if necessary) to measure the speed.
- Refit the fan. Follow the procedure of §5.8 depending on the way the fan is fixed.

5.10. Replacing the lock



In all cases, it may be necessary to remove the fan in order to access the DLM pivot pin (22). To do this, unscrew the fan mounting screw and remove the fan + sleeve + mounting screw assembly.
After the operation, refit the fan + sleeve + mounting screw assembly and tighten the screw to torque (3 Nm +/- 10%).

5.10.1. DLM system:

Before the operation, the DLM system must be in the rest position.

- Remove the DLM return spring (25).
- Unscrew the DLM pivot pin (22).
- Remove the lock (21) and replace it by the new part.
- Screw the DLM pivot pin (22) and tighten to torque according to the following table:

Brake size	Tightening torque of the DLM pivot pin (22)
FFB1, FFB2, FFB3	5.75 Nm (+/- 10%)
FFB4, FFB5	9.9 Nm (+/- 10%)

- Reposition the DLM return spring (25).

Check the adjustment of the DLM system (§5.4).

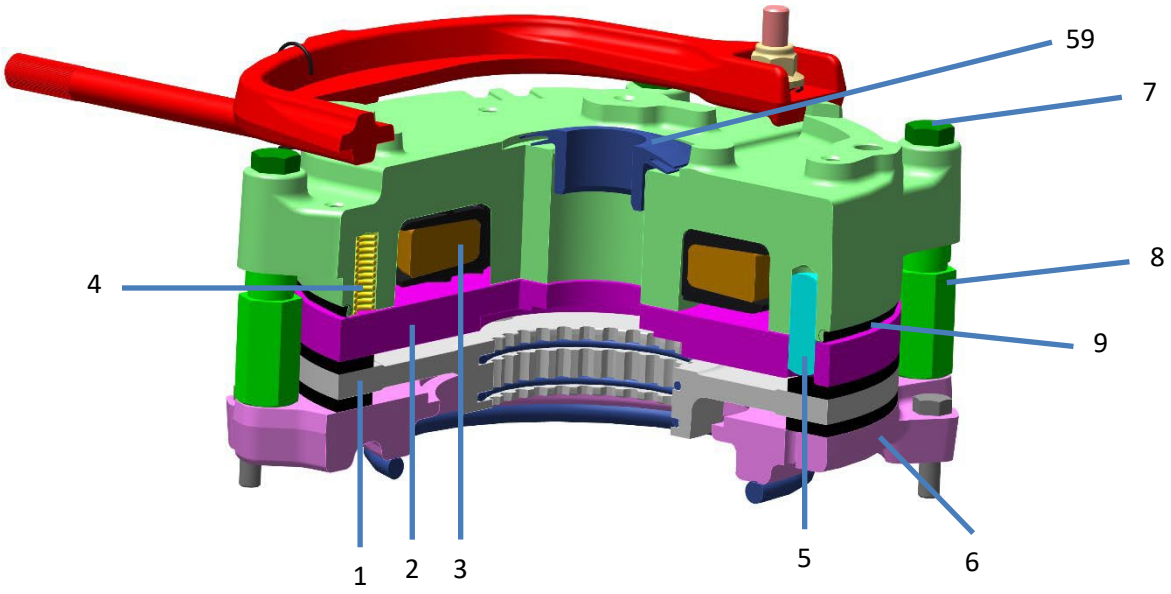
5.10.2. DMD system:

Before the operation, the DMD system must be in the rest position.

- Unscrew the DLM pivot pin (22).
- Remove the lock (21) from the core of the weathervaning coil (30).
- Position the new lock (21), by inserting its fork into the axis of the core of the weathervaning coil (30).
- Screw the DLM pivot pin (22) and tighten to torque according to the table of §5.10.1.

Check the adjustment of the DMD contact according to §5.5.

5.11. Replacing the yoke



Danger: Take all the necessary precautions concerning the loads held by the brake.

This procedure allows you to access all the brake parts. If necessary, take the opportunity to replace any worn parts.

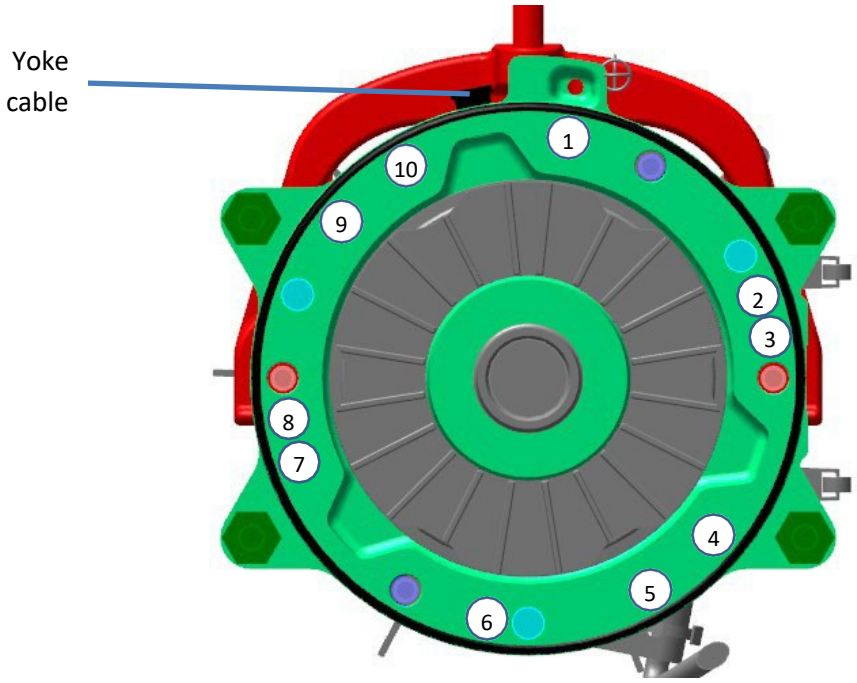
Proceed as follows to replace the yoke only:

- Remove the fan. Follow the procedure of §5.8 depending on the way the fan is fixed.
- Remove the encoder (60) (if fitted), or the pulse disc (86) used by the inductive sensor (if fitted) to measure the speed.
- Remove the inductive sensor support (82) + inductive sensor (80) assembly (if fitted).
- Remove the DLRA brake release system (remove the spring (12), nuts (14), springs (15) and caliper (11)).
- Remove the DMD system (if fitted): remove the weathervaning coil (30) + DMD return spring (31) assembly, then the weathervaning contact (32).
- Remove the DLM system (if fitted): remove the DLM return spring (25) if fitted, the DLM pivot pin (22), the lock (21), and the DLM flanged self-locking nuts (24).
- Remove the DLMA system (if fitted): remove the DLMA pivot pin (29) and the DLM flanged self-locking nuts (24).
- Remove the brake release contact (70) (if fitted).
- Remove the seal (59).
- Disconnect the electric cable from the yoke (2) in the motor terminal box.
- Unlock the adjustment spacers (8), and move them closer to the yoke (3).
- Unscrew and remove the fixing screws (7).

The yoke (3), the springs (4), the O-ring (9) and the mobile armature (2) are now free. Be careful not to drop any of these parts.

- Identify the position of the yoke with respect to the motor, using the position of the yoke electrical cable.

- Remove the yoke (3) + springs (4) + O-ring (9) + mobile armature (2) assembly, and place it with the yoke side on the ground to keep the position of the springs in the yoke.
- Remove the mobile armature (2) and the O-ring (9).
- Replace the yoke (3).
- Remove the adjustment spacers (8) from the old yoke. Screw the spacers sufficiently on the new yoke.
- Position the springs (4) in the new yoke. The position of the springs in the yoke must respect the following correspondence table:



	Spring location									
Number of springs	1	2	3	4	5	6	7	8	9	10
3	X			X			X			
4		X			X		X			X
5		X			X	X			X	X
6	X	X		X		X	X		X	
7		X	X		X	X		X	X	X
8	X	X	X		X	X	X	X		X

- Position the O-ring (9). Replace it if necessary.
- Assemble the mobile armature (2) on the yoke. Check that the holes in the armature are aligned with the safety pins (5) and the various accessories (DLRA, DLM, DLMA, DMD, or brake contact).
- Position the assembly on the motor, in the initial position, previously identified.
- Install the fixing screws (7). Check that the O-ring (9) is in the correct position.
- Adjust the air gap according to the procedure described in §5.2.
- Connect the yoke electrical cable.
- Position the seal (59). Replace it if necessary.
- Install the brake release contact (70) and adjust it according to the procedure described in §5.6 (if fitted).
- Install the DLM / DLMA system (if fitted). Do not tighten the nuts (24) fully.
- Install the DMD system (if fitted).

- Install the DLRA brake release system.
- Adjust the DLRA system according to the procedure described in §5.3.
- Adjust the DLM / DLMA / DMD system (if fitted) according to the procedure described in §5.4.
- Adjust the DMD system contact (if fitted) according to the procedure described in §5.5.
- Install the inductive sensor support (82) + inductive sensor (80) assembly (if fitted).
- Install the pulse disc (86) used by the inductive sensor (if fitted) to measure the speed. Adjust the inductive sensor according to the procedure described in §5.7.
- Install the encoder (60) (if fitted), according to the procedure described in §6.2.
- Reposition the fan according to the procedure described in §5.8.
- Position the brake cover. Check that there is no interference with the brake release levers (10) and (20). If necessary, adjust the cover trap door according to the procedure described in §5.2.

6. Manitowoc accessories

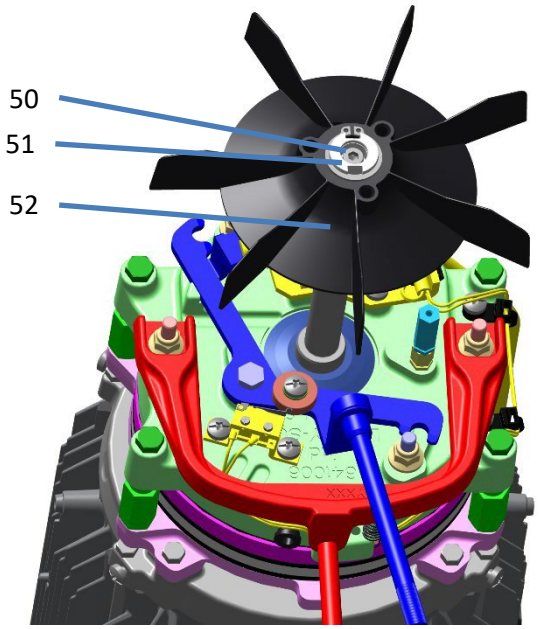
6.1. Slewing mechanism crank

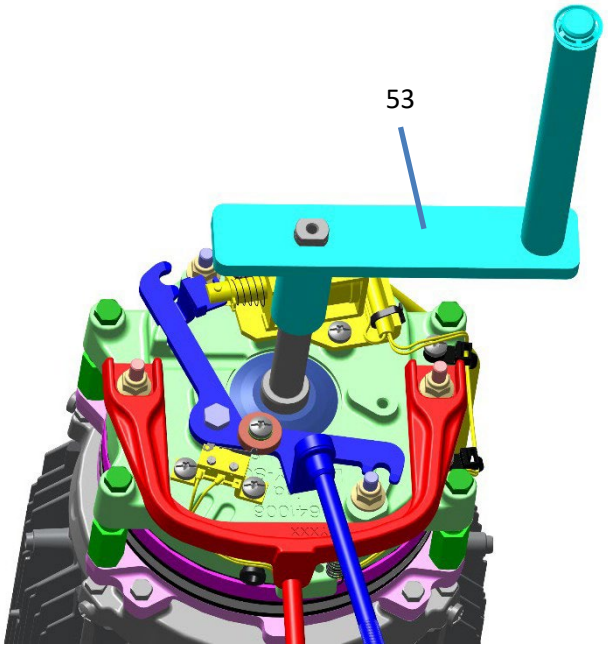
Slewing motors equipped with FFB brakes, for the GME range, can be fitted with a crank on the second end of the shaft.
This crank can be used to slew the crane if there is no electrical power or in case of a technical problem.

The code of the crank compatible with the FFB brake is: **84060979**.

6.1.1. Use procedure

It is preferable to use the crank on a motor not equipped with an encoder.





50: mounting screw

51: sleeve

52 : fan

53 : crank

Installing the crank:

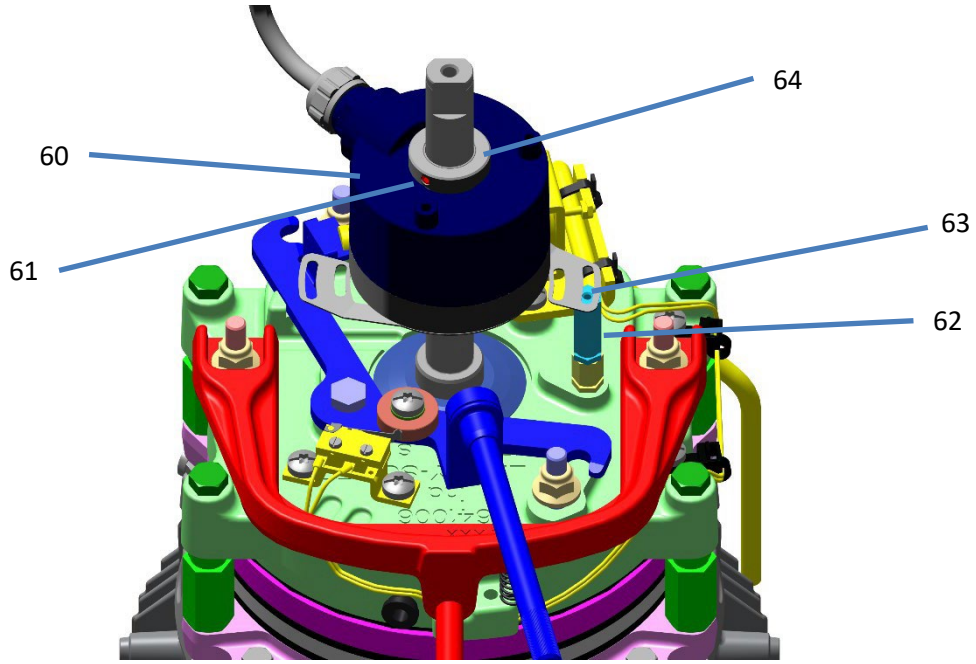
- Remove the fan according to the procedure described in §5.8.1.
- Insert the crank (53) along the motor shaft, until the end of the motor shaft fits into the end of the crank (53).
- Release all the slewing brakes installed on the crane, using the DLM system of each brake (see §4.3).
- The crank can be used to slew the crane.

Dismantling the crank:

- Reactivate all the slewing brakes installed on the crane, using the DLRA system of each brake (see §4.3.4).
- Remove the crank (53) from the motor shaft.
- Refit the fan according to the procedure described in §5.8.1.

6.2. Slewing encoder

The slewing encoder can be installed on the end of a second shaft of a motor equipped with an FFB brake.



60 : slewing encoder

61 : radial locking set screw

62: encoder support spacer

63: encoder rotation locking screw

64: encoder clamping ring

The procedure for installing the encoder is as follows:

- Remove the fan according to the procedure described in §5.8.1.
- Slide the encoder along the motor shaft.
- Lock the encoder axially using the encoder rotation locking screw (63) on the encoder support spacer (62).
- If necessary, install the encoder clamping ring (64) on the hollow shaft of the encoder. There must be a slight air gap between the encoder clamping ring (64) and the encoder body.
- Tighten the encoder rotation locking screw (63) to torque according to the following table:

Brake size	Tightening torque of the encoder rotation locking screw (63)
FFB1, FFB2, FFB3, FFB4, FFB5	0.8 Nm (+/- 10%)

- Tighten the 2 radial locking set screws (61) of the encoder to torque according to the following table:

Brake size	Tightening torque of radial locking set screw (61)
FFB1, FFB2, FFB3, FFB4, FFB5	2 Nm maximum

- Refit the fan according to the procedure described in §5.8.1.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