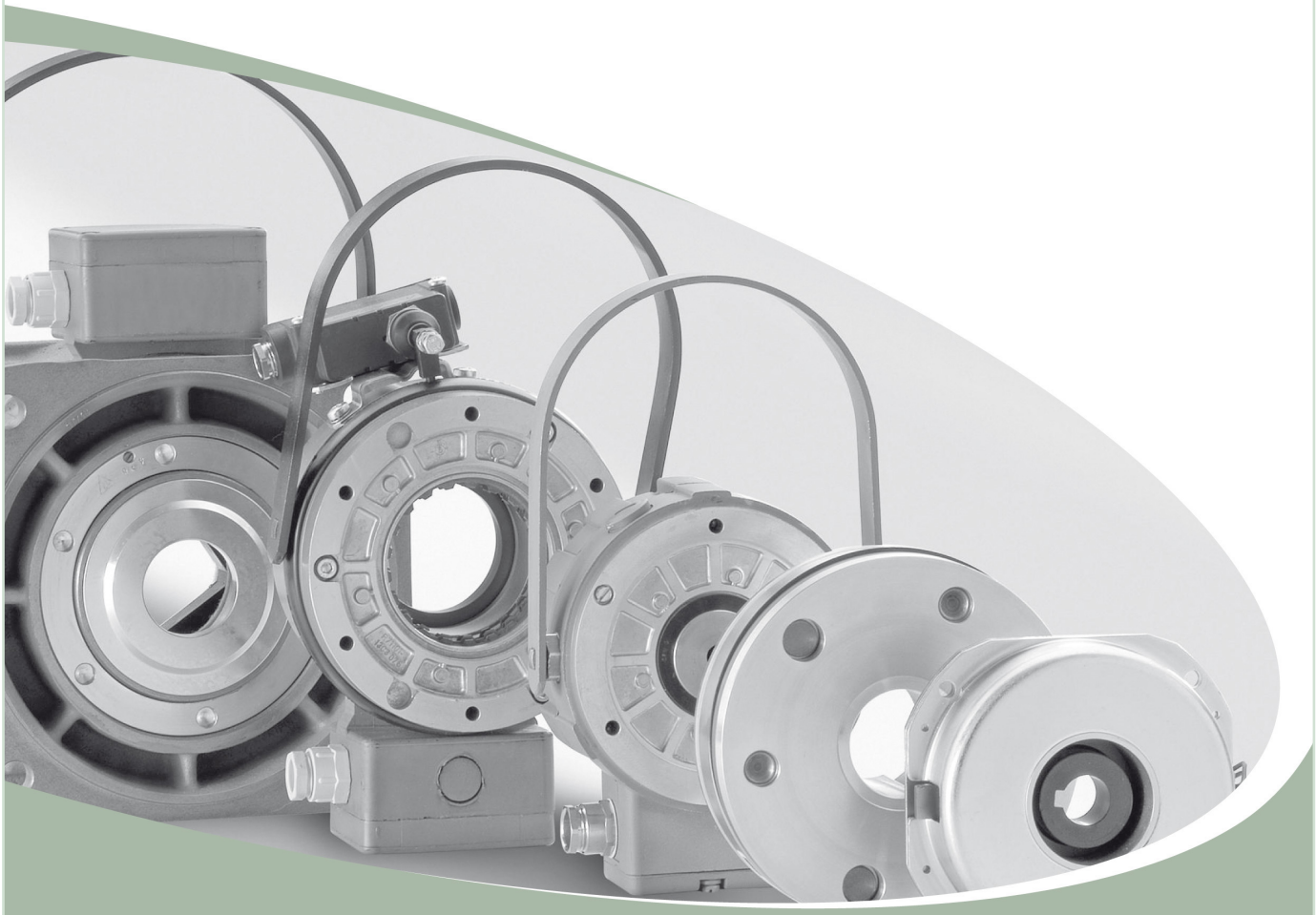
KENDRION

INDUSTRIAL DRIVE SYSTEMS



ACTIVE CLUTCH LINE

Operating Instructions 86 011..E00

Electromagnetic single-face clutch

Types:

86 01103E00	86 01104E00	86 01106E00
86 01107E00	86 01109E00	86 01111E00
86 01114E00	86 01117E00	86 01121E00

BINDER

Contents

Issued by: Kendrion Binder Magnete GmbH
Industrial Drive Systems
Replaces the issue dated: -
Translation of original German operating instructions issue dated: 30 December 2009

1. General

1.1 Introduction

These operating instructions describe the operating principle and features of the 86 011..E00 series of Kendrion electromagnetic single-face clutches. The safety information provided in this manual must be strictly observed during the set-up of the machine (e.g. motor) and during the start-up, operation and maintenance of the electromagnetic single-face clutch. Should any queries arise with respect to torques, torque variations, installation position, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion and ask for clarification before starting to use the clutch. Kendrion electromagnetic single-face clutches in the 86 011..E00 series are not ready-to-use devices, but are intended to be incorporated into or assembled with other equipment. Consequently, they will be referred to as components in the following sections.

1.2 Standards and directives

The state-of-the-art clutches have been designed, built and tested in accordance with the requirements of DIN VDE 0580 concerning electromagnetic devices and components. Being classified as “electromagnetic components”, electromagnetic single-face clutches are not subject to the Low Voltage Directive and must not bear a CE mark of conformity. The user is required to employ suitable switching devices and controls to ensure use of the clutches in accordance with EMC Directive 2004/108/EC.

1.3 Declaration of Incorporation (in accordance with Annex II, part 1, Section B of Machinery Directive 2006/42/EC)

We hereby declare that the products below comply with the essential health and safety requirements specified in Annex I of Machinery Directive 2006/42/EC:

Annex I General Principles, Annex I Sections 1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.5.1

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC. The relevant technical documentation required for the partly completed machinery has been compiled in accordance with Annex VII, part B of Machinery Directive 2006/42/EC. The manufacturer undertakes to submit an electronic copy of the relevant technical documentation compiled for the partly completed machinery if reasonably requested by national authorities.

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Standards and regulations:

EN 60529	Enclosure protection ratings
DIN VDE 0580	Electromagnetic devices and components

Products: Electromagnetic single-face clutch

86 01103E00	86 01109E00	86 01121E00
86 01104E00	86 01111E00	
86 01106E00	86 01114E00	
86 01107E00	86 01117E00	

Kendrion Binder Magnete GmbH
Industrial Drive Systems

Villingen, 30 Dec. 2009 by proxy. Matthias Dannemann

Dr. Matthias Dannemann
(Head of Development at IDS)

1.4 Manufacturer's liability

The manufacturer will not assume any responsibility for damage caused by failure to use the products in accordance with their intended use or by failure to observe safety information and other instructions provided in this manual. The information in this manual was correct and up-to-date before going to print. The information contained herein shall not entitle users to raise claims with respect to components purchased at an earlier date.

2. Product description

2.1 Operating principle

The electromagnetic single-face clutch for front-end mounting is designed to operate dry. The force generated by an electromagnetic field is utilized for torque transmission. The electromagnetic single-face clutch engages when DC voltage is applied. The clutch releases (opens) in unpowered condition when DC voltage is removed. The zero backlash connection between the armature and flange hub of the clutch (output side) ensures zero backlash transmission of the clutch torque to the output shaft of the machine and reliable disconnection of the single-face clutch with zero residual torque.

2.2 Clutch design

The solenoid housing (1.1) of the electromagnetic single-face clutch accommodates the firmly fitted field coil (1.2) with wire leads (1.3) that exit on the rear side of the clutch. The magnet body (2) with the front-side friction lining (3) is firmly connected with the drive shaft (12) of the machine (e.g. motor). The solenoid housing (1.1) is fitted to the front face of the clutch and centred. Sufficient clearance is provided between the rotating magnet body (2) and the solenoid housing (1.1) so that the components will not rub against each other. Depending on the specific clutch design, the armature (4) is mounted to the Kendrion flange hub (5) provided or to a customer-specific flange hub version and thus connected directly to the output side of the machine by means of segment springs (7) and rivet fasteners (6) or socket head cap screws (6)[2)] (if armature systems without Kendrion flange hub (5) are used). The armature connection thus established is axially movable, torsion-proof and friction-free. This ensures zero residual torque during horizontal or vertical clutch operation. The rated air gap 's' between the armature (4) and magnet body (2) of the electromagnetic single-face clutch is adjusted during clutch mounting (e.g. through mounting tolerances).

The electromagnetic field force generated when DC voltage is applied to the field coil (1.2) of the electromagnetic single-face clutch attracts the armature (4) and pulls it in frictional contact with the friction lining (3) or magnet body (2), causing the clutch to engage. Except for the minimal force exerted by the segment springs (7), the output shaft (13) and drive shaft (12) are not exposed to any other axial force.

Key to Fig. 5/1:

1.1	Solenoid housing	7	Segment spring
1.2	Field coil	8	Set screw
1.3	Wire leads	9	Rating plate
2	Magnet body	10	Mounting screws
3	Friction lining	11	Fixture for solenoid housing (1.1)
4	Armature	12	Drive shaft
5	Flange hub [1)]	13	Output shaft
6	Rivet fastener [2)], socket head cap screw	14	Feather key

[1)] Clutches with armature systems equipped with Kendrion flange hub (5) or customer-specific flange hub version

[2)] Only in armature systems equipped with Kendrion flange hub (5); rivet fasteners (6) for fixing the segment spring (7) on the armature (4) plus rivet fasteners (6) for fixing the segment spring (7) to the Kendrion flange hub (5). If a customer-specific flange hub version is used, the segment spring (7) is fixed to the flange hub by means of socket head cap screws (6).

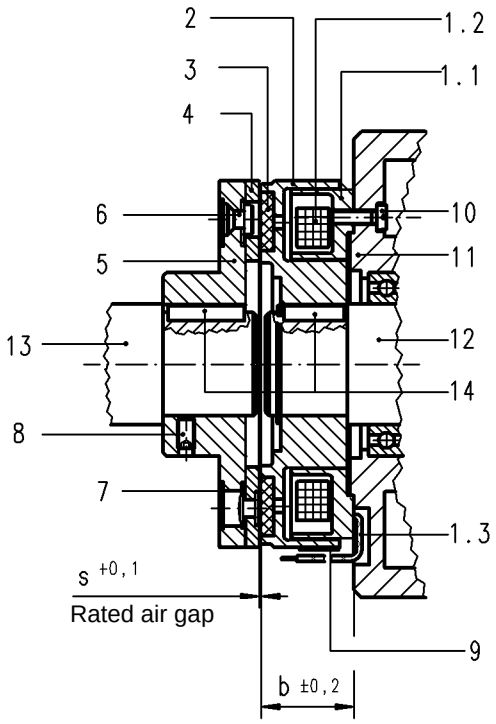


Fig. 5/1: Electromagnetic single-face clutch 86 011..E00 with flange hub (5)

3. Installation

3.1 Mechanical installation

After having centred the solenoid housing (1.1) with the fixture (11) of the machine (e.g. motor) over the inside or outside housing diameter, screw the entire assembly (without magnet body (2)) to the rear side of the mounting surface of the fixture (11) provided on the machine (e.g. motor). Use the mounting screws (10) (e.g. socket head cap screws to ISO 1207, property class 5.8) for this purpose. Tighten the mounting screws (10) evenly in several steps. The M_A tightening torques (see Table 8/1) specified for the mounting screws (10) and the thread lengths (see Table 8/1) must be strictly observed. After completion of these operations, press the magnet body (2) onto the drive shaft (12) of the machine and secure it axially. The drive shaft (12) features a feather key (14). For uniform loads, the drive shaft should have a j6 tolerance, whereas a k6 tolerance is required for irregular loads. The maximum mismatch (see Table 8/1) between the solenoid housing (1.1) and magnet body (2) must not be exceeded.

Armature system with Kendrion flange hub (5):

Slide the flange hub (5) with the armature (4) onto the output shaft (13) of the machine and secure it axially (e.g. by means of a set screw (8)). If a flange hub (5) without keyway is used, press the flange hub (5) onto the output shaft (13) without using a set screw (8). Ensure that the output shaft (13) of the machine is dimensioned in such a way that the rated air gap 's' (see Table 23/1 “Technical specifications”) is achieved automatically when the flange hub (5) is mounted (e.g. output shaft (13) with contact shoulder for flange hub (5)). If there is no contact shoulder, use a feeler gauge or similar instrument for the axial adjustment of the rated air gap 's' (see Table 23/1 “Technical specifications”).

Note!

When the flange hub (5) is in contact with a shaft contact shoulder, use shim rings for adjustment, if necessary.

Armature system without Kendrion flange hub (5) (customer-specific flange hub (5)):

Screw the armature (4) directly to the customer-specific flange hub (5) provided on the machine. Use socket head cap screws (6) to ISO 1207, property class 5.8, for this purpose. For size 07 clutches and over, use socket head cap screws (6) to DIN 7984, property class 8.8. The number of socket head cap screws (6) to be used and the M_A tightening torques are specified in Table 7/1. Apply Loctite 241 to the socket head cap screws (6). Ensure that the customer-specific flange hub (5) of the machine is dimensioned in such a way that correct operation of the armature system is achieved when the armature (4) has been installed. To this end, the customer-specific flange hub (5) must be provided with an undercut, clearing holes and fastening threads as shown in Fig. 6/1. The geometrical dimensions of the customer-specific flange hub (5) are specified in Table 7/1. Ensure that the output shaft (13) of the machine is dimensioned in such a way that the rated air gap 's' (see Table 23/1 “Technical specifications”) is achieved automatically when the customer-specific flange hub (5) is mounted (e.g. output shaft (13) with contact shoulder for flange hub (5)). If there is no contact shoulder, use a feeler gauge or similar instrument for the axial adjustment of the rated air gap 's' (see Table 23/1 “Technical specifications”).

Note!

When the flange hub (5) is in contact with a shaft contact shoulder, use shim rings for adjustment, if necessary.

Note!

If an armature system without Kendrion flange hub (5) is used, make sure to apply Loctite 241 to the socket head cap screws (6) used to fix the armature (4). The depth of the undercut provided for the segment springs (7) must be strictly observed to ensure that the return force required by the segment springs (7) is achieved.

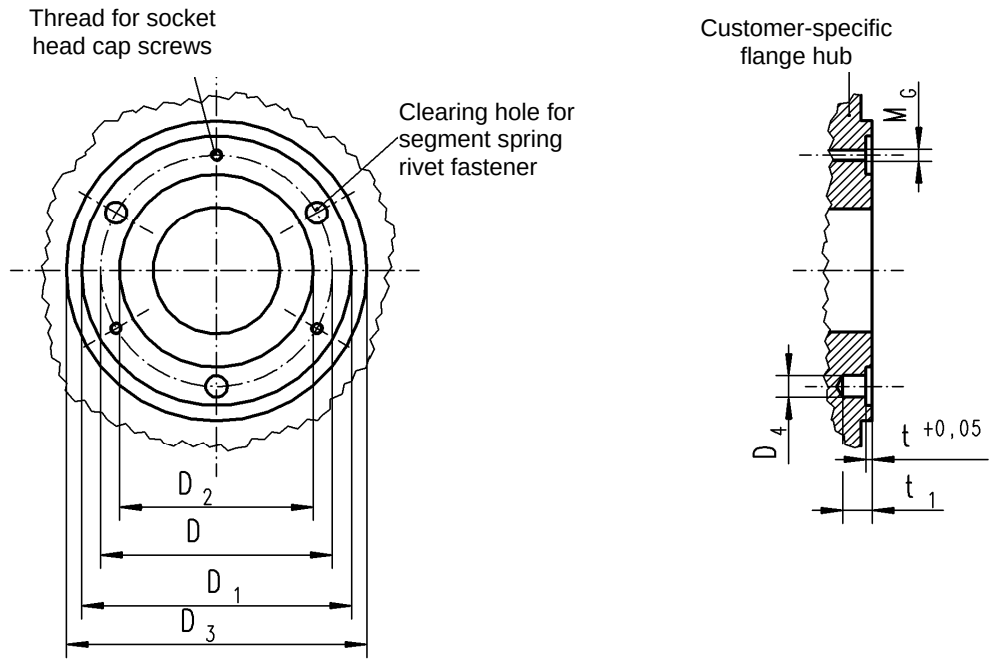


Fig. 6/1: Customer-specific flange hub (5) design

	Size								
	03	04	06	07	09	11	14	17	21
Depth $t^{+0.05}$ of undercut [mm]	0.75	1.3	1	1.2	1.3	1.6	2.3	2.5	2.5
Outside diameter D_1 of undercut [mm]	26	37	54	68	88	108	136	161	186
Inside diameter D_2 of undercut [mm]	11	16	35	46	60	78	98	104	134
Min. diameter D_3 for armature (4) [mm]	28	39.5	56	70	90	110	140	170	202
Depth t_1 of clearing hole for rivet fastener (6) [mm]	2.2	2.2	2.8	2.8	4	5	6	6	7
Diameter D_4 of clearing hole for rivet fastener (6) [mm]	5	7	7	8.5	10.5	12	16	16	18
Number of clearing holes for rivet fastener (6)	2x180°	2x180°	3x120°	3x120°	3x120°	3x120°	3x120°	3x120°	3x120°
Pitch circle diameter D [mm]	19.5	29	46	60	76	95	120	135	158
Thread of socket head cap screws (6) M_G	M2	M3	M3	M4	M5	M6	M8	M8	M10
Number of socket head cap screws (6)	2	2	3	3	3	3	3	3	3
M_A tightening torque of socket head cap screws (6) [Nm]	0.23	0.9	0.9	3.3	6.5	11	27	27	53

Table 7/1: Customer-specific flange hub (5) design specifications for armature systems without Kendrion flange hub (5): thread size, number of socket head cap screws (6), M_A tightening torques of socket head cap screws (6)

Note!

The air gap must not be larger or smaller than the rated air gap 's' (see Table 23/1 “Technical specifications”). The assembled components, especially the friction surface, must be free of oil and grease. The axial runout of the mounting surface relative to the drive shaft (12) must be less than 0.1 mm (measuring radius = pitch circle). During clutch installation, all parts must be axially secured and axial bearing play must be eliminated. During installation of the Kendrion or customer-specific flange hub (5) with armature (4), deformation of the segment springs (7) must be avoided.

Warning!

If a flange hub (5) without keyway is used, the output shaft (13) and flange hub (5) must be fitted together in such a way that reliable transmission of the generated clutch torques is ensured.

Attention!

The maximum axial offset between the drive shaft (12) and output shaft (13) must not exceed 0.05 mm. The maximum angular offset must not exceed 10 angular minutes. If greater deviations occur, an additional flexible coupling or compensating coupling will be required.

Note!

When the magnet body (2) is pressed in place, ensure that the pressure force is not transmitted to the magnet body (2) via the outer pole ring. Any impact of the magnet body (2) must be avoided to prevent potential deformation of the friction surfaces and damage to the machine bearings.

		Size								
		03	04	06	07	09	11	14	17	21
Max. mismatch	[mm]	0.04	0.04	0.04	0.04	0.04	0.08	0.08	0.08	0.08
Thread length	[mm]	3	3	4	5	5	6	8	8	8
Mounting height b±0.2 of magnet body (2)	[mm]	15	17.5	19	23	24.5	28	33.5	42.5	43
M_A tightening torque of mounting screws (10)	[Nm]	0.23	0.23	0.9	0.9	0.9	2	4	7	16

Table 8/1: Max. mismatch between magnet body (2) and solenoid housing (1.1); mounting height b of magnet body (2); M_A tightening torques; maximum possible thread length of mounting screws (10)

Attention!

The M_A tightening torques specified for the mounting screws (10) (see Table 8/1) and socket head cap screws (6) (see Table 7/1 for customer-specific flange hub (5)) must be strictly observed. Tighten the mounting screws (10) and socket head cap screws (6) evenly in several steps.

Note!

Magnetic interference fields may affect reliable clutch operation. Consequently, the clutch should always be installed outside the reach of magnetic interference fields.

3.2 Electrical connection and operation

The electromagnetic single-face clutch must be connected to a DC power source via the wire leads (1.3). Various rectifier versions are available (see examples in Table 9/1) to allow the clutch to be connected directly to an AC power source. Depending on the clutch size and torque, voltage ripple due to intermittent power supply may cause humming or incorrect operation. Perfect operation must be ensured by the user or system manufacturer by providing suitable electrical controls.

Note!

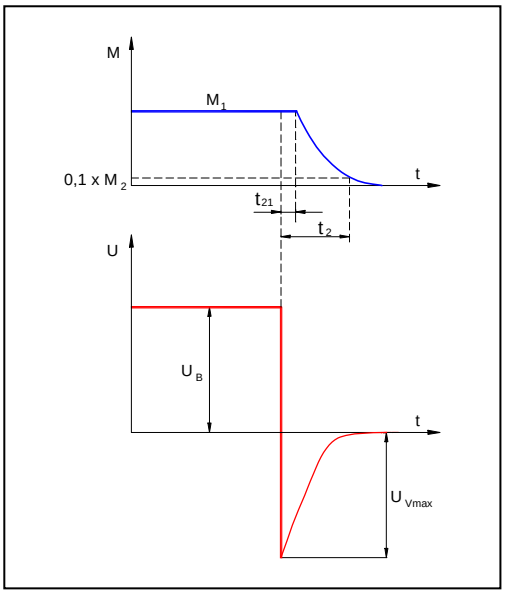
During operation, any contact of the wire leads (1.3) with the rotating armature or other rotating parts must be avoided. Reduce the lead length, if necessary.

Rectifier series	Rectifier type	Rated input voltage range U_1/VAC (40-60 Hz)	Output voltage U_2/VDC	Max. output current R-load I/ADC	Max. output current L-load I/ADC
32 07.03B0.	bridge	0 – 500 (±10%)	U_1 • 0.890	1.6	2.0
32 07.23B.0	bridge	0 – 400 (±10%)	U_1 • 0.890	1.6	2.0
The relevant rectifier specification sheets must be observed!					

Table 9/1: Recommended rectifiers for single-phase AC voltage supply

3.2.1 DC power supply

The figure to the right shows the voltage curve after the field coil (1.2) has been de-energized.



U_B operating voltage (coil voltage)
U_{Vmax} disconnection voltage

Attention!

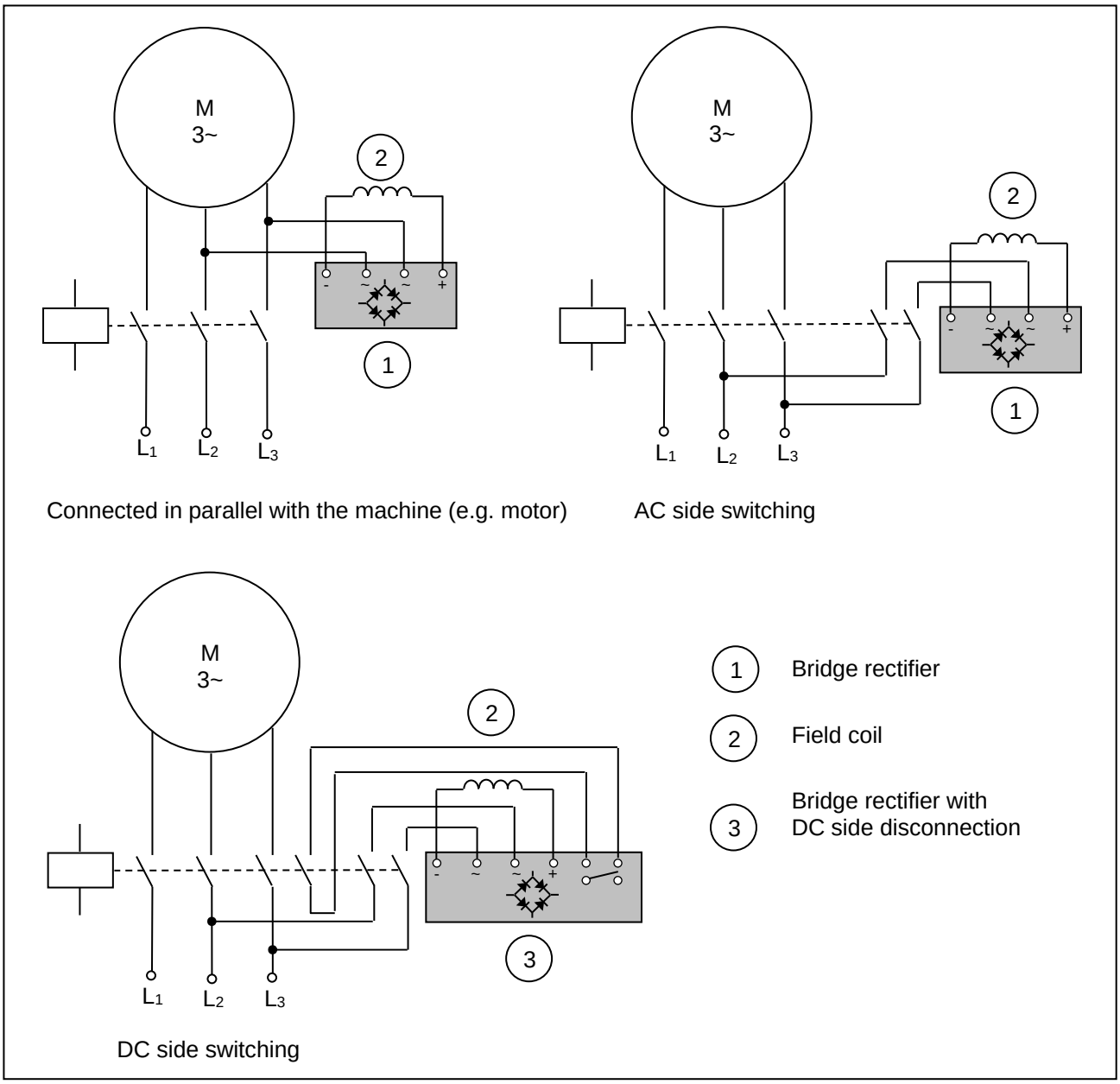
The peak voltage U_{Vmax} during disconnection without protective circuit may reach **several thousand volts** in the millisecond region. This may cause irreversible damage to the field coil (1.2), switching contacts and electronic components. Sparking will occur on the switch during disconnection. Consequently, a protective circuit must be provided to reduce the current during disconnection and to limit the voltage. The maximum permitted overvoltage during disconnection is 1500 V. If Kendrion rectifiers are used (see Table 9/1), the protective circuit required for the built-in electronic components and field coil (1.2) is included in the rectifier. This does not apply to the external contacts required for DC side switching as there would be no galvanic isolation of the external contact.

Attention!

Sensitive electronic components (e.g. logical components) may also be damaged by the lower voltage.

3.2.2 AC power supply

Direct clutch connection to an AC power source is only possible if a rectifier is used. Wiring of the clutch in case of single-phase AC power supply must be performed in the same way as with three-phase voltage. The coupling times vary depending on the switching type (DC side switching or AC side switching).



Bridge rectification:

Bridge rectifiers provide voltage with minimum residual ripple. This means that humming can be avoided even if small size clutches are used. In case of bridge rectification, the U_2 coil voltage is lower by factor 0.89 than the rectifier input voltage.

AC side switching:

The easiest wiring method is to connect the rectifier in parallel with the clutch in the terminal box of the machine (e.g. motor). It must be considered, however, that the motor may act as a generator after AC voltage has been removed and thus extend the coupling time significantly (by factor 5 or over). The disconnection times remain unchanged.

DC side switching:

In case of DC side clutch switching, an auxiliary contact is provided on the motor contactor, for example. This auxiliary contact is designed to interrupt the power supply on the DC side.

Attention!

In case of DC side switching, the clutch must be provided with a protective circuit to avoid overvoltage. Additional protective elements (e.g. varistors, spark arresters, etc.) must be installed to avoid damage such as burns or fusing of contacts.

Warning!

Work on the clutch must only be carried out by suitably qualified personnel. Make sure that no voltage is applied during clutch connection. The specifications on the rating plate and the information provided in the circuit diagram in the terminal box or in the operating instructions must be strictly observed.

Warning!

The clutch is a DC operated system. Permanent voltage variations on the power source of the electromagnetic clutch must be limited to +/-10% of the rated voltage.

The following checks must be carried out when connecting the clutch:

- Check that the connecting cables are suitable for the intended use and for the voltage and amperage of the clutch.
- Check that the connecting cables are secured with screws, clamps or other suitable fixtures to avoid interruptions in the power supply.
- Check that the connecting cables are long enough for the intended use and that suitable torsion, strain and shear relief features as well as bending protections are provided.
- Check that the PE conductor (only for protection class I) is connected to the earthing point.
- Check that no foreign matter, dirt or humidity is trapped inside the terminal box.
- Check that unused cable entries and the terminal box are suitably sealed to ensure compliance with the protection class requirements to EN 60529.

3.3 Electromagnetic compatibility

As required by the German Electromagnetic Compatibility Act (EMVG), electromagnetic compatibility is essential to ensure immunity to external electromagnetic fields and conducted interference. Furthermore, the emission of electromagnetic fields and line-conducted interference during clutch operation must be minimized. Since the clutch features depend on the circuitry and operation, a declaration of conformity with the applicable EMC standard can only be furnished for the wiring type, but not for a specific clutch. The electromagnetic single-face clutch type 86 011..E00 is designed for industrial applications to which the following EMC standards apply: Generic Immunity Standard EN 61000-6-2 and Generic Emission Standard EN 61000-6-3 / EN 61000-6-4. Other applications may be subject to different generic standards which must be considered by the manufacturer of the overall system. The requirements in terms of electromagnetic compatibility of devices and components are determined by basic standards derived from the generic standards. Wiring recommendations will be provided in the following sections to ensure compliance with the individual basic standards that are relevant for industrial use and other applications. Please refer to the specification sheets for additional information on electromagnetic compatibility, especially with respect to the recommended electronic rectifiers specified in Section 3.2.

Immunity according to EN 61000-4:

EN 61000-4-2 Electrostatic discharge:
The electromagnetic single-face clutches in the 86 011..E00 series comply at least with severity level 3 without requiring additional measures. The recommended rectifiers specified in Section 3.2 conform to severity level 3 without additional measures.

EN 61000-4-3 Electromagnetic fields:
The clutches comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3 without additional measures.

EN 61000-4-4 Fast transients (burst):
The clutches comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-5 Surge:
The clutches comply at least with severity level 3 without requiring additional measures. The recommended rectifiers conform to severity level 3.

EN 61000-4-9 Pulse magnetic fields, EN 61000-4-10 Damped oscillatory magnetic fields:
Since the operating magnetic fields of the electromagnetic clutches are stronger many times over than interference fields, the clutch function will remain unaffected. The clutches comply at least with severity level 4. The recommended rectifiers conform at least to severity level 3.

EN 61000-4-11 Voltage dips, short interruptions, and short supply voltage variations:

a) Voltage interruptions:
Clutches that comply with the requirements of DIN VDE 0580 are de-energized after the specified switching times at the latest. The switching time depends on the control and mains conditions (e.g. generator effect of running down motors). Voltage interruptions of shorter duration than the response delay specified by DIN VDE 0580 will not cause any malfunctions. The user is required to take adequate precautions to avoid consequential damage (e.g. slip of an electromagnetically engaged system due to torque drop). The functional reliability of the electromagnetic component and its electronic accessories remains unaffected if the aforementioned consequential damage is avoided.

b) Voltage dips and short supply voltage variations:
Electromagnetically released systems:
Voltage dips and supply voltage variations to below 60% of the rated voltage and lasting longer than the response delay specified by DIN VDE 0580 may cause the clutch to be de-energized temporarily. Consequential damage as described under a) above must be avoided by the user by taking adequate precautions.
Electromagnetically engaged systems:
Voltage dips and supply voltage variations to below the minimum tolerance threshold will cause torque reductions. The user is required to take adequate precautions to avoid consequential damage.

Radio interference suppression in accordance with EN 55011:
The clutches and the recommended electronic rectifiers are classified as Group 1 equipment in accordance with EN 55011. As far as the emissions from this equipment are concerned, one distinguishes between field guided radiated interference and line-conducted interference.

a) Radiated interference:
When operated with DC voltage or rectified 50/60 Hz AC voltage, all clutches comply with the limit values applicable to Class B equipment.

b) Conducted interference:
When connected to a DC power source, the electromagnetic clutches meet the limit values applicable to Class A equipment. If the clutches are connected to a 50/60 Hz AC power source and equipped with electronic rectifiers or other electronic controls, interference suppression measures as shown in Fig. 13/1 must be taken to ensure compliance with the limit values applicable to Class A equipment. Interference suppression capacitors should be used which must be dimensioned to suit the connection data of the electromagnetic components and the specific mains conditions. The recommended rectifiers specified in Section 3.2 are CE mark certified in accordance with the EMC Directive. They have built-in interference suppression components and comply at least with the requirements of EN 55011 for Class A equipment, unless otherwise specified in the specification sheet.

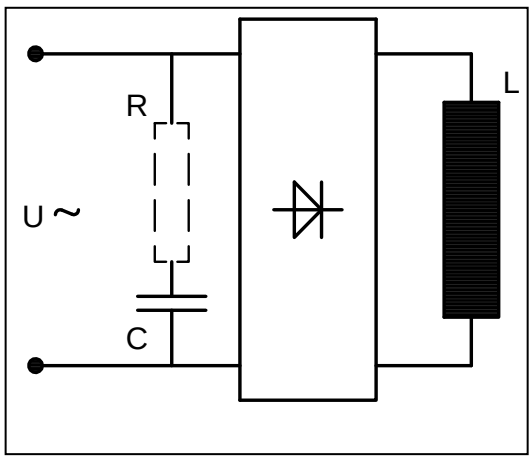


Fig. 13/1

When clutches are used with the specified rectifiers or with other types of rectifiers, the recommended values listed in Table 14/1 should be observed. Interference suppression components should be installed as close as possible to the consumer. Interference caused during switching operations of the electromagnetic component is generally attributable to the inductive load. Where necessary, assemblies designed to limit the disconnection voltage (e.g. anti-parallel diode) or voltage limiting components (e.g. varistors, suppressor diodes, resistance diodes and the like) can be installed. However, such components will inevitably change the switching times of the clutch and increase the generated noise level. The rectifiers specified in Section 3.2 are equipped with free-wheel diodes and/or varistors to limit the disconnection voltage. In case of DC side switching, a varistor rated for the type-specific maximum operating voltage and connected in parallel with the field coil (1.2) limits the peak voltage to the values specified in Table 14/2.

If the clutch is used in connection with other electronic accessories, the user is responsible to ensure compliance with EMC requirements. Compliance with applicable standards concerning the design and operation of components, sub-assemblies or equipment employed shall not relieve the user and manufacturer of the overall system from their obligation to furnish proof of conformity of the overall system with such standards.

Rectifier series	Rated input voltage range U_1/VAC (40-60Hz)	DC at L-load (ADC)	Capacitor nF (VAC)
Bridge rectifier 32 07.23B.0	up to 400 (±10%)	up to 2.0	no additional interference suppression measures required
Bridge rectifier 32 07.03B0.	up to 230 (±10%) up to 500 (±10%)	up to 2.0 up to 2.0	47/250~ 100/500~

Table 14/1

Max. rectifier operating voltage (VAC)	Recommended disconnection voltage for DC side switching (V)
250	700
440	1200
550	1500

Table 14/2

3.4 Set-up and start-up

Warning!

Functional testing of the clutch must not be performed unless the machine (e.g. motor) has been switched off and secured against accidental or unintentional start-up.

The following checks must be carried out:

Check compliance with the specifications provided on the rating plate with respect to the mounting position and protection class. After connection of the clutch, a functional test must be performed to check that the output shaft (13) rotates smoothly. For this purpose, turn the shaft (13) while the clutch and the machine (e.g. motor) are unpowered. After completion of mounting, all necessary covers and guards must be installed.

Warning!

Before starting the machine (e.g. motor) test run without driven components, the feather key (if used) must be secured in such a way that it cannot be hurled out. The output shaft (13) must not be exposed to load torques. Before the machine is re-started, the clutch must be energized.

Caution!

The clutch surface temperature may rise to over 100°C. Heat-sensitive parts such as conventional cables or electronic components must not be fixed to or be in contact with these surfaces. If necessary, suitable protections and hand guards must be installed to avoid accidental contact with hot surfaces! If the shaft needs to be turned during set-up operations while the machine (e.g. motor) is switched off, the clutch must be unpowered and disengaged.

Attention!

High-voltage tests performed during clutch installation within an overall system or during start-up must be carried out in such a way that damage to the built-in electronic accessories is avoided. The limits for high-voltage tests and follow-up tests specified by DIN VDE 0580 must be observed.

Attention!

Check that the clutch has been connected in accordance with the specifications provided on the rating plate before it is put into operation. Even short-term operation outside the specified supply voltage limits may cause irreversible damage to the clutch or electronic accessories. Such damage may not be apparent immediately. DC side clutch switching without protective circuit as described in Section 3.3 will cause damage to electronic rectifiers, electronic accessories, switching contacts and to the field coil (1.2).

4. Maintenance

4.1 Checks and service

The electromagnetic single-face clutch does not require any particular maintenance except that the air gap 's' must be measured at regular intervals. When the maximum air gap s_{max} (see Table 23/1 “Technical specifications”) between the armature (4) and magnet body (2) of the electromagnetic single-face clutch has been reached, the entire clutch must be replaced by a new one. Follow the instructions in Section 3.1 (“Mechanical installation”) to adjust or correct the air gap 's'. (For information on the rated air gap, please refer to Table 23/1 “Technical specifications”. If the clutch is not operated for a long period of time, the pole faces may corrode and reduce the torque. A short break-in process (see Table 23/2) will restore correct and reliable clutch operation.

Note!

Replace the clutch by a new one after the air gap 's' has been adjusted (corrected) twice.

Attention!

The M_A tightening torques specified for the mounting screws (10) (see Table 8/1) and socket head cap screws (6) (see Table 7/1 for customer-specific flange hub (5)) must be strictly observed. Tighten the mounting screws (10) and socket head cap screws (6) evenly in several steps.

Caution!

Depending on its operating condition, engagement of the electromagnetic single-face clutch may no longer be possible when the maximum air gap s_{max} (see Table 23/1 “Technical specifications”) has been exceeded. This may affect the reliability of the clutch system.

Warning!

Whenever inspection and maintenance work is carried out, ensure that

- the machine (e.g. motor) is secured against accidental or unintentional start-up.
- no load torque acts on the shaft.
- the lock provided to prevent accidental start-up of the machine (e.g. motor) is removed after completion of inspection and maintenance work.
- all friction surfaces are free of grease and oil. An oily or greasy friction surface cannot be cleaned.
- no swelling or glazing of the friction lining has occurred.

4.2 Spare parts and accessories

The electromagnetic single-face clutch does not require any maintenance, provided it is used in accordance with its intended use. If defects occur on the clutch or individual components, the entire clutch needs to be replaced. Individual spare parts or accessories are not available for the clutch.

5. Condition at delivery

Upon receipt of the shipment, the clutch must be checked for transit damage before storage. The electromagnetic single-face clutch is delivered ready for mounting. The rated air gap 's' (see Table 23/1 “Technical specifications”) must be adjusted during clutch installation. After the clutch has been mounted, it requires a break-in process using the break-in parameters specified in Table 23/2.

Note!

The coil system of the clutch and the flange hub with armature (if a Kendrion flange hub is used) are factory-adjusted to ensure reliable clutch release (opening). Consequently, individual components cannot be replaced. If the clutch is not installed immediately upon delivery, it must be stored in a dry, dust-free and vibration-proof place.

6. Emissions

6.1 Noise

The electromagnetic single-face clutch produces switching noise during engagement and release. The noise level is determined by the installation conditions, circuitry (e.g. with overexcitation) and air gap. Depending on the mounting position, operating conditions and state of the friction surfaces, audible vibrations (squealing) may be produced during clutch operation.

6.2 Heat

Clutch operation and gradual heating of the field coil cause the temperature of the solenoid housing and magnet body to increase substantially. Under adverse conditions, the surface temperature may rise to well over 100°C.

Caution!

Risk of burns in case of contact with hot surfaces! Suitable covers and hand guards must be installed to provide protection against accidental contact.

7. Troubleshooting

Fault	Cause	Corrective actions
Clutch engagement failure	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if required.
	• No voltage applied to clutch	Check the electrical connection and correct faults, if found.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Damaged rectifier	Check the rectifier and replace it, if necessary.
	• Damaged field coil	Check the resistance of the field coil. Install a new clutch, if necessary.
Delayed clutch engagement	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if required.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
Clutch release failure	• Voltage applied to field coil in unpowered condition too high (residual voltage)	Check whether residual voltage is applied to the field coil and correct faults, if found.
	• Armature plate blocked mechanically due to fusing of armature and magnet body	Separate the armature from the magnet body. Install a new clutch, if necessary.
Delayed clutch release	• Voltage applied to field coil too high	Check the field coil supply voltage and correct faults, if found.
Clutch torque too low	• Air gap too large	Check the air gap and adjust it, if necessary. Install a new clutch, if required.
	• Clutch operating temperature too high	Reduce the clutch switching work / switching power. Cool the clutch, if necessary.
	• Voltage applied to field coil too low	Check the field coil supply voltage and correct faults, if found.
	• Friction lining projects from pole faces	Install a new clutch, if necessary.
	• Friction surface thermally overloaded	Install a new clutch.
	• Oily or greasy friction surfaces	Check the friction surfaces. Install a new clutch, if necessary.

Table 17/1: Possible faults, causes and corrective actions (list not exhaustive)

8. Safety

The clutches described in these operating instructions have been designed and built on the basis of an analysis of hazards and in accordance with the requirements of the applicable harmonized standards and technical specifications. They correspond to the state of the art and provide maximum safety. However, safety hazards can only be avoided if the user of the equipment takes adequate precautions and makes sure that safety instructions are strictly adhered to. It is the duty of the machine owner to plan these measures and to check their implementation.

The machine owner is required to ensure that:

- the clutches are only used in accordance with their intended use (see “Product description” section).
- the clutches are in perfect working order and checked at regular intervals.
- a complete and fully legible copy of these operating instructions is kept available at the place of use of the clutches at all times.
- start-up, maintenance and repair work is only done by authorized and suitably qualified personnel.
- such personnel are kept informed on all relevant occupational safety and environmental protection issues and familiar with these operating instructions and with the safety information contained herein.
- the clutches are not exposed to other strong magnetic fields.

8.1 Intended use

The clutches described in these operating instructions are intended to be assembled with machines, in particular electric motors, for use on industrial plant. Operation in potentially explosive or firedamp atmospheres is not allowed. The clutches must be used in accordance with the operating requirements detailed in this manual. The rated power limits specified herein must not be exceeded.

8.2 General safety information

Clutches fitted to motors feature hazardous live components and rotating parts and may exhibit hot surfaces. Any work associated with the transport, connection, start-up and periodical maintenance of the clutches must be carried out by authorized and suitably qualified personnel (in accordance with VDE 0105; IEC 364). Failure to observe safety, operating and maintenance instructions may cause serious personal injury and severe damage to the equipment. Whenever special measures are required in accordance with the instructions contained herein, such measures should be agreed with the clutch manufacturer before the machinery into which the clutch is to be incorporated is set up. Should any queries arise with respect to torques, torque variations, installation positions, wear, wear reserve, switching work, break-in conditions, release range, ambient conditions and the like, please contact Kendrion and ask for clarification before using the clutch. Retrofitting or modification work to be carried out on the clutch is subject to the approval from Kendrion. Accident prevention regulations applying to the specific field of application of the clutch must be strictly observed. The clutches described in this manual are **not designed for use as “safety components”**. This means that torque reductions caused by factors beyond the user's control cannot be excluded.

8.2.1 Set-up

Requirements in terms of the permitted number of switching operations per hour and the maximum switching work per switching operation specified in the technical specifications must be strictly observed during the set-up of machines and plant (jog mode). Failure to observe these instructions may irreversibly affect reliable clutch operation and cause malfunctions. Normal operating conditions are those specified by DIN VDE 0580. The protection rating conforms to EN 60529. In case of deviations, special measures must be taken after prior consultation with the manufacturer. Bear in mind that the armature may freeze to the flange hub if ambient temperatures fall below -5°C or if the clutch remains unpowered for prolonged periods of time. In this case, special precautions must be taken after consultation with the manufacturer.

8.2.2 Start-up

The clutches must not be put into operation when:

- power supply cables/wires or connections are damaged.
- the solenoid housing or coil sheath is damaged.
- other defects are suspected.

8.2.3 Installation

The voltage level and voltage type specified on the rating plate must be strictly observed when connecting the clutches described in these operating instructions. Sufficient heat dissipation must be ensured when the clutch is fitted to or incorporated into other equipment. Adequate precautions must be taken to avoid overvoltage during disconnection or voltage peaks. The magnetic field of the products may cause interference outside the clutch or even feedback to the clutch in case of adverse installation conditions. Should you have queries concerning mounting and fitting conditions, please contact the clutch manufacturer and ask for clarification.

Adequate safety measures (DIN VDE 0848, part 4; DIN 31000/VDE 1000; DIN VDE 0100, part 0420) must be taken by the clutch user to avoid hazards to persons and animals or damage to equipment caused by:

- direct or indirect effects of electromagnetic fields,
- heated components,
- mobile parts.

8.2.4 Operation

Ensure that live components such as plug contacts or the field coil are not exposed to water. The clutch cable connections must not be crushed, squeezed or exposed to mechanical loads. Make absolutely sure that the friction surfaces of the friction elements are not contaminated with grease, oil or other fluids to avoid substantial torque reduction. Bear in mind that the original torque cannot be restored even if the friction surfaces are cleaned after contact with fluids. The gradual clutch wear (only with dynamic clutches) must be taken into consideration in the set-up of the machine or overall system. Due to the diverse ambient conditions in which the clutches may be used, always check that the clutch is in perfect working order before start-up. Torque reductions cannot be excluded if the clutch is used for applications where only minimum friction work is required. In such cases, the user should ensure that the clutch occasionally performs sufficient friction work.

Note!

The clutch must be operated at an ambient temperature of between -5°C and +35°C and at a maximum relative humidity of 75% (at 20°C ambient temperature).

Attention!

A maximum 6g continual shock load over a service life of 20,000 operating hours is permitted for the clutch. The armature connection, hub connection and electrical connection are subject to the user's approval. Vibration loads with a maximum excursion of 1.5 mm and a maximum 6g acceleration are permitted within a frequency band of 10 to 2000 Hz.

Note!

The clutch, and more specifically the armature, is not subject to specific requirements in terms of the balance quality grade to DIN ISO 1940-1. Consequently, the required balance quality must be agreed between the manufacturer and customer in each individual case.

Note!

The maximum air gap s_{max} (see Table 23/1 “Technical specifications”) must not be exceeded throughout the entire clutch service life. (Please refer to Section 4 “Maintenance” for details.)

Note!

The M_2 rated torque (see Table 23/1 “Technical specifications”) is not fully reached until the break-in process has been completed (burnishing of friction surfaces). The break-in parameters are specified in Table 23/2. Before the clutch is first used, the break-in process must be conducted by the product owner.

8.2.5 Maintenance and repair

Repair work must only be carried out by qualified personnel (definition to IEC 364). Failure to perform repairs according to requirements may cause serious personal injury or equipment damage. Make sure that no voltage is applied to the clutches when carrying out maintenance work.

8.3 Warning symbols

Personal injury or equipment damage			
Symbol / Term		**Warns against...**	**Potential risks and hazards**
	Danger	imminent personal injury	fatal accidents or serious injury
	Warning	potential risk of serious personal injury	fatal accidents or serious injury
	Caution	potential risk of personal injury	minor injury
	Attention	potential risk of equipment damage	damage to components or other equipment
Information			
Symbol / Term		**Provides information on …**	
	Note	the safe use and operation of the product	

9. Definitions

(based on: DIN VDE 0580 July 2000, not exhaustive)

Switching torque M_1	torque acting on the shaft during brake or clutch slip
Rated torque M_2	switching torque specified by the manufacturer to identify the clutch. The rated torque M_2 is the mean value of at least 3 measurements of the maximum switching torque M_1 after completion of the transient response.
Transmissible torque M_4	highest torque that can be applied to the engaged brake or clutch without causing the brake/clutch to slip
Residual torque M_5	torque transmitted by the released brake or clutch
Load torque M_6	torque acting on the drive of the engaged brake or clutch; determined by the power requirement of the driven machine at a given speed
Switching work W	heat generated by friction inside the brake or clutch as a result of the switching operation
Maximum switching work W_{max}	maximum switching work to which the brake or clutch may be exposed
Switching power P	switching work converted into heat per unit of time
Maximum switching power P_{max}	maximum permitted switching work converted into heat per unit of time
Coil ON time t_5	time between power on and power off
Coil OFF time t_6	time between power off and power on
Total cycle time t_7	coil ON time plus coil OFF time
Duty cycle	percentage relationship of coil ON time to total cycle time
Switching operation	one complete switching on and off operation
Switching frequency Z	number of regular switching operations per hour
Response delay during coupling t_{11}	time between power off (releasing systems) or power on (engaging systems) and beginning of torque increase
Rise time t_{12}	time it takes to reach 90% of the M_2 rated torque from the beginning of the torque increase
Coupling time t_1	response delay t_{11} plus rise time t_{12}
Response delay during disconnection t_{21}	time between power on (releasing systems) or power off (engaging systems) and beginning of torque decrease
Fall time t_{22}	time it takes for the torque from the beginning of the torque decrease to fall to 10% of the M_2 rated torque
Disconnection time t_2	response delay t_{21} plus fall time t_{22}
Slip time t_3	time from the beginning of the torque increase up to the end of the braking process (brakes) or until the synchronization torque M_3 has been reached (clutches)
Making time t_4	response delay t_{11} plus slip time t_3 (braking or acceleration time)
Operating condition at operating temperature	condition at which the steady-state temperature is reached. The operating temperature corresponds to the overtemperature according to DIN VDE 0580 plus the ambient temperature. Unless otherwise specified, the ambient temperature is 35°C.
Overtemperature $\Delta\vartheta_{31}$	difference between the temperature of the electromagnetic device or a part thereof and the ambient temperature
Limit temperatures of coil insulating materials	in accordance with DIN VDE 0580. The individual insulating materials are classified by insulation classes to DIN IEC 85.
Rated voltage U_N	supply voltage specified by the manufacturer for voltage windings to identify the device or component

Rated current I_B	amperage determined by the manufacturer for the specified operating conditions. Unless otherwise specified, the rated current refers to the rated voltage, 20°C winding temperature and to the rated frequency for a given operating mode of voltage windings.
Rated power P_N	power value to identify the device or component
Rated power at 20°C winding temperature P_B	determined from the rated current of voltage-controlled devices and components and the R_{20} resistance at 20°C winding temperature

10. Technical specifications

Product built and tested to DIN VDE 0580

		Size								
		03	04	06	07	09	11	14	17	21
Rated torque M_2	[Nm]	0.2	1	2.2	5	11	21	60	80	150
Max. speed n_{max}	[rpm]	16000	12000	10000	8000	6000	4800	3600	3000	2500
Max. switching power P_{max}	[kJ/h]	65	100	160	250	350	500	700	1000	1300
Max. switching work W_{max} (Z=1)	[kJ]	0.9	1.6	4.5	6	11	30	53	80	110
Rated power P_N	[W]	6	8	10	12	17	22	35	40	45
Coupling time t_1	[ms]	13	15	15	25	45	70	110	110	150
Disconnection time t_2	[ms]	12	16	18	25	38	40	65	70	90
Moment of inertia J – armature (without flange hub)	[kgcm^2]	0.01	0.05	0.22	0.65	2.1	5.7	20	48	97
Moment of inertia J – magnet body	[kgcm^2]	0.06	0.17	0.55	2.45	7	20	36	85	217
Weight (without flange hub) m	[kg]	0.06	0.15	0.35	0.65	1.15	2	4	7.4	11
Rated air gap $s^{+0.1}$	[mm]	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4
Max. air gap s_{max} (at 70% of rated current)	[mm]	0.45	0.5	0.5	0.5	0.75	0.75	0.75	0.75	1.0
Duty cycle	[%]	100								
Standard rated voltage	[VDC]	24								
Insulation class		F								
Pollution degree		2								
Protection		IP00								
Clutch type		dynamic clutch								

Table 23/1: Technical specifications

		Size								
		03	04	06	07	09	11	14	17	21
Speed n	[rpm]	1000	1000	1000	1000	1000	1000	1000	1000	1000
Coil ON time t_5	[s]	1	1	1	1	1	1	1	1	1
Coil OFF time t_6	[s]	0.8	0.8	1.5	2.5	5	6	17	17	21
Break-in period t_{total}	[min]	approx. 0.75	approx. 0.75	approx. 1	approx. 1.5	approx. 2.5	approx. 3	approx. 7.5	approx. 7.5	approx. 9

Table 23/2: Break-in process parameters for the electromagnetic single-face clutch

Explanations on the technical specifications:

W_{max} (maximum switching work) is the switching work that must not be exceeded during clutch operations at max. 1000 rpm. Clutch operations at speeds greater than 1000 rpm substantially reduce the maximum permitted switching work per switching operation. Such operation must be agreed with the manufacturer. The maximum switching power P_{max} is the switching work W that can be converted by the clutch per hour. In case of applications where the number of switching operations per hour is Z>1, Fig. 24/1 applies. The P_{max} and W_{max} values are approximate values. The specified times apply to the following conditions: DC side clutch switching, operating temperature, rated voltage, and rated air gap. All values are mean values that are subject to variation. In case of AC side clutch switching, the disconnection time t_2 is substantially longer. The specified rated torques M_2 characterize the torque level. Depending on the application the clutch is used for, the switching torque M_1 and the transmissible torque M_4 may differ from the specified M_2 values. The switching torque M_1 depends on the speed (rpm). If the friction surfaces are contaminated with oil, grease or dirt, the transmissible torque M_4 and the switching torque M_1 may drop. The technical specifications apply after the break-in process has been completed (see Table 23/2).

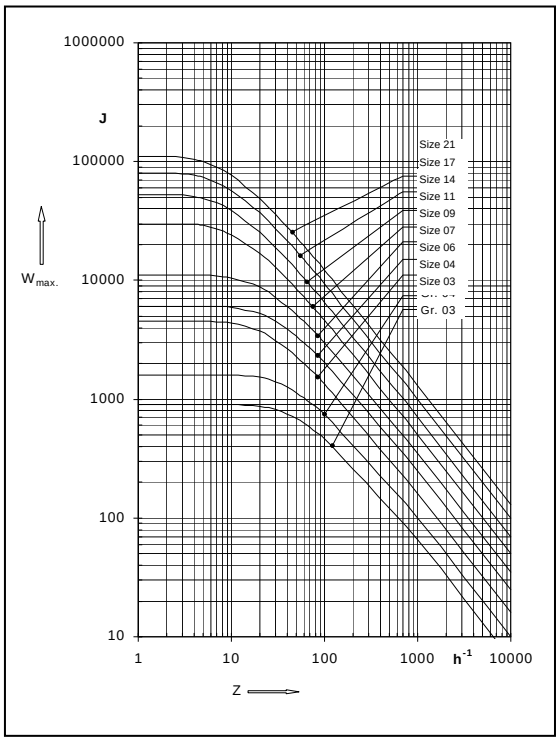


Fig. 24/1: Max. switching work W_{max} per switching operation as a function of the number of switching operations per hour Z (values based on n=1000 rpm)

Note: A current level corresponding to 70% of the rated current is reached when the electromagnetic single-face clutch is operated at rated voltage and at a coil temperature of 130°C.

The required operating conditions specified in **DIN VDE 0580** and the information provided in the **ACTIVE CLUTCH LINE specification sheet** and offer drawing for the specific clutch types must be observed during operation of the electromagnetic single-face clutch!

Specifications subject to change without notice!

11. Authorized repair shops for service and maintenance

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