KENDRION

WE MAGNETISE THE WORLD

INDUSTRIAL MAGNETIC SYSTEMS

Product Overview

BINDER

WE MAGNETISE THE WORLD

Kendrion N.V. is one of the leading manufacturers of solenoids and electromagnetic components worldwide.

Consisting of the four business units Industrial Magnetic Systems, Commercial Vehicle Systems, Industrial Drive Systems and Passenger Car Systems, Kendrion guarantees solution-oriented customer care. The company excels in innovative design and manufacturing excellence.

Over the years Kendrion has integrated the brands Binder, Magnet AG, Neue Hahn Magnet, Thoma Magnettechnik, Linnig Antriebstechnik, Tri Tech LLC, Magneta and FAS Controls.

The Industrial Magnetic Systems unit develops, manufactures and distributes linear-, holding-, locking-, spreading-, control-, rotary and vibrator solenoids as well as solenoid valves for a variety of applications worldwide.

The strengths of Kendrion lie both in the area of standard applications and in the area of customer-specific solutions.

Our technological know-how allows us to optimise the product design for each application.

All products are tested and developed according to DIN VDE 0580.

Kendrion Magnettechnik GmbH is an company certified according to DIN EN ISO 9001:2008.

The main locations are in Donaueschingen (D) and Engelswies (D).

Further locations are in Hausen am Albis (CH), Linz (A), Bradford (UK), Suzhou (CN), Mishawaka (USA) and Turin (I).

With our global distribution network we are available for our customers at any time.

Our products are used in almost all industrial areas. To name a few:

- Machine building
- Safety engineering
- Transportation industry
- Medical engineering
- Power engineering
- Environmental technology
- Elevator industry
- Fluid dispensing
- Automation

Your industry is not listed?
We are sure to be able to create a product to meet your needs.

Wherever innovations and new approaches are required our staff will be happy to assist you.

Contact us. We're looking forward to assisting you!

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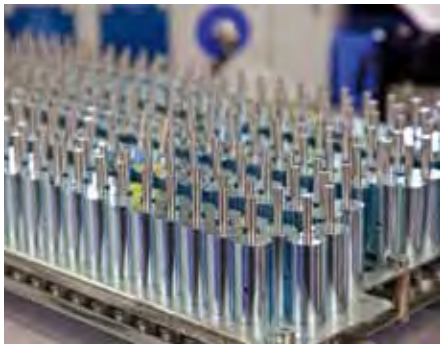
Please find detailed performance data in our product catalogues or with the help of our experts or our product finder on:

www.kendrion.com



Custom Products

Customer-Specific Solutions

With our many years of product experience, our large product portfolio and our modern manufacturing methods we guarantee you first-class products.

We develop special linear solenoids, rotary solenoids, combined lifting/holding systems, solenoid valves as well as coils and components for a wide range of industries:

- Switchchgear engineering
- Medical engineering
- Safety engineering
- Sorting technology
- Environmental technology
- Special engineering
- Beverage dispensing
- Control technology
- Fluid control/metering

Linear Solenoids

Classic Line

- Direct acting solenoids
- Monostable direct acting solenoids

High Performance Line

- High performance direct acting solenoids

High Power Line

- Direct acting solenoids
- Reversible solenoids

Control Power Line

- Control solenoids

Elevator Line

- Single-acting spreader solenoids
- Double-acting spreader solenoids

ATEX Line

- Explosion-proof direct acting solenoids

Locking Line

- Locking solenoids

System Line

- AC solenoids

Holding Magnets

HAHN CQ^{LINE}

- Door holders

Industrial Line

- Holding magnets
- Permanent holding magnets

Oscillating Solenoids

Oscillating Line

- Shaker solenoids
- Arc vibrators
- Inline vibrators
- Linear vibrators

- Oscillating solenoids

Custom products	Customer-Specific Solutions
Our Claim	We develop custom designs for your individual linear solenoids, rotary solenoids, combined actuating/holding systems and solenoid valves as well as coils and components optimised to suit your needs and application. With our many years of product experience, our large product portfolio and modern manufacturing methods we guarantee you first-class products.
Functions	**Linear solenoids** where the stroke can be set to the exact millimetre, with special strokes, different voltages, switching times and protection classes. **Rotary solenoids** for DC or AC, with/without permanent magnets, with extremely short switching times and a wide rotation angle. **Combined actuating / holding systems** keeping work-pieces exactly in the position desired by means of an additional electromagnet. **Solenoid valves** from proportional to on/off, from battery operation to alternating current, from pneumatic valves to valves for aggressive media such as cleansing liquids or fertilizers as well as a very wide range of possible pressures and flow rates. And much more!
Application	• Switchgear engineering • Robotics • Safety engineering • Environmental technology • Medical engineering • Special engineering • Sorting technology • Beverage dispensing • Fittings engineering • Control technology • Automation engineering • Fluid dispensing
Remarks	We develop our electromagnetic products together with our customers. By partnership we understand solutions which both strengthen the position of our customers and our own position in the market. Whether components or complete systems: We develop innovative products. Contact us – we are looking forward to hearing from you!

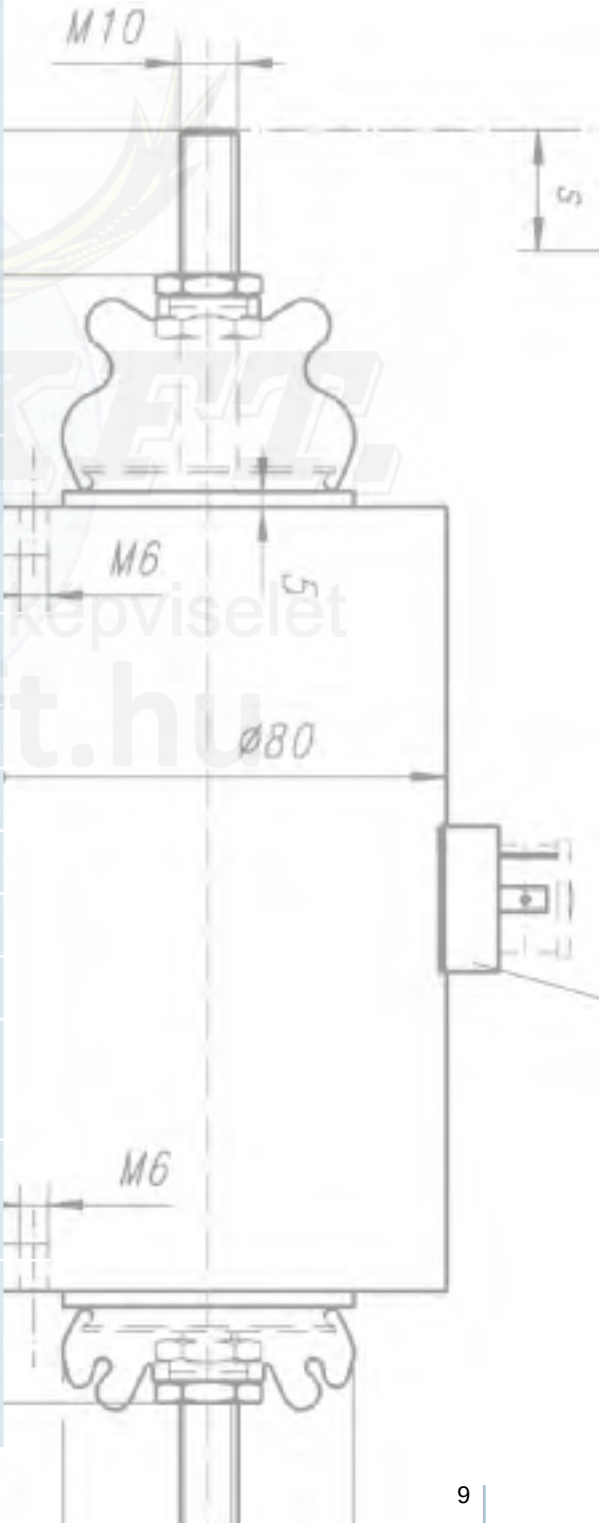
Product Line	Classic Line	High Performance Line
Function / Application	Solenoids of the Classic Line are universal and cost-effective. Actuation solenoids are ideally suited for use in precision engineering and industrial applications. These solenoids are especially suited for use in almost any branch of industry. Advantages include individual mounting options, maintenance-free armature bearing and compact design.	The square solenoids of the High Performance Line offer a large stroke and a flexible modular design. These solenoids are used wherever large forces, short duty cycles and high efficiency with limited installation space are required. They fulfil special requirements when used in high voltage circuit breakers and railway door lockings as well as in general actuating functions in automation and medical engineering.
Sizes	30 / 12 / 14-105 / 70 / 80 mm (L / W / H)	28 / 16 / 16-55 / 35 / 35 mm (L / W / H)
Standard Supply Voltage	24 V DC / 230 V AC / 50 Hz (205 V DC)*	24 V DC / 230 V AC / 40-60 Hz (205 V DC)*
Standard Duty Cycle	100 %	100 %
Stroke	3-30 mm (0.12-1.18 Inch)	5-30 mm (0.2-1.18 Inch)
Power	2.6-680 W	11-810 W
Force	0.2-400 N (0.04-89.2 lbs)	5-1100 N (1.12-247.29 lbs)
Thermal Class	B, E, F	F
Accessories / Options	• Connection box with/ without rectifier • Return spring set • Switching device with overexcitation • Bellow • Fork head, ES-bolt	• Connection box with/ without rectifier • Return spring set • Sealing ring • Bellow • Fork head
Protection Class	Device: IP 00 / IP 40 / IP 54 Connection: IP 00 / IP 65	Device: IP 40 / IP 54 Connection: IP 00 / IP 65
Remarks	*Via connection box with integrated bridge rectifier. 120 V AC or other voltages available upon request.	*Via connection box with integrated bridge rectifier. 120 V AC or other voltages available upon request.

Product Line	High Power Line	Control Power Line
Function / Application	Solenoids of the High Power Line offer extremely large forces and long strokes as well as maintenance-free operation. They can be widely used in general mechanical engineering, especially in the packaging industry as well as in automation, control and environmental technology.	Solenoids of the Control Power Line are short-stroke solenoids. Their features include high magnetic forces, precise switching and unique dynamics. These solenoids are generally used as actuators, holding modules in conveying systems or for the switching of valves.
Sizes	Ø 40-200 mm	Ø 50-90 mm
Standard Supply Voltage	24 V DC / 230 V AC / 40-60 Hz (205 V DC)*	24 V DC / 230 V AC / 40-60Hz (205 V DC)*
Standard Duty Cycle	100 %	100 %
Stroke	8-60 mm (0.31-3.36 Inch)	4-8 mm (0.16-0.31 Inch)
Power	12.5-3150 W	16-31 W
Force	8-920 N (1.8-206.82 lbs)	37-130 N (8.32-29.23 lbs)
Thermal Class	B	B
Accessories / Options	• Connection box with/ without rectifier • Fork head • ES-bolt • Mounting flange	• Connection box with/ without rectifier
Protection Class	Device: IP 54 Connection: IP 65	Device: IP 00 Connection: IP 65
Remarks	*Via connection box with integrated bridge rectifier. 120 V AC or other voltages available upon request.	*Via connection box with integrated bridge rectifier. 120 V AC or other voltages available upon request.

Elevator Line	ATEX Line	Locking Line
Single-acting and double-acting spreader solenoids of the Elevator Line excel by a short stroke and an extremely high magnetic force. These spreader solenoids are particularly suitable for use in elevators and escalators as well as in industrial brakes for the lifting of block and drum brakes.	Solenoids of the ATEX Line are designed for applications in explosive areas such as plant construction, refineries, oil entrepots or on oil platforms. In order to achieve explosion protection significant measures preventing the occurrence of sparks, arcs and dangerous temperatures have been taken.	Solenoids of the Locking Line are locking units specially designed for use in safety devices of machines, automation mechanisms and in object security. With these solenoids special attention has been paid to compact and sturdy design, universal mounting options and an integrated feedback of the locking function.
Ø 88-200 mm	Ø 60-200 mm	91/38/40-175/80/55 mm (L/W/H)
205 V DC	24 V DC	24 V DC/230 V AC*
40 %	100 %	100 %
(Single-acting spreader solenoids) 4-8 mm (0.16-0.31 Inch) (Double-acting spreader solenoids) 2x2-2x6 mm (0.07x0.07-0.07x0.24 Inch)	15-60 mm (0.59-2.36 Inch)	8-15 mm (0.31-0.59 Inch)
28-1050 W	22-180 W	12.8-30.5 W
190-7500 N (42.71-1686.07 lbs)	20-400 N (4.5-89.92 lbs)	5-50 N (1.12-11.24 lbs)
B, F	B	F
• Overexcitation rectifier • Hand lifting lever • Fork head	–	• Connection box with/ without rectifier • Connector • Bolt receptacle
IP 43	IP 54	IP 64
When operated with overexcitation a suitable overexcitation rectifier must be selected (overexcitation factor 2:1 or 3.4:1). The AC-mains-, overexcitation and holding voltage has to be noted with the order.	Ignition protection type “e” Protection class: II 2 G EEx e II T4 Explosion protection: Sizes 06-09 with the test certificate PTB 03 ATEX 2175 X Sizes 10-20 with the test certificate PTB 04 ATEX 2009 X	Locking bolt Ø: 10-16mm Radial forces: 1000N – 3000N Feedback via micro-switch Integrated reset spring *120 V AC or other voltages available upon request.

Product Line	System Line	HAHN CQ^{LINE}
Function / Application	AC-solenoids of the System Line allow for extremely fast switching times and very high attracting forces. These solenoids are often found in mechanical engineering and can be used in a wide range of applications, e.g. in switchgear engineering.	These door holding systems are primarily used as locking devices for fire-protection closures. The unique holding systems have been developed in attractive design and offer architects completely new decoration options. A wide range of colours and surfaces as well as integrated LED-lighting can be selected. Door-holding solenoids are typically used for doors in the private and industrial area as well as in fire alarm and safety technology.
Sizes	46/35/50-142/99/186 mm (L/W/H)	HAHN CQ^{STANDARD} HAHN CQ^{SAFE} HAHN CQ^{STAR}
Standard Supply Voltage	230 V AC/50 Hz	24 V DC
Standard Duty Cycle	100 %	100 %
Stroke	15-50 mm (0.59-1.97 Inch)	–
Power	8.2-4290 VA	1.5-3 W
Force	4-300 N (0.9-67.44 lbs)	200-1568 N (44.96-352.5 lbs)
Thermal Class	B	B
Accessories / Options	• Stroke limitation yoke	• Wall and floor angles • Base, Armature • Breaker button
Protection Class	IP 00	IP 54/IP 65
Remarks	–	VdS quality-tested Tested according to EN1155 EX-protected products available upon request.

Industrial Line	Oscillating Line
Holding solenoids of the Industrial Line include all electromagnetic and permanent magnetic holding systems which are circular (C), flat (F) or rod-shaped (S). These holding solenoid systems are used where loads must be held or transported quickly and reliably. The special advantage of the use of permanent magnetic holding systems is the safe holding even in the case of power failure.	Electromagnetic oscillating systems of the Ocscillating Line include five product types, thus offering optimal solutions for many applications. The components are used in feeding, automation, conveyor and process technology. Due to their special design they are particularly suitable for the conveying, vibrating, dosing, mixing, compacting, separating and sorting of bulk material.
(C) 15/12-100/40 mm (Ø/H) (F) 56/13-170/29 mm (Ø/H) (S) 101.5/32/31-501.5/60/49 mm (L/W/H)	Inline vibrators (OMW) Linear vibrators (OLV) Shaker solenoids (OSR) Arc vibrators (OAB) Oscillating solenoids (OAC)
24 V DC	230 V AC/50 Hz 110 V AC/60 Hz
100 %	100 %
–	0.5-7 mm (0.02-0.28 Inch)
1.4-90 W	7-3520 VA
36-30000 N (8.09-6744.27 lbs)	7-900 N (1.57-202.33 lbs)
E	B, F
• Connection box • Terminal clamp • Flexible armature plate	• Bellow • Control units • Connectors
Device (coil moulded): IP 65 Device (coil sheathed): IP 54 Connection: IP 00	IP 00/IP 20/IP 40/IP 54/IP 65
–	Loading weight: 0.1-17 kg Shielded cable available, other voltages, available upon request.



Definitions

Holding magnets

Holding magnets consist of an iron yoke with internal and external pole and a coil excited by direct current. The magnetic circuit which is open in energised condition allows to hold ferromagnetic parts. When the voltage applied is switched off, the part to be held falls off immediately. Possible residual magnetism, especially with light parts, can be avoided effectively by applying a foil of non-magnetic material such as brass, aluminium, copper or plastics.

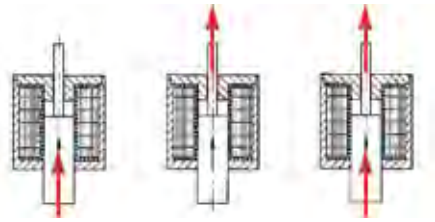
Permanent holding magnets contain an additional integrated permanent magnet which becomes effective in the de-energised state of the device and is able to hold ferro-magnetic parts. The energised coil neutralises the magnetic field at the holding surface and the parts can be taken or thrown off. They are ideally suited for use as safety magnets in transport equipment and lifting gear, as the ferromagnetic parts are safely held in the case of power failure.

Door holding magnets/door holders are special locking devices which are used for doors in the private and industrial area as well as in fire alarm and safety technology. The holding solenoid systems keep doors resp. closures in open state. If required, the smoke detector sends the signal to interrupt the holding current so that the doors can be shut by means of an automatic door closer, thus preventing the spread of fire and smoke.

Kendrion product lines:
- HAHN CQ^{LINE}
- Industrial Line
- Customer-Specific Solutions

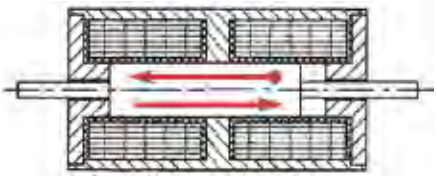
Linear Solenoids

A **direct acting solenoid** is a device in which the stroke movement is effected by electro-magnetic force from stroke starting position to stroke end position. The reset is performed by an external force. Corresponding to the power output direction of the armature one can distinguish between pulling and pushing operation.



Spreader solenoids can be classified into single-acting and double-acting spreader solenoids. Due to their design and technical data they are primarily used for lifting drum brakes. Spreader solenoids are used in elevator and escalator drives.

A **reverse solenoid** works according to the same principle as a direct-acting solenoid. Depending on the excitation the stroke movement is effected from one stroke end position to the opposite, the stroke end position in one direction being the stroke starting position in the opposite direction.



Control solenoids are considered to be part of the single-acting solenoids group. Due to their design and technical data they are primarily used for actuating valves in the hydraulic control technology.

A **monostable direct-acting** solenoid is not only equipped with a direct-acting solenoid but also with a permanent magnet. The latter one keeps the armature in the stroke end position after the tightening, with a certain holding force and without electric current. The switching process is actuated by a reverse voltage impulse depending on the reset force provided by the customer.

High performance direct-acting solenoids allow for an optimum transformation of electrical energy into mechanical stroke movement due to their efficient and low scattering design. They excel by a very long life cycle even if operated with high duty cycles.

Rotary solenoids are solenoids transforming a short stroke movement into a rotary movement which can be tapped. The reset is performed by an internal or external force.

Explosion-proof direct-acting solenoids are suitable for use in potentially explosive areas. With these electromagnetic drive elements significant precautions have been taken to prevent the occurrence of sparks, arcs and excessive temperatures.
All solenoids comply with the ignition protection type “e”. The explosion protection was approved for sizes 06 to 09 with the test certificate PTB 03 ATEX 2175 X and for sizes 10 to 20 with the test certificate PTB 04 ATEX 2009 X of the Federal Institute of Physics and Metrology (“Physikalisch-Technische Bundesanstalt”, PTB) in Brunswick, Germany.

AC solenoids allow for extremely short switch-on times and very high attracting forces. For these solenoids yoke and armature are available in laminated type.
In general it has to be made sure that the solenoid armature reaches its stroke end position, i.e. after finishing the switching on process the pole face of the armature has to rest on the pole face of the solenoid housing, the yoke.

Locking solenoids have been especially designed for use in protective devices of machine and automation systems as well as for object protection.
These electomagnetically actuated locking elements are used along with mechanical locks for form-locking with feedback.

Kendrion product lines:
- Classic Line
- High Performance Line
- High Power Line
- Control Power Line
- Elevator Line
- ATEX Line
- Locking Line
- System Line
- Customer-Specific Solutions

Solenoid valves

A **solenoid valve** is a valve which is acuated by a solenoid. The enormous range of required pressures, flow-rates and media to be controlled results in a very high number of solenoid valve designs which cannot be discussed in detail here.

Solenoid valves are the most frequent type of control elements used in fluid technology. They are applied for locking, opening, spreading, dosing and mixing liquids and gases.

Solenoid valves excel by fast and safe switching, high reliability, long life cycles, good compatibility with media, low power consumption and compact design.

Kendrion product lines:
- Customer-Specific Solutions

Oscillating Solenoids

Oscillating systems are AC systems in which the force of an electromagnetic alternating field is used to generate a harmonic oscillating movement (linear or arc-shaped). With our system a gentle, constant and efficient material flow is achieved.

Oscillating solenoids are able to oscillate independent of the mounting position, no matter if shaker solenoids (OSR), arc vibrators (OAB), inline vibrators (OMW), linear vibrators (OLV) or oscillating vibrators (OAC).

Oscillating solenoids are solenoid systems which execute periodic sinus-shaped oscillating movements. The functional principle is based on a double oscillator with mains frequency. The oscillating frequency (f) is the frequency with which the device oscillates. Normally the drive frequency equals the mains frequency.

Kendrion product lines:
- Oscillating Line
- Customer-Specific Solutions

Technical Explanations

Thermal Classes

As shown in the table below thermal classes are classified according to DIN VDE 0580/07.2000 into insulation classes on the basis of their long-term thermal stability. Depending on the type our solenoids are manufactured in thermal classes E, B and F. If required by the application most devices can also be delivered in thermal class H.

Thermal class	Limit temperature °C	Limit over-temperature °C
Y	90	50
A	105	65
E	120	80
B	130	90
F	155	115
H	180	140

Protection Classes (IP)

Protection classes are indicated by a short symbol consisting of the two invariable code letters IP and two code letters for the degree of protection. The protection classes indicated are determined according to IEC 60529. They apply to protection against contact, foreign substances and humidity. The first code letter applies to protection classes against contact and against penetration of foreign substances. The second code letter applies to protection classes against penetration of water.

In case the protection class of e.g. the electrical connection deviates from that of the solenoid the protection class of the connection is indicated separately, e.g.
housing IP 54, connection IP 00.

Code Letters Protection against contact and foreign substances	
0	no protection
1	protection against big foreign substances
2	protection against medium-sized foreign substances
3	protection against small foreign substances
4	protection against grain-shaped foreign substances
5	protection against dust deposit
6	protection against dust penetration

Code Letters Protection against water	
0	no protection
1	protection against vertical dripping water
2	protection against dripping water falling at an angle
3	protection against spray water
4	protection against splashing water
5	protection against hose water
6	protection against flooding
7	protection during immersion
8	protection during submersion

Rated Modes of Operation

Continuous operation is the operation during which the duty cycle is so long that the steady-state temperature is reached.
Intermittent operation is the operation during which duty cycle and current-less break alternate in regular and irregular intervals, the breaks being so short that the device cannot cool down to the reference temperature.
Short time operation is the operation during which the duty cycle is so short that the steady-state time is not reached. The current-less break is so short that the solenoid cools down to the reference temperature.

Technical Terms Related to Electricity

The rated voltage (U_N) is the voltage with which the solenoid is operated in normal operation.
The rated power (P_N) is the power which results from the rated voltage and the rated current with DC solenoids of a coil temperature of 20°C.
The rated current (I_N) is the current which results from the rated voltage (U_N) and the resistance (R_{20}) with a coil temperature of 20°C.

Technical Terms Related to Force

Magnetic force is the exploitable mechanical force reduced by the friction which is generated in stroke direction. The magnetic force is safely reached with 90% rated voltage and maximum warming. With rated voltage the listed values rise by approx. 20%.

Stroke force is the magnetic force which acts outside taking the respective component of armature weight into consideration.

Holding force is the magnetic force in stroke end position with DC-solenoids; with AC-solenoids it is the average value of the magnetic force periodically fluctuating with the alternating current in stroke end position.

Reset force is the force required to reset the armature into stroke start position after switching off the excitement.

Duty cycle is the time passing between switching the exciting current on and off.

Relative duty cycle (% ED) is the ratio between duty cycle and cycle time in per cent. It is calculated according to the following formula:

% ED=(duty cycle/cycle time) *100

In order to calculate the relative duty cycle the preferred value of the cycle time acc. DIN VDE 0580 item 3.2.2 of 5 minutes is usually taken as a basis.

If the cycle time is irregular the relative duty cycle is determined from the ratio between the sum of the duty cycles and the sum of the cycle times over a longer period of operation. The maximum values of the duty cycle must not be exceeded. If the relative duty cycle was determined and its value exceeds the permitted maximum value acc. DIN VDE the higher %-ED has to be selected into the range of which the duty cycle fits in. (Tables 1 and 2)

Cycle time is the sum of the duty cycle and the current-less break. For DC-solenoids the cycle time is max. 5 minutes = 300s. This equals 12 switches per hour. The minimum cycle time is limited by the actuation and release times in connection with the relative duty cycle. For a cycle time of 300s there are maximum values for the duty cycle which must not be exceeded. In case the permitted duty cycle is exceeded a solenoid of the next higher relative duty cycle has to be selected.

If the duty cycle of 180s is exceeded the solenoid has to be selected for 100% ED (continuous energisation) or in special cases of the duty cycle calculated from the on/off ratio needs to be adapted by a proper selection of the magnetic coil. If the cycle time is irregular the relative duty cycle is determined from the ratio between the added duty cycles and the added cycle times over a longer period of operation.

Under **playing sequence** we understand a single or periodically returning sequence of values for cycle time.

Relative duty cycle (%ED)	5	15	25	40	60	100
Permitted maximum duty cycle (s)	15	45	75	120	180	random

Table 1

Switching number (S/h)	12		120		300		600		1200		3000	
Cycle time (s)	300		30		12		6		3		1.2	
% ED	t_{ein}	t_{aus}	t_{ein}	t_{aus}	t_{ein}	t_{aus}	t_{ein}	t_{aus}	t_{ein}	t_{aus}	t_{ein}	t_{aus}
5	15	285	1.5	28.5	0.6	11.4	0.3	5.7	0.15	2.85	0.06	1.14
15	45	255	4.5	25.5	1.8	10.2	0.9	5.1	0.45	2.55	0.18	1.02
40	120	180	12.0	18.0	4.8	7.2	2.4	3.6	1.20	1.80	0.48	0.72
60	180	120	18.0	12.0	7.2	4.8	3.6	2.4	1.80	1.20	0.72	0.48
100	random											

Table 2

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