VORTEX ENGINEERING WORKS

Vortex

Electromagnetic Multi Disc Toothed Clutches, Brakes & Clutch-Plates

ELECTROMAGNETIC MULTI DISC TOOTHED CLUTCHES, BRAKES & CLUTCH-PLATES

GENERAL TECHNICAL INFORMATION

Selection and sizing of clutches and brakes

Friction clutches and barkes can synchronize two pieces of machinery, which are rotating at different speeds; they absorb energy in the process. If safety requirements dictate the use of holding-current type brakes or clutches which must provide energy dissipation, the spring applied multiple-disc designs, which are suitable for wet or dry operation should be selected.
Positioning functions in conjunctions with re-circulating ball mechanism can be performed by the zero-backlash spring-applied holding brakes-run dry, but not used as stopping single-disc clutches and brakes. These clutches and brakes are not included in the preview of this catalogue but can be had on request.

Sizing according to torque

M=9550. P/n in Nm

Where : P is power in kW
n is the speed in min-1
Peak loads and shock must be taken into account.

Sizing according to energy dissipation, Operating frequency or life

It is necessary to distinguish between wet and dry operation.

Wet operation
For wet operation the wear of the friction surfaces is very slight if the sizing and lubrication are correct.

The energy dissipation can be calculated from the following equation :

$$W = \frac{J\,(n_2-n_1)^2 \cdot Ms}{182.4.\,(Ms \pm M_l)} \quad \text{in Ws}$$

Where:
J in kg m^2 moment of inertia including inherent masses (in Sl units)
n_1 in min^{-1} low speed
n_2 in min^{-1} high speed
Ms in Nm dynamic torque of clutch or brake (see table)
M_l in Nm load torque
Ms –M_l for acceleration
Ms + M_l for deceleration
W in Ws work

Dry operation

For dry operation a certain amount of wear takes place, depending on the energy to be dissipated, which limits the life of clutches. Incorrect sizing can cause increased wear rates and, in the case of multiple-disc clutches, distortion of the discs.

Permitted speeds with slipring-type clutches

Wet operation
The maximum permitted operating speeds of slipring-type clutches depend on the rubbing velocity permitted for the slipring. This may be up to 20 m/s when the slipring is carrying current; above 10m/s an additional dummy brush should be provided. A dummy brush is also necessary at lower rubbing velocities if the slipring is almost always carrying current. Rubbing velocities up to about 70 m/s are allowed when there is no current flowing.

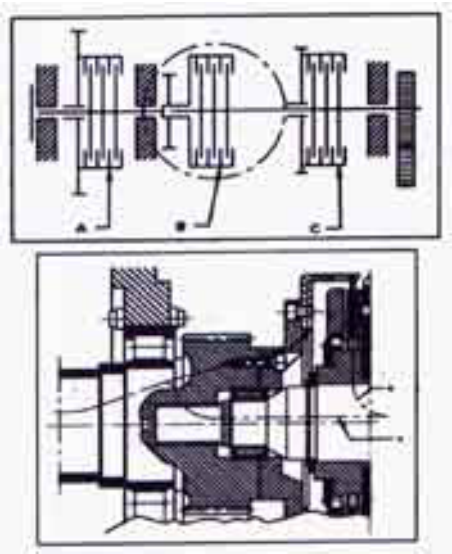
Dry operation
Higher slip-ring rubbing velocities, and therefore higher rotational speeds, are permitted for dry operation, provided the current supply brushes are rigidly supported add there is no danger of contamination by oil or grease.

Permitted speeds with stationary-field clutches

In the case of stationary-field clutches the maximum permitted speed is determined by the maximum speed permitted for the bearing supporting the magnet body.
Higher speeds are permitted when the clutches have no such bearing (i.e. housing versions).

Vertical installation
Installation of multiple-disc clutches and brakes in the vertical position increases the drag torque in both wet and dry operation.
The design must be such that the armature is at the bottom in order to prevent increased drag torque in the case of multiple disc clutches.
Internal lubrication should be employed if possible for the wet operation for multiple-disc clutches in the vertical position.
The disc clearance should be reduced to 0.2 mm; otherwise the engagement times will be greater.

Magnetic insulation
As well as magnetizing its own components, an electromagnetic clutch also magnetizes the shaft on which it is mounted and for this reason such clutches should not be mounted on machine spindles if at all possible.
With overhung clutches, it is possible to provide magnetic insulation in the form of bushes and carries of a non-magnetic material such as bronze or a magnetic bridge through which the magnetic flux can be transferred directly to the housing.



Without magnetic bridge a large amount of leakage flux passes through the carrier components and the clutch, adversely affecting the disengagement process and drag torque.
Similar problems arise with a discontinuous gear shaft carrying several clutches.
If clutch A or C is engaged and clutch B disengaged, for example, shunt induced in the shaft will flow through the carrier paths and discs of clutch B in the other shaft if there is no magnetic bridge.
The leakage flux in the disengaged clutch will cause increases drag torque, which can lead to overheating.
Whenever the physical arrangement of a clutch gives rise to the possibility of substantial magnetic flux or permanent flux in the working air gap of a disengaged or unexcited clutch, appropriate measures must be taken to prevent or divert the magnetic flow.

Lubrication and cooling for wet operation
Internal lubrication is recommended for multiple-disc clutches and brakes which provide energy dissipation, or are run at high speeds or are installed vertically. Ask for advice if necessary.
Splash lubrication or an external oil spray directed on to the disc pack is sufficient for other operating conditions.
In most cases the oil cloud provides adequate lubrication for the sliprings and for the magnet-body bearing of stationary-field clutches.

Oil quality
Only mineral oils with good resistance to aging and with neutral characteristics to copper and steel in the presence of slight condensation and elevated temperatures should be used for lubrication and cooling.
The oils must not have any electrolytic characteristics, which might promote oxidation or the formation of deposits, which could cause malfunction of the coil. In cases of doubt enquire form the oil supplier.

Oil viscosity

In accordance with DNL 43648 the catalogue values of torque and operating time refer to an oil viscosity, of 21 mm2/s. If the nominal ratings of the clutches are to be maintained the oil chosen must have a viscosity, at operating temperature, not exceeding that stated above.
Thicker oils will reduce the torque and increase the operating times.

Oil flow rates

The oil flow rate for the internal lubrication of friction-type clutches and brakes should be approximately 0.1 to 0.2 1/min per clutch. An excessive flow rate will increase the engagement time and, when the energy dissipation is low, can lead to a reduction of the static torque. Electromagnetic clutches should not, if possible , run in oil because apart from affecting the engagement time and torque, the oil will be heated considerably by turbulence when running at high speeds. In the case of slipring-type clutches running in oil at high speed there is also danger of interruptions in the flow of current between slipring and brushes, which can damage the slipring.
The flows of oil for internal lubrication must be appropriate tp the power dissipation (i.e. the product of energy dissipation and operating frequency).
A proven empirical value is :
12 cm^3 / k J

The oil flow through a clutch can be calculated from the following equation :

Q = W. z / 5000 in cm3/min
Where
W = Energy dissipation per operation in Ws
z = Operating frequency in operations/hour
In most cases 0.1 and 0.2 I/min is adequate, especially for clutches of rated torque ≤ 300 Nm. Excessive oil flow increases the drag torque, slows the engagement time and, especially at low speeds, reduces the rated torque. Insufficient oil leads to overheating, heavy wear and rapid destruction of the discs. When the flow is insufficient it is also possible for the oil to be heated so much that vapour is produced and the resulting oil/air mixture in the gearbox may be flammable. A spark in the gearbox (due to a poor electrical contact or rubbing between two parts, etc.) can give rise to an explosion which could possibility lift the cover of the gearbox.
Since this situation requires a specific stochiometric ratio of oil vapour to air and the simultaneous presence of an ignition spark, it is an extremely rare occurrence.
Nevertheless, it is advisable to take all appropriate measures to eliminate danger by observing the recommended temperatures and lubrication rates.
Moreover, gearboxes should have a large cover, which will lift at a low pressure and so avoid serious secondary damage.

Oil quantities in clutched gearboxes.

Experience has shown that main gearboxes whose clutches are providing high-energy dissipation require an oil capacity of approximately 5:1 per clutch or brake.
Feed gearboxes whose clutches provide less energy dissipation have been shown to require less oil and therefore less storage capacity.

Electrical circuits

The engagement and disengagement times of Electro-magnetically operated clutches and brakes are related to their size and design. Many years of experience have resulted in a range of clutches and brakes whose operating time and torque ratings satisfy all requirements over a wide range of applications.

The operating times indicated in the tables are based on rated voltage, normal operating temperature of the oil, and the use of the recommended varistors for surge protection. The operating times can also varied by mechanical methods.
The normal circuitry is shown in Figs.
The clutch or brake coil is connected to the rated voltage via a contract or an electronic switching element. When the clutch is engaged (or brake applied) the rated voltage should be available at the coil connection itself. Allowance should be made for voltage drops due to long cable runs or high loads. Surge-protection devices must be used to avoid harmful voltages when the coil is switched off.

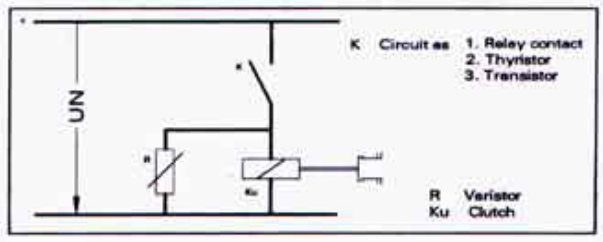
Surge-protection devices

The inductance of electromagnetic clutches causes a voltage peak when the supply current is switched off, which may exceed 1000V.

This may cause damage to the insulation or to the switching elements. A surge-protection device therefore has to be fitted to limit this voltage peak.

The following types of surge-protection devices can be used :
1. Varistor (non-linear resistors)

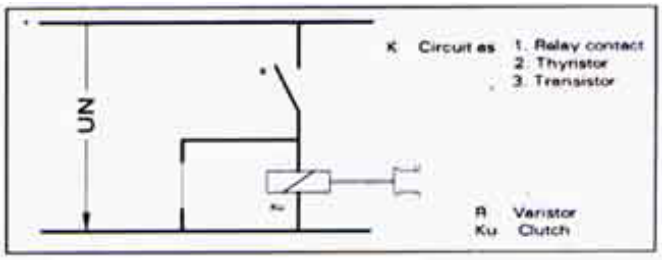
Recommended type with Order No.
Q69- X3022



This type of varistor can be used with any operating voltage up to 30 V. The voltage peaks when the coil is switched off are limited to less than 100 V.

If the voltage of 30 V. exceeded on over excitation, a diode must be connected in series with the varistor, operating in the inverse voltage direction.

This type of circuit is suitable for all clutches and brakes shown in this catalogue. The voltage peak on switch off, approximately 90 V may still be excessive if sensitive contacts or solid-state circuits are used.



2. Zener diode
A diode must always be connected in series with the Zener diode
The Zener diode is particularly recommended for use with solid-state components because the induced voltage does not rise much above the Z voltage. With Z voltages in excess of 60 V the disengagement time corresponds to that stated in the catalogue. If the Z voltage is less than 60 V the disengagement time is increased.

3. Diode
A diode is primarily used for switching inductances with semiconductors. The use of a diode prevents a voltage peak when the coil is switched off. Allowance should be made for the fact that the disengagement time may be up to 5 times longer than that stated in the catalogue.

Slip-ring type toothed clutches

Construction and mode of operation
The slip ring-type toothed clutch can transmit a higher torque than a multiple-disc clutch of approximately the same size. It can be operated wet or dry.

A slip ring-type toothed clutch comprises a magnet body containing a potted coil, a toothed ring and slip-ring mounted on the outside and an armature disc. Springs on guide pins ensure that the two toothed rings are kept apart when the clutch is de-energized.

An adapter plate can be supplied for mounting the armature disc, although the customer can provide the necessary gear teeth on the mating part if he wishes.

When the coil is energized it produces magnetic flux.

The clutches operate from 24V DC supply.

The clutch can only be engaged when each tooth is opposite a tooth space.

The user must employ a suitable means of ensuring that the “tooth-to-tooth” position is avoided.

There must be no speed differential when the clutch is being engaged, except when there are torsionally flexible elements in the input and output, in which case a slight speed differential is permitted. The amount of differential can be determined by tests conducted on the item of machinery for which the clutch is intended.

Engagement shocks, which overload the toothed clutch causing it to disengage, must be avoided because the slipping of the teeth will ruin the clutch.

The value of static torque in the Selection tables must not be exceeded, however briefly.

The clutches can be disengaged under load and at any speed.

Unlike friction clutches, no figure of dynamic torque can be quoted for toothed clutches. They have only a static torque which is applicable when there is no relative movement between the teeth.

Such relative movement can be the result of shaft misalignment, sag or vibration.

The torque is transmitted without slip.

In contact to multiple-disc friction clutches there is no drag torque with a toothed clutch.
Both toothed rings are made of nitrided steel and are therefore very hardwearing.

Stationary-field toothed clutches

The main applications for stationary-field toothed clutches are when access to the machine is poor and when high speeds make the use of slipring-type clutches difficult because of the restricted slipring rubbing velocity.

Construction and mode of operation

The stationary-field toothed clutch can transmit a higher torque than a stationary-field multiple-disc clutch of approximately the same size. It can be operated wet or dry, although wet operation is preferable.
A stationary-field toothed clutch comprises of a stationary magnet body containing a potted coil, bearings, a hub with a magnetic flux guide disc, toothed ring and an armature disc. Springs on guide pins ensure that the two toothed rings are kept apart when the clutch is de-energized.
An adapter plate can be supplied for mounting the armature disc, although the customer can provide the necessary gear teeth on the mating part if he wishes.

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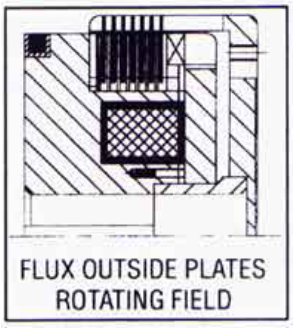
Electromagnetic multi-disc friction clutches & brakes vis-à-vis toothed clutches :

A) Electromagnetic toothed clutches are used for very high killing speeds due to zero drag torque as compared to a slight residual friction torque in friction clutches.

B) Electromagnetic multi-disc clutches synchronize two pieces of machinery, which are rotating at completely different speeds, absorbing energy in the process. Electromagnetic toothed clutches can provide a dis-engageable connection between two shafts or pieces of machinery but can also be operated when shafts are stationary, running at same speed or at very slight differential speeds.

C) Size-to size, Electromagnetic toothed clutches can be suitably modified with respect to their tooth profile to get accurate positioning.
E.g. : By suitably modifying the tooth profile, clutches can be designed to engage at a fixed point over the entire circumference of the clutch.

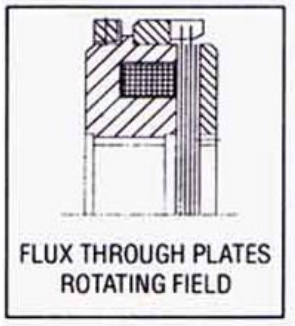
After studying the general technical information, we come to the range of clutches and brakes, which are presently covered in this catalogue.
VORTEX manufacture a very wide range of electromagnetic multi-disc and toothed clutches and brakes to cater to a wide plethora of application, primarily in the field of industrial machinery, drives and automation.
VORTEX range of electromagnetic clutches covered in this catalogue consist of two main types :



Friction type and Toothed type

1. Versions of magnetic lines of flux :

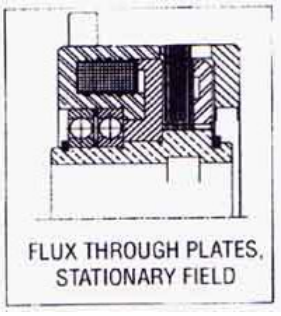
a) Flux-through plates : Friction combination is steel-steel and used for completely wet, oil immersed operations (BZ, CZ, AZ, PZ, SY, DY series)
steel-steel and used for completely wet, oil immersed operations (BZ, CZ, AZ, PZ, SY, DY series)



b) Flux-outside plates : Friction combination is steel-sintered bronze for wet and intermittent wet. Dry versions use the steel-organic friction lining combination (KZ, LZ, FS)

2. Versions of magnetic field :

a) Rotating field : Slip-ring type clutches with rotating coil; current supply is through telescopic brush (BZ, CZ, AZ, PZ, EX, FX, KZ, LZ, DY series); These are available in single and double slip-ring versions.

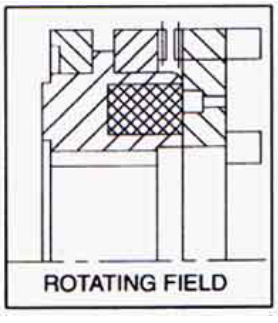


b) Stationary field : Stationary coil versions with a driving rotor, bearings and fixed potted coil. (SX, SY series)

3. Functional versions :

a)Clutch : Magnetic field causes the driving clutch-plate to transmit the drive to the driven clutch-plates (BZ, CZ, AZ, KZ, LZ, SY, DY series); These are available in single and double slip-ring versions.

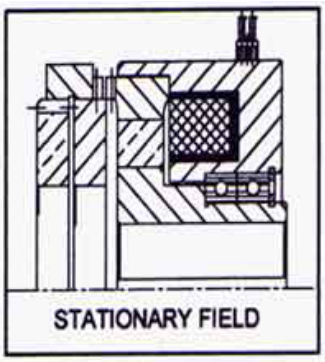
b)Brake : Magnetic field causes the driving clutch-plates to be braked by the stationary driven clutch-plates, which act as the brake plates (PZ, RZ series)
Thus the slip-ring versions act as clutches while their equivalent non slip-ring versions are used as brakes.



Version of mounting locations :

a) Mounting holes with central T-slot locations (EX, PZ, LZ series)

b) Mounting holes with bore location (FX, SX, BZ, AZ, LZ, DY, SZ, KZ series)

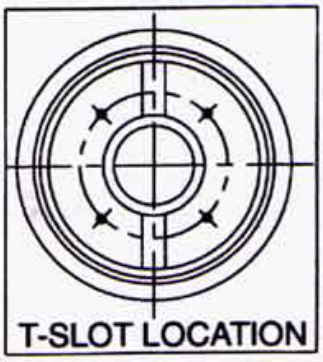


5. Versions of the operating environment :

a) Oil-immersed wet running : Clutches and brakes with the steel-steel friction combination are used with the oil functioning as the heat dissipation catalyst and simultaneously permitting larger friction pairs and hence the friction area, resulting in very compact design (BZ, CZ, AZ, DY, SY series)

b) Intermittent wet and dry running : Clutches and brakes with sintered-bronze / special material (paper, graphite) to result in very high torque and vastly improved wear-resistance properties, especially for severe heavy-duty applications (KZ, LZ, FS series)

c) Dry running : Clutches and brakes with steel-organic friction combination for dry, non-oil environment.
Note : Toothed clutches can be operated in either dry or wet environments, only precaution needs to be taken in the bearing versions by suitable greasing of the bearings (or use of enclosed greased bearings) for eg., in SX series



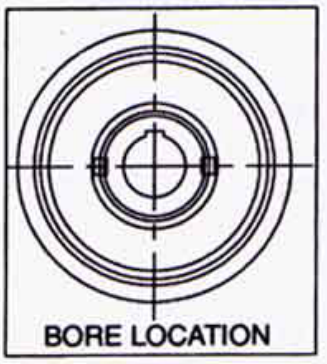
6. Armature versions (for toothed clutches)

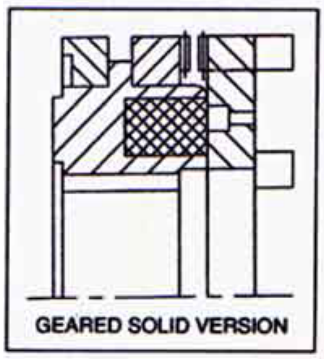
a) Geared armature version for standard regular applications

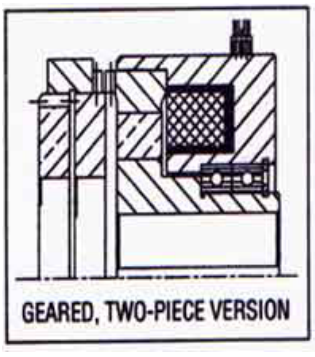
b) Slotted two-piece armature versions for applications demanding rapid disengagement with the maximum consistency.

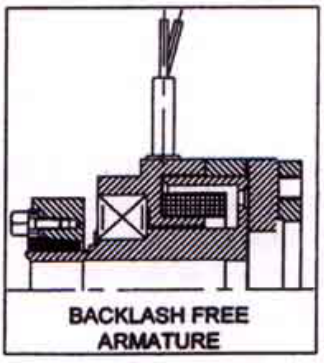
c) Backlash-free armature with leaf springs.

Toothed clutches have numerous versions based on the various possibilities with the toothed profiles to suite a very wide array of customer applications, hence fitting into a wide design possibilities due to their very high degree of flexibility.



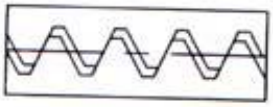




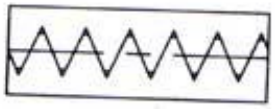


VERSIONS OF TOOTH PROFILE:

1. STANDARD
Torque transmission in both directions with minimum backlash.



2. STANDARD – BACKLASH FREE
Torque transmission in both directions of rotation without backlash.

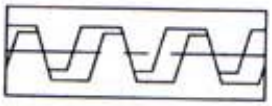


3. OVERLOAD TEETH
Through increasing the flank angle. the torque capacity is reduced to approximately 50% of the normal torque. Transmits torque in both directions with little backlash. Only supplied with fixed position engagement.

4. SAW TOOTH – CLOCKWISE
Transmits the nominal torque in the clockwise direction. In the reverse direction approximately 10% of the torque can be transmitted. Engagement is possible at higher speeds.

5. SAW TOOTH – ANTICLOCKWISE
Transmits the nominal torque in the anti clockwise direction. In the reverse direction approximately 10% of the torque can be transmitted. Engagement is possible at higher speeds.

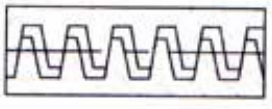
6. SPACED TEETH
Torque transmission in both directions with a large amount of backlash. Can be engaged at higher speed.



7. STEPPED TEETH - CLOCKWISE
Transmits the torque in a clockwise direction with little backlash. In the apposite direction approximately 20% of the nominal torque is transmitted with a little backlash. Can be engaged at higher speeds. Only supplied with fixed position engagement.

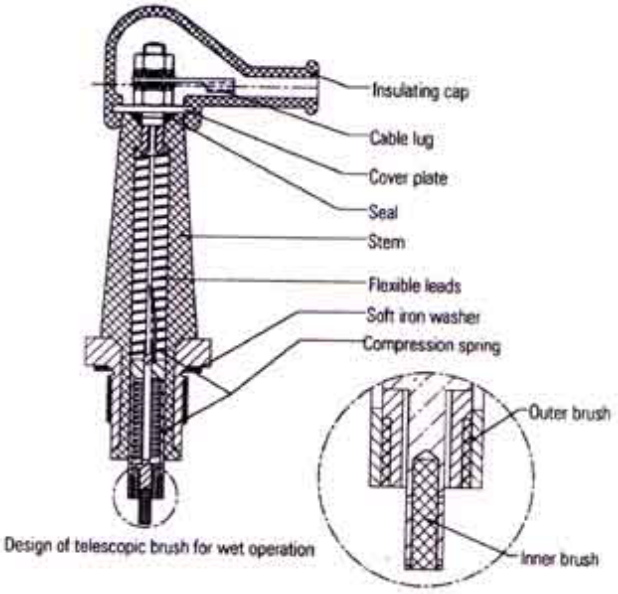
8. STEPPED TEETH-ANTICLOCKWISE
Transmits the torque in anti-clockwise direction with little backlash. In the apposite direction approximately 20% of the nominal torque is transmitted with a little backlash. Can be engaged at higher speeds. Only supplied with fixed position engagement.

9. SELF LOCKING
Due to a very steep tooth flank angle, the teeth will not disengaged under load even with the power switched off. Torque transmission in both directions with little backlash.



CURRENT SUPPLY BRUSHES FOR SLIPRING-TYPE CLUTCHES

Another very important component, especially with the slipring clutches are the telescopic current supply brushes.



Design of telescopic brush for wet operation

Construction and mode of operation

Telescopic brushes for wet operation

The telescopic brush has been designed to give good transfer of current to the slipring despite the presence of a film of oil. The wire tips of the brush inserts are forced into contact with the case hardened slipring with high specific pressure and this penetrates the oil film.

The outer brush scrapes the oil from the splipring. The outer and inner brushes have different natural frequencies in order to ensure good contact in the presence of vibration because only one brush at a time can be in resonance. It also lengthens the life of the brushes.

Provided the telescopic brushes are fitted correctly it is possible for them to give trouble free services for years.
The figure shows a telescopic brush for wet operation. There are two brushes arranged concentrically and each is connected to the terminal by a separate flexible lead. Each brush has its own spring for providing the necessary down force. The steam is made of plastic and is moulded in one piece with the screwed body. An insulating cap covers the terminal.

Telescopic brushes are available in various different versions to suit requirements. Long brushes and dummy brushes are available in lengths between 30 and 100 mm (in 10 mm steps). These can be shortened by the customer to the size required, whenever necessary.

Brushes of normal length can be expected to have to be a longer life than the long versions because they have fewer tendencies to vibrate.

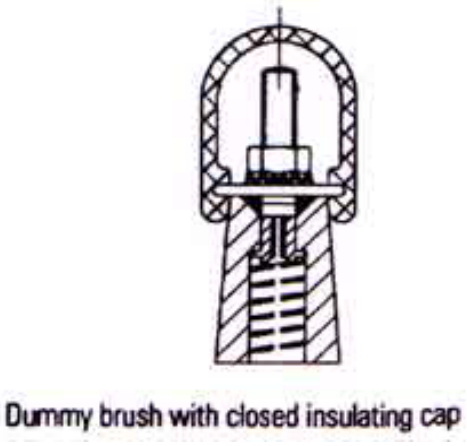
Worn brush inserts are easy to change; the amount of wear allowed is given in the operating instructions.

The less severe operating conditions with the smallest clutches enable a type of brush to be used having only one insert of two.

Slipring velocities of up to 20 m/s are allowed when carrying current. Above 10 m/s a dummy brush must also be fitted. It should also be fitted for velocities below 10m/s if the slipring is almost constantly carrying current. Dummy brushes are not connected to the electrical supply.

Dummy brushes for wet operation

Dummy brushes are similar in construction to telescopic brushes; the only difference is the omission of the cable lug at the top of the stem and the second hexagon nut and lock washer for securing the lug. It has a closed
insulating cap.



Dummy brush with closed insulating cap

Brushes for dry operation

Fig. Shows a brush for wet operation prior to and after fitting. The same fitting constructions apply to both dummy brushes and brushes for dry operation

Brushes for dry operation

Current supply brushes for dry operation have a carbon insert. It is essential to keep oil and grease away from the slipring and brush if the clutch is to perform satisfactorily. Both the normal and long length versions of the brushes are available and there are different designs to suit all applications.

Dummy brushes are not required under dry operating conditions.

The design of a brush for dry operation is shown in the figure below. There is a central carbon brush connected to the terminal by a flexible lead. A spring produces the necessary down force. The stem is made of plate and is moulded in one piece with the screwed body. An insulating cap protects the terminal.

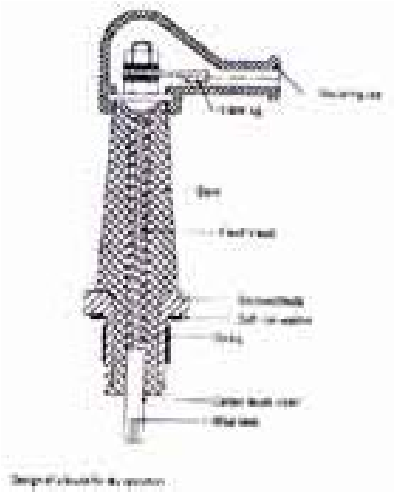
Worn brush inserts are easy to change; the amount of wear allowed is given in the operating instructions.

Earth return is used in the majority of applications because of the short life of a second slipring, or brush, for the negative pole would have at higher slipring velocities.
Contact us for more details and the wide varieties of current supply brushes we have to offer.

Design notes and installation

The specified brushes should always be used in order to guarantee good current transfer to the slipring.

1. Slipring velocities



Wet operation

Slipring velocities upto 20 m/s are allowed when carrying current. Above 10 m/s a dummy brush must also be fitted.

A dummy brush should also be fitted for lower slipring velocities if the slipring is almost constantly carrying current.

Ordinary brushes and dummy brushes can only be distinguished externally by the different insulating caps. The dummy brush can be presented before or after the current supply brush.

Dummy brushes are not connected to the electrical supply.

Slipring velocities of up to 70 m/s are tolerable when de-energized; this may occur under some circumstances with gearboxes involving reverse driving.

Dry operation

Much higher slipring velocities are possible for dry operation provided the brushes and slipring are kept free from all traces of oil and grease. Dummy brushes are not needed for dry operating conditions.

2. Lubrication for wet operation

In gear boxes the oil splashes or clouds provides adequate lubrication for the brushes.

The slip-ring must not dip into oil.

A build-up of oil in front of the brush due to excessive lubrication can be harmful.

3. Installations

Proper installation with minimum vibration is essential for long life. If the brushes are not screwed directly into the machine housing they must be supported by strong bolted brackets on each side rigid enough to prevent any vibration.

4. Insertion Length

The specified insertion length “l” must be adhered to with a tolerance of - 1 mm, if the dimension is exceeded the down force of the brush will be insufficient and sparking may occur with subsequent pitting of the slipring.

Brushes of normal insertion length (14 and 22 mm) can be expected to have a longer life than the long types because they are less prone to vibration.

5. Polarity

The brushes must be connected to the positive pole of the supply. The life of the brushes and slipring will be reduced substantially if they are connected to the negative pole.

6. Fitting

The brushes should not be fitted in the oil sump because of the danger of short-circuiting due to metal particles in the oil. Also, unavoidable shrinkage of the plastic stem may result in leaks in the course of time.

7. Earthing

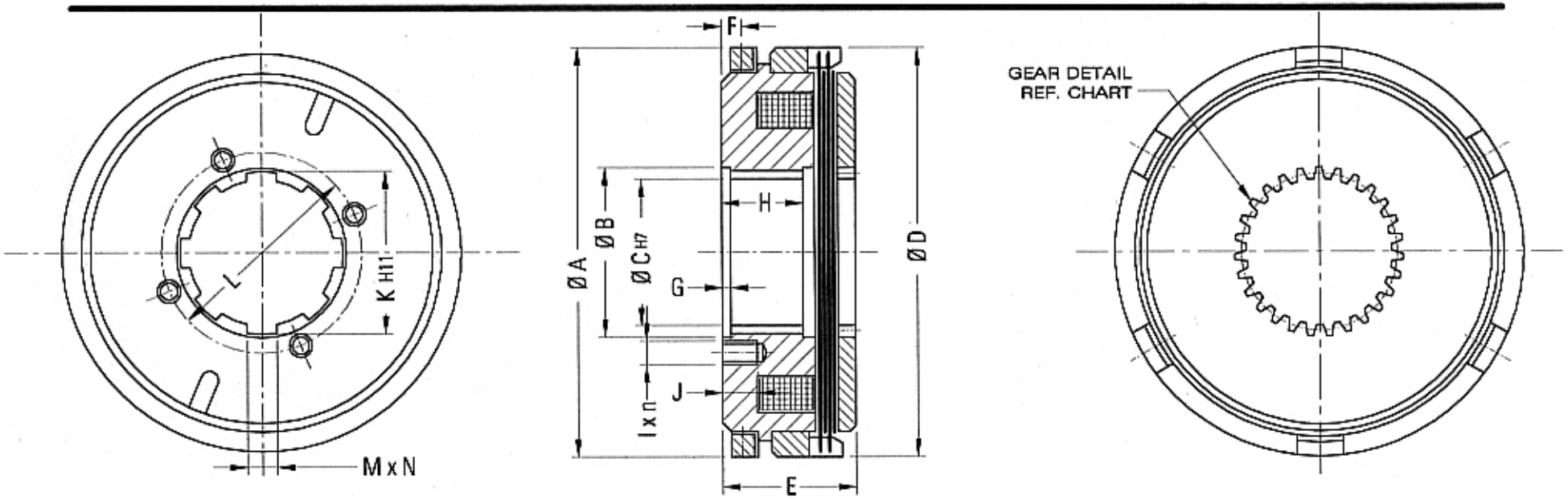
If a poor contact to earth (negative pole of the supply) is anticipated, e.g. when journal bearings are used, it will be necessary to provide a secondary conductive path giving a good connection between the clutch body and the machine housing or negative pole of the supply.

8. Special versions

Different values of insertion length to those given in the tables can be obtained by shortening longer brushes.

BZ SERIES

Vortex

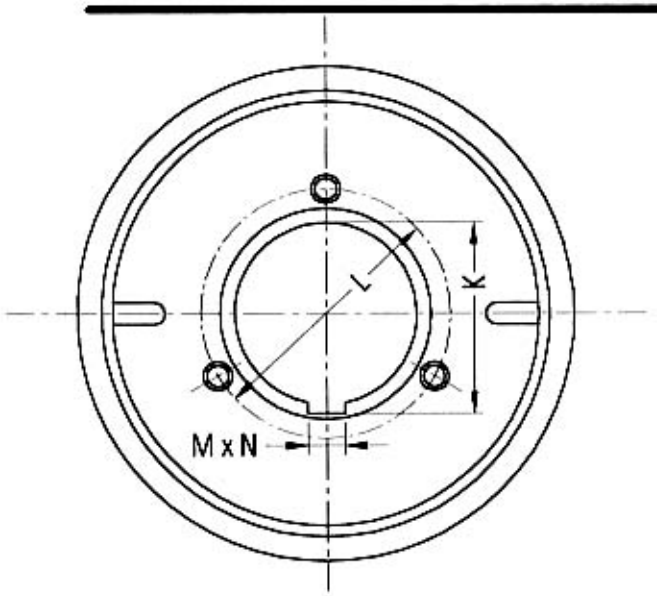


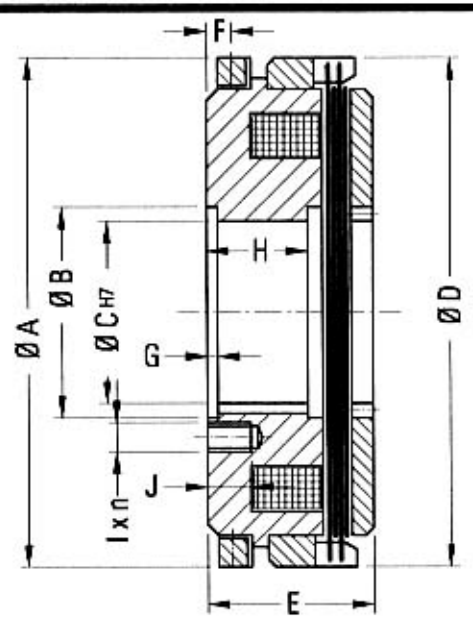
SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)													GEAR DATA			NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I x n	J	K	L	M x N	No.of teeth	Mod.	P/A	I	O	A/G			
1	02BZH	3.6	2	92	37	32	90	32	5.5	1.5	18	M6 4	10	36	45	6 8	22	1.5	20°	4	4	1.8	34	17	24 V
2	02BZA	5	2	95	42	36	93	36	5.5	1.5	20	M6 4	10	40	50	7 8	27	1.5	20°	4	4	1.2	32	18	
3	05BZA	10	5.5	114	52	46	114	45.5	7	2	23	M6 4	12	50	60	9 8	27	1.75	20°	5	5	1.8	26	22	
4	10BZA	20	10	140	70	52	140	52	7	2	26	M8 4	15	58	72	10 8	28	2.0	20°	5	5	2.0	20	29	
5	20BZA	40	20	166	80	72	166	58.5	7	2.5	30	M10 5	15	78	92	12 10	27	2.5	20°	5	5	2.5	14	41	
6	40BZB	80	40	195	80	72	195	67	7	3	31	-- --	--	78	80	12 10	25	--	20°	6	6	4.0	10	57	
7	40BZA	80	40	195	90	82	195	68.5	7	3	33.5	M10 5	18	88	110	12 10	33	2.5	20°	6	6	3.5	9.8	59	
8	60BZA	110	60	210	100	92	210	73.5	8.5	3	35	M10 5	20	98	120	14 10	36	2.5	20°	6	6	4.0	7.3	79	

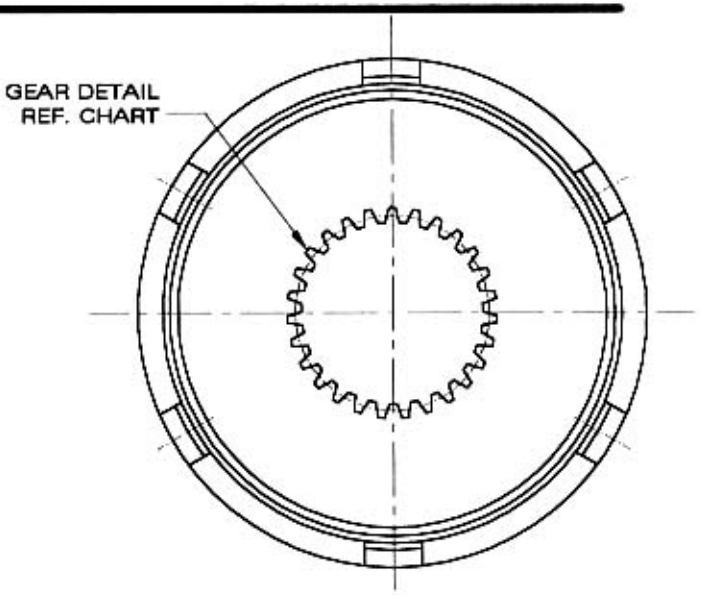
NOTE : AVAILABLE ON REQUEST, 80BZA,120BZA,160BZA & 320BZA.

AZ SERIES

Vortex





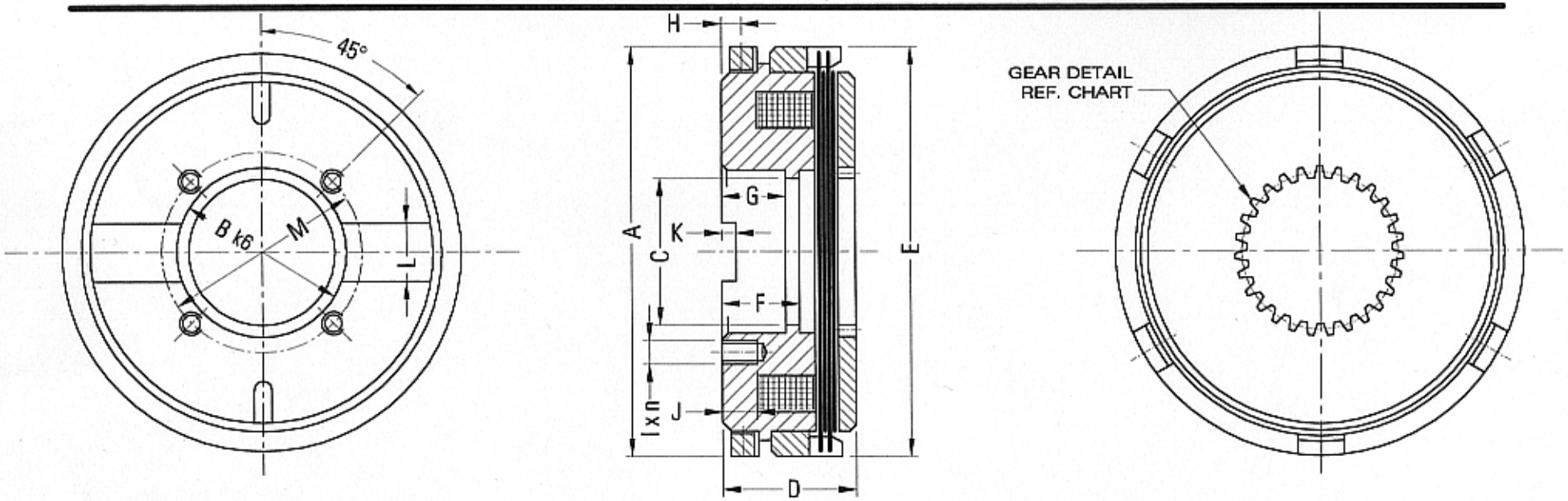


SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)														GEAR DATA			NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I x n	J	K	L	M x N		No.of teeth	Mod.	P/A	I	O	A/G			
1	0.5AZA	0.7	0.5	70	27	25	70	23	3.5	1.5	14	M4 3	6	26.5	32	6	1	15	1.5	20°	2	2	0.7	55	10	24 V
2	01AZA	2	1	82	36	34	80	29.5	5.5	1.5	16.5	M4 3	10	35.7	41	6	1	20	1.5	20°	4	4	1.2	39	15	
3	05AZA	10	5	114	52	32	114	46	6	2	26	M6 4	12	34.2	60	10	1	27	1.75	20°	5	5	1.8	26	22	
4	20AZA	40	20	166	80	40	166	58.5	7	2.5	30	M10 5	15	45.4	92	16	2	27	2.5	20°	5	5	2.5	14	41	
5	40AZA	70	20	195	90	45	195	68.5	7	3	33.5	M10 5	18	51.2	110	14	4	33	2.5	20°	6	6	3.5	9.8	59	
6	60AZB	110	60	210	100	50	210	73.5	7	3	35	M10 5	20	56.2	120	14	4	36	2.5	20°	6	6	4.0	7.3	79	
7	80AZA	180	100	240	110	75	240	77	8.5	3	37	M12 5	20	79.1	136	20	4	42	2.5	20°	6	6	5.0	6.5	88	
8	120AZA	240	130	258	123	85	258	80	8.5	3	35	M12 5	20	89.1	160	22	4	54	2.5	20°	8	8	4.0	4.6	130	

NOTE : AVAILABLE ON REQUEST,160AZA & 320AZA.

CZ SERIES

Vortex

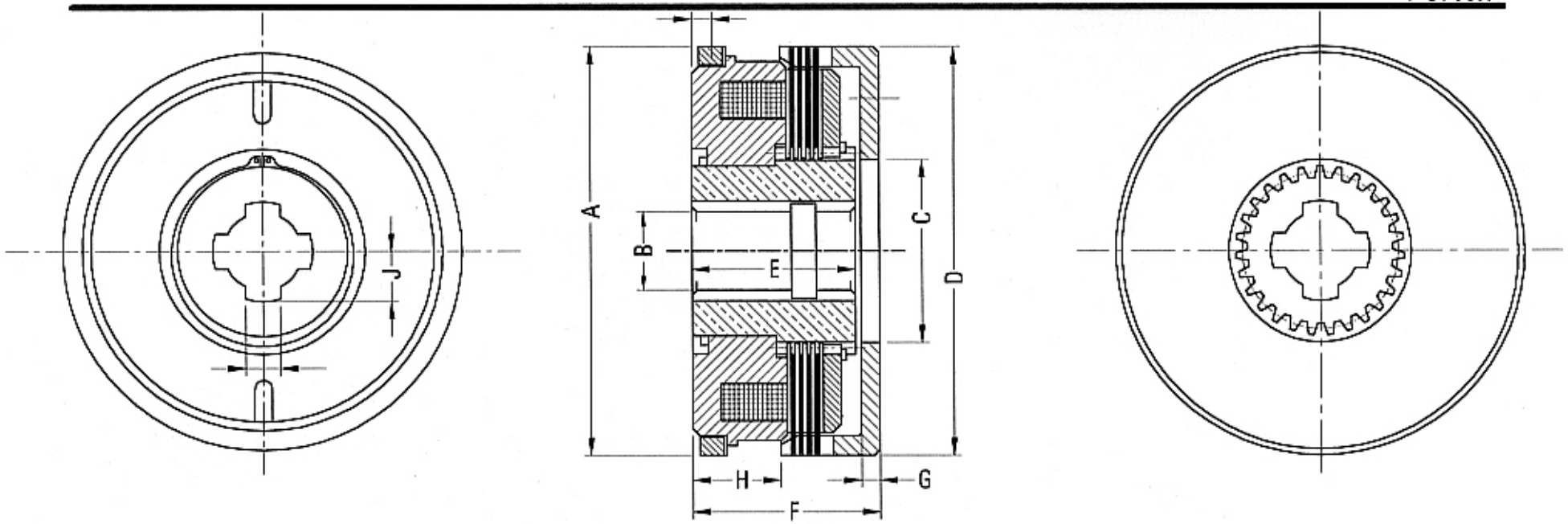


SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)													GEAR DATA			NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I x n	J	K	L	M	No.of teeth	Mod.	P/A	I	O	A/G			
1	01CZA	2	1	82	35	31	31	80	19	17	7.5	M5 4	5	2.5	12	50	20	1.5	20°	4	4	1.2	32	15	24 V
2	02CZA	5	2	95	42	37	38	93	22	20	7.5	M6 4	5	2.5	12	56	27	1.5	20°	4	4	1.2	32	18	
3	05CZA	10	5.5	114	55	45	49.5	114	27	22	11	M8 4	7	5	14	75	27	1.75	20°	5	5	1.8	26	22	
4	10CZA	20	10	140	68	60	55	140	29	22	11	M8 4	8	5	16	90	31	2.0	20°	5	5	2.0	21	27	
5	20CZA	40	20	166	75	65	58.5	166	30	25	13	M10 4	10	6	20	100	27	2.5	20°	5	5	2.5	14	41	
6	40CZB	80	40	195	90	80	69	195	34	28	13	M10 4	12	6	20	116	33	2.5	20°	6	6	3.5	9.8	59	
7	60CZA	110	60	210	100	90	77.5	210	39	31	14.5	M12 4	16	6	20	130	36	2.5	20°	6	6	4.0	7.3	79	
8	80CZA	180	100	240	110	100	80	240	40	32	14.5	M12 4	18	6	25	145	42	2.5	20°	6	6	5.0	6.5	89	

NOTE : AVAILABLE ON REQUEST, 120CZA,160CZA & 320CZA.

DY SERIES

Vortex

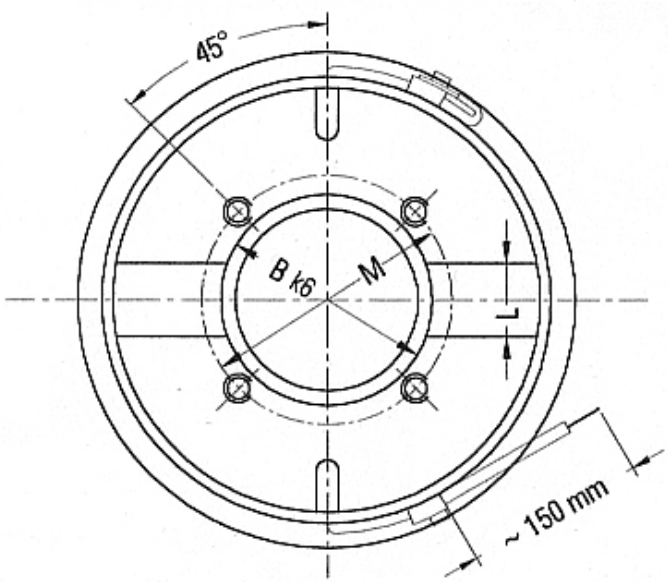


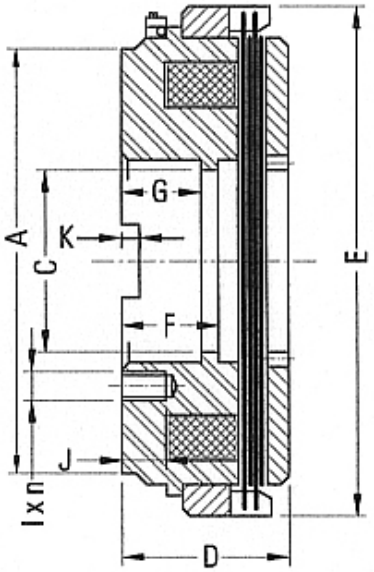
SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)											NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I	x	n	J	I	O	A/G		
1	01DYA	2	1	82	16	34	82	33	38	5	16	5		1	9.3	3	3	1.0	39	15	
2	02DYA	5	2	95	21	45	95	41	46	5	23.5	8		4	12.5	5	4	1.2	32	18	
3	05DYA	10	5.5	114	28	51	114	49	55	6	26	10		4	16	6	5	1.8	26	22	
4	10DYB	20	10	134	40	70	134	56	61.5	6	29	12		1	22.1	6	5	2.0	20	29	24 V
5	10DYC	20	10	134	30	60	134	56	61.5	6	29	8		1	16.8	6	5	2.0	20	29	
6	10DYD	20	10	134	42	60	134	56	61.5	6	29	12		1	23.1	6	5	2.0	20	29	
7	20DYA	40	20	166	46	75	166	64	71	8	33	14		4	26	6	5	2.5	14	41	
8	20DYB	40	20	166	42	75	166	64	71	8	33	12		1	23.1	6	5	2.5	14	41	

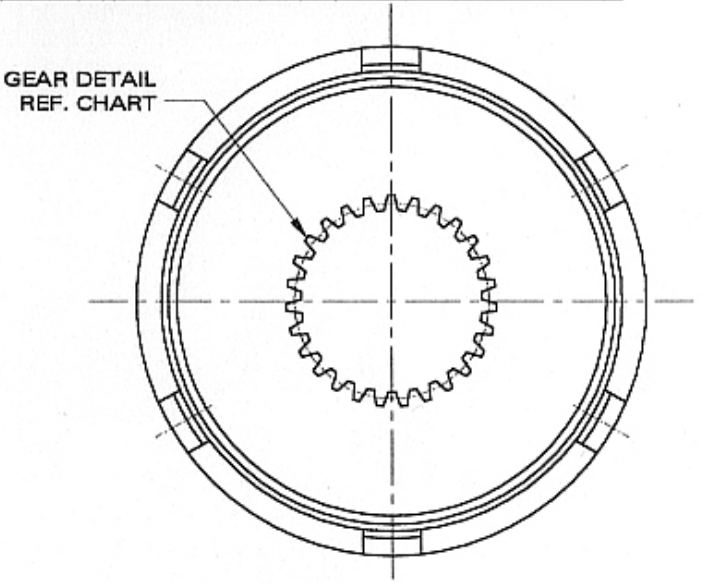
NOTE :BORE COULD BE SUITED TO CUSTOMER REQUIREMENTS, ALSO AVAILABLE ON REQUEST, 40DYA & 60DYA.

PZ SERIES

Vortex





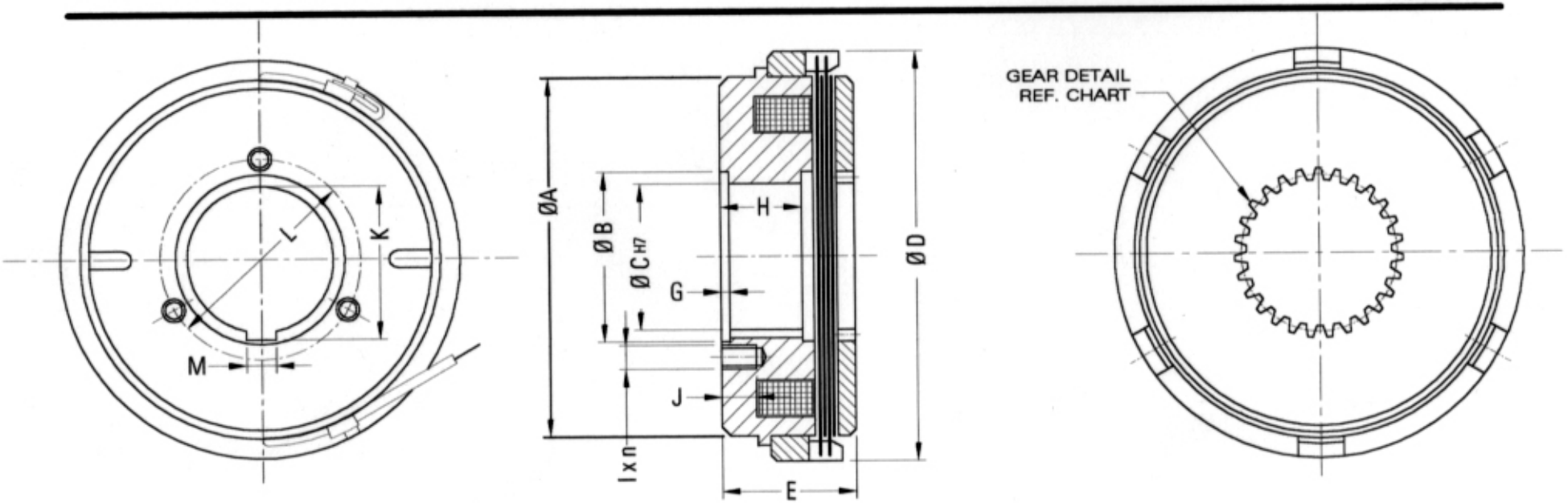


SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)													GEAR DATA			NO.OF PLATES			COIL RESISTANCE at 25°c (Ω ohms)	POWER at 25°c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I x n	J	K	L	M	No.of teeth	Mod.	P/A	I	O	A/G			
1	01PZA	2	1	67	35	31	31	80	19	17	7.5	M5 4	5	2.5	12	50	20	1.5	20°	4	4	1.0	39	15	24 V
2	02PZA	5	2	78	42	37	38	93	22	20	7.5	M6 4	5	2.5	12	56	27	1.5	20°	4	4	1.2	32	18	
3	05PZA	10	5.5	95	55	45	49.5	114	27	22	11	M8 4	7	5	14	75	27	1.75	20°	5	5	1.8	26	22	
4	10PZA	20	10	120	68	60	55	140	29	22	11	M8 4	8	5	16	90	31	2.0	20°	5	5	2.0	21	27	
5	20PZA	40	20	142	75	65	58.5	166	30	25	13	M10 4	10	6	20	100	27	2.5	20°	5	5	2.5	14	41	
6	40PZA	80	40	170	90	80	69	195	34	28	13	M10 4	12	6	20	116	33	2.5	20°	6	6	3.5	9.8	59	
7	60PZA	110	60	184	100	90	77.5	210	39	31	14.5	M12 4	16	6	20	130	36	2.5	20°	6	6	4.0	7.3	79	
8	80PZA	180	100	216	110	100	80	240	40	32	14.5	M12 4	18	6	25	145	42	2.5	20°	6	6	5.0	6.5	89	

NOTE : AVAILABLE ON REQUEST, 120PZA,160PZA & 320PZA.

RZ SERIES

Vortex

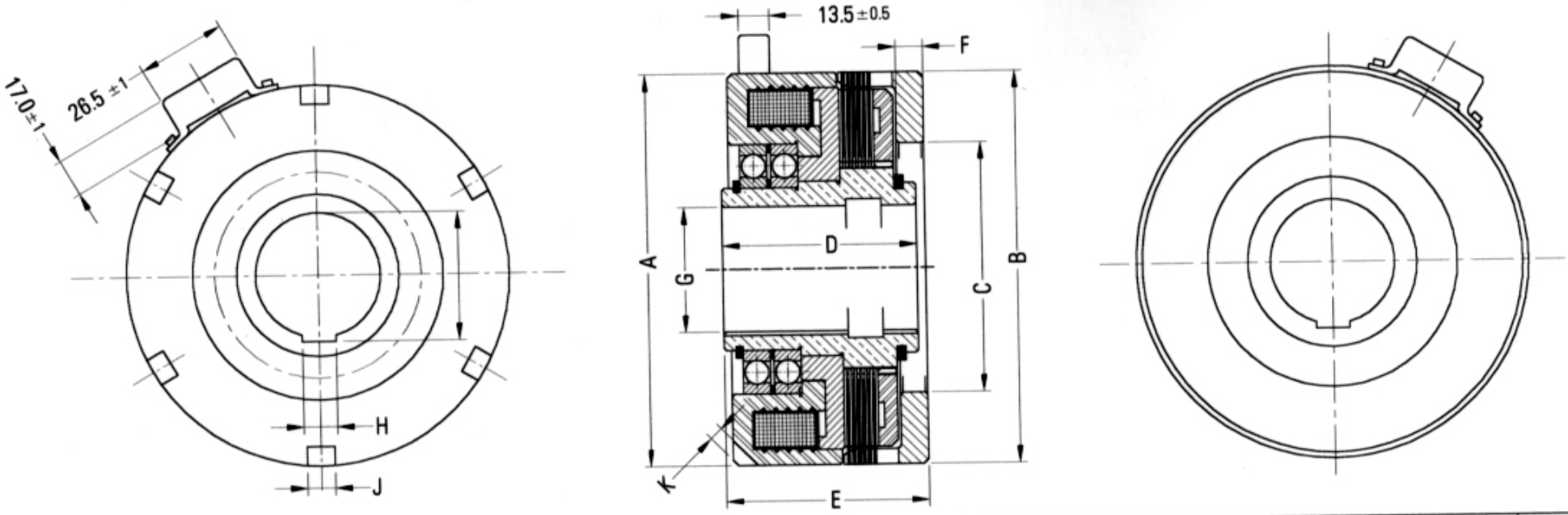


SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)												GEAR DATA			NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	G	H	I x n	J	K	L	M x n	No.of teeth	Mod.	P/A	I	O	A/G			
1	0.5RZA	0.7	0.5	67	27	25	70	23	1.5	14	M4 3	6	26.5	32	6 1	15	1.5	20°	2	2	0.7	55	10	24 V
2	01RZA	2	1	78	36	34	80	29.5	1.5	16.5	M4 3	10	35.7	41	6 1	20	1.5	20°	4	4	1.2	39	15	
3	05RZA	10	5	95	52	32	114	46	2	26	M6 4	12	34.2	60	10 1	27	1.75	20°	5	5	1.8	26	22	
4	20RZA	40	20	120	80	40	166	58.5	2.5	30	M10 5	15	45.4	92	16 2	27	2.5	20°	5	5	2.5	14	41	
5	40RZA	70	20	142	90	45	195	68.5	3	33.5	M10 5	18	51.2	110	14 4	33	2.5	20°	6	6	3.5	9.8	59	
6	60RZB	110	60	170	100	50	210	73.5	3	35	M10 5	20	56.2	120	14 4	36	2.5	20°	6	6	4.0	7.3	79	
7	80RZA	180	100	184	110	75	240	77	3	37	M12 5	20	79.1	136	20 4	42	2.5	20°	6	6	5.0	6.5	88	
8	120RZA	240	130	216	123	85	258	80	3	35	M12 5	20	89.1	160	22 4	54	2.5	20°	8	8	4.0	4.6	130	

NOTE : AVAILABLE ON REQUEST,160RZA & 320RZA.

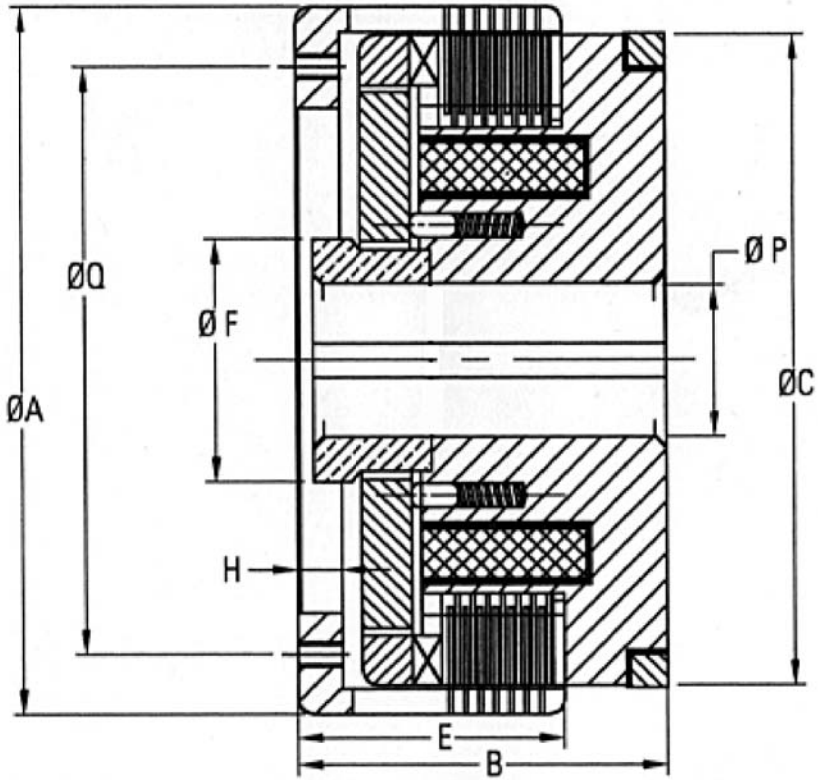
SY SERIES

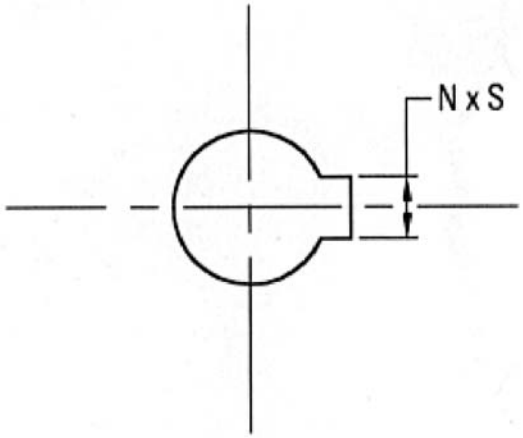
Vortex



SR NO.	MODEL NO.	TORQUE IN (kg-m)		OVERALL DIMENSIONS (MM)											NO.OF PLATES			COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
		STA.	DYN.	A	B	C	D	E	F	G	H	I	J	K	I	O	A/G			
1	02SYA	4	2.5	95	95	60	52	58	5	25	8	28.3	6	3	5	4	1.0	15	37	24 V
2	05SYA	10	5	114	114	70	57	64.5	6	30	8	31.9	6	4	6	5	1.4	14	42	
3	10SYA	20	10	134	134	80	60	70	8	40	12	42.5	8	5	6	5	2.0	9.5	63	
4	15SYA	25	15	147	147	100	65	72	6	30	8	33.3	8	5	6	5	2.2	10	53	
5	20SYB	40	20	157	157	100	67	81	9	50	14	52.5	8	6	6	5	2.5	9	60	
6	20SYA	40	25	165	165	100	67	76	8	35	8	38	8	6	6	5	2.5	7	85	
7	30SYA	50	30	165	165	90	82	90	8	50	14	54	8	6	7	6	3.0	6	98	
8	40SYA	80	40	195	195	102	85	94	12	60	18	63	10	8	6	5	3.5	7	89	

NOTE :ALSO AVAILABLE WITH DIFFERENT BORE DIMENSIONS AS PER CUSTOMER REQUIREMENTS.
ALSO AVAILABLE WITHCONNECTING WIRE LEADS.



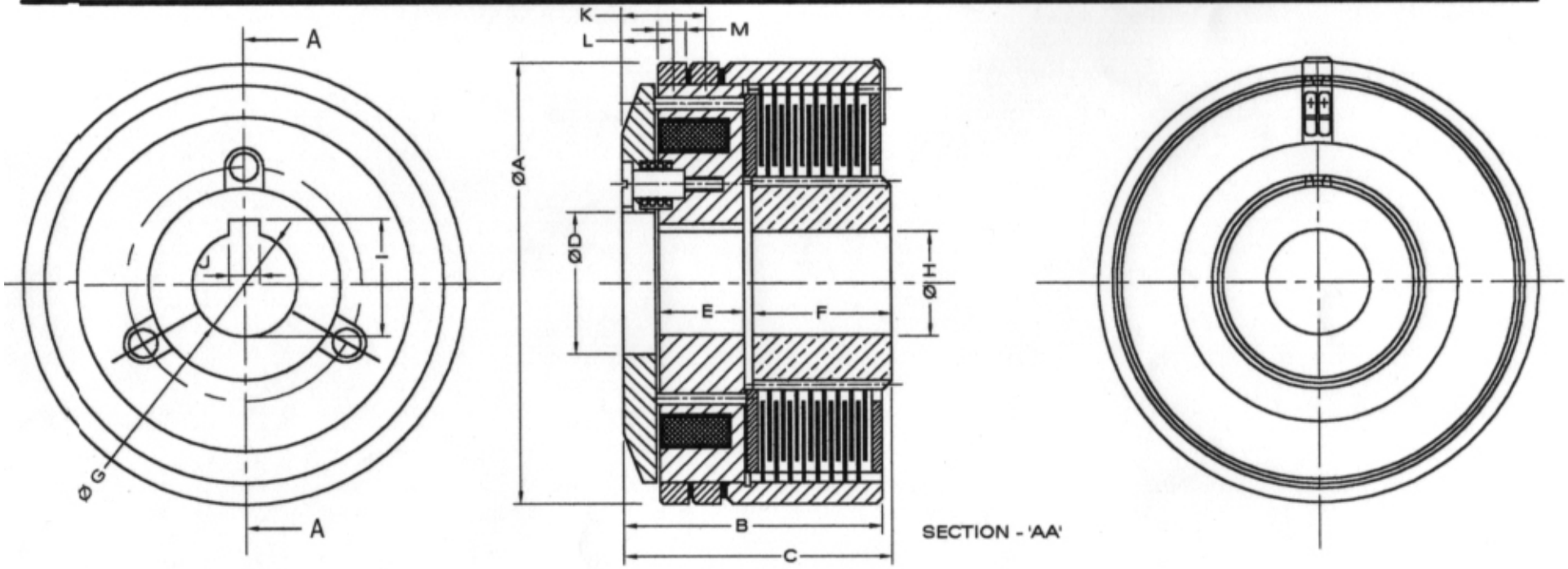


SR NO.	MODEL NO.	TORQUE IN (kg-Nm)		OVERALL DIMENSIONS (MM)							MOUNTING DIM. (mm)			KEY WAY DIM.(mm)		COIL RESISTANCE at 25°C Ω (ohms)	POWER CONSUMP. at 25°C (WATTS)	VOLTAGE (VOLTS)
				A	B	C	E	F	G	H	Q	NO.OF HOLES	SIZE	P (MAX)	WIDTH (N x S)			
1	01KZA-S	20	12	100	45	100	33	35	42	5	85	4	M6	22	2 x 6	22	26	
2	02KZA-S	40	25	110	48	110	34	42	45	5	90	4	M6	28	2 x 6	22	27	
3	04KZA-S	63	40	120	52	120	39	48	48	6	100	6	M6	32	3 x 6	17	33	
4	06KZA-S	100	63	132	55	132	43	52	50	7	105	6	M8	35	3 x 6	13	43	
5	10KZA-S	160	100	147	58	145	45	58	53	7	120	6	M8	42	3 x 8	13	43	
6	16KZA-S	250	160	162	62	160	47	65	57	7	135	6	M8	48	3 x 8	12	47	24V
7	25KZA-S	400	250	182	68	180	52	72	63	8	155	6	M10	55	3 x 10	10.5	55	
8	41KZA-S	630	400	202	76	202	61	82	70	9	170	6	M10	60	3 x 10	9.3	62	
9	64KZA-S	1000	630	235	86	230	70	95	80	10	200	6	M12	70	3 x 14	8.3	70	
10	100KZA-S	1600	1000	270	100	255	75	105	92	12	235	6	M12	80	3 x 14	7.3	79	
11	161KZA-S	2500	1600	310	115	295	90	120	107	14	260	6	M12	90	3 x 16	6	97	

NOTE : ALSO AVAILABLE : 250 KZA-S, 400 KZA-S, 630 KZA-S AND 1000 KZA-S ON REQUEST (STEEL - SINTERED BRONZE Combination)
ALSO AVAILABLE : KZA-T VERSIONS OF ALL SIZES FOR DRY APPLICATIONS (STEEL - ORGANIC LINING Combination)

LZ SERIES

Vortex

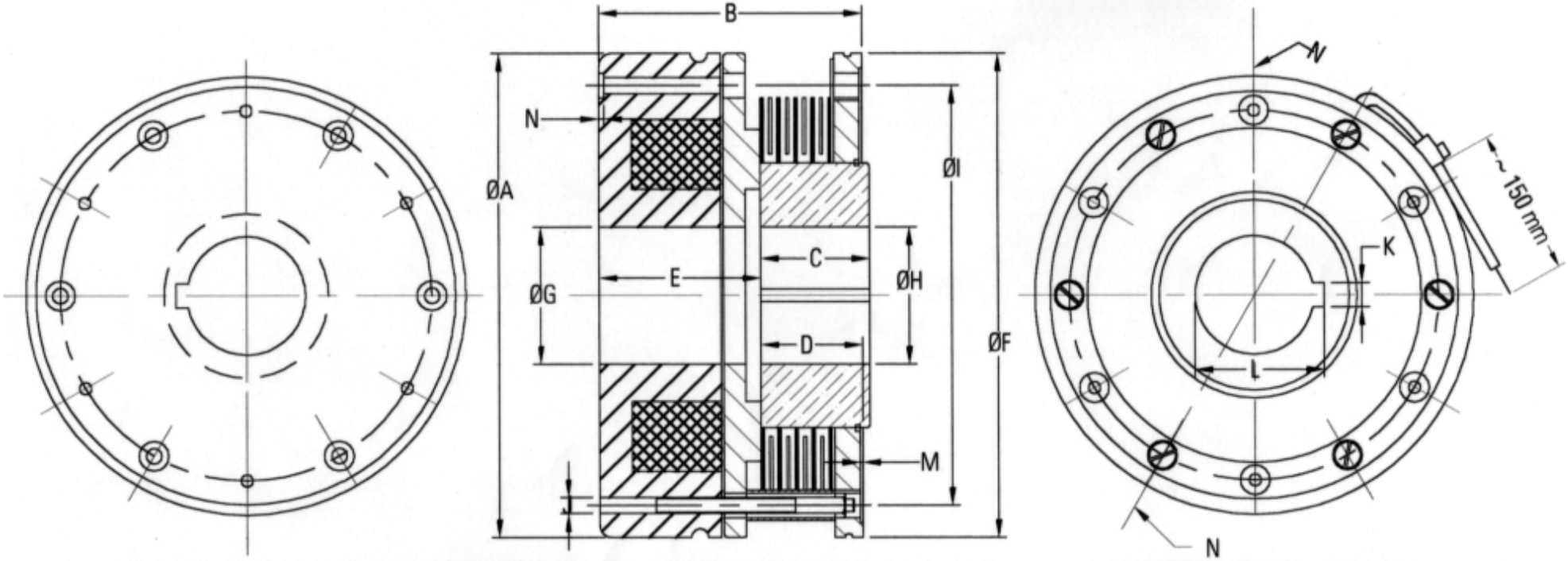


SR NO.	MODEL NO.	TORQUE IN (kg-m)	OVERALL DIMENSIONS (MM)						MOUNTING DIM. (mm)				SLIPRING DIM. (mm)			RESISTANCE AT 25°C Ω (ohms)	POWER CONSUMP. AT 25°C (watts)	VOLTAGE (volts)
			A	B	C	D	E	F	G	H	I	J	K	L	M			
1	03 LZA	2.5	95.5	43.2	46.2	43	21.5	14	35	35	37.5	10	20	10.7	7.5	29	20	
2	05 LZA	5	116.5	54.5	57.5	57	23.5	21.5	48	48	50.9	14	22.5	12.7	8	26	22	
3	10 LZA	10	140.5	64.5	67.5	66	24	28.5	56	56	59.4	16	24.3	14	8.5	17	31	
4	20 LZA	20	166.5	70.3	73.3	78	26	31	66	66	69.8	20	27.5	16.8	8.5	11	55	24V
5	40 LZA	40	210.5	80.5	83.5	93	31	33	80	80	--	--	33.2	20.6	10	8	75	
6	80 LZA	80	240.5	102	105	109	41	39	95	95	--	--	40.2	23	10	6	110	
7	160 LZA	160	295.5	110	113	125	41	44.5	110	110	--	--	43.5	25.5	12	4	160	

NOTE : ALSO AVAILABLE IN STEEL - ORGANIC LINING Combination (LZA - T series) for dry applications
ALSO AVAILABLE IN STEEL - SINTERED BRONZE Combination (LZA - S series) for wet applications

FS SERIES

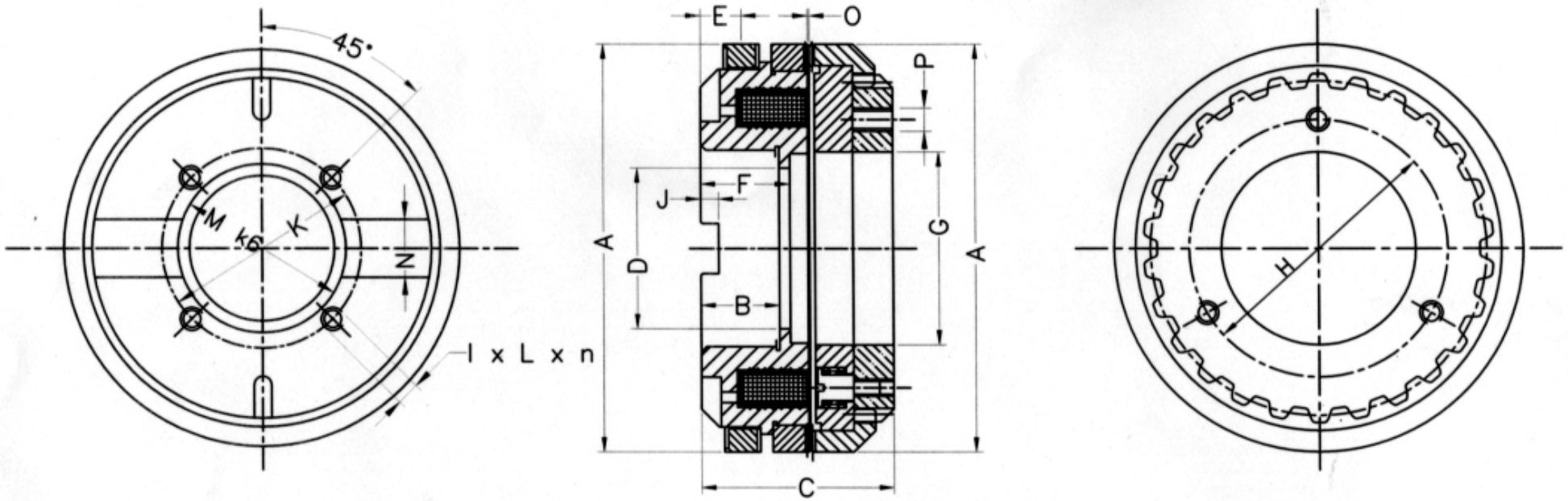
Vortex



SR NO.	MODEL NO.	TORQUE IN (kg-m)	OVERALL DIMENSIONS (mm)						MOUNTING DIMENSION (mm)								COIL Resistance at 25°C (ohms)	POWER at 25°C (WATTS)	VOLTAGE (VOLTS)
			A	B	C	D	E	F	G	H	I	J	K	L	M	N			
1	01 FSB	0.8	100	61	30	20	41	88	31	25	75	5.5	6	27.5	2.5	1.5	21	28	
2	02 FSB	1.8	115	65	35	23.5	41.5	100	39	35	90	5.5	8	38.3	2.5	1.5	15	39	
3	03 FSB	3.5	135	75	40	27.0	48	120	45	40	110	6.5	8	43.3	2.5	1.5	13	43	24 v
4	08 FSB	7.5	165	95	45	34.5	60.5	150	62	50	140	6.5	12	53.3	2.5	2	11	54	
5	15 FSB	15	190	105	55	37.5	67.5	170	67	60	160	8.5	14	63.8	3	3	6	108	
6	30 FSB	30	220	120	60	45	75	195	72	60	180	10.5	14	63.8	3	3	5	124	
7	60 FSB	60	250	138	70	54	84	222	80	70	205	12.5	18	74.4	4.5	4	4	139	

EX SERIES

VORTEX

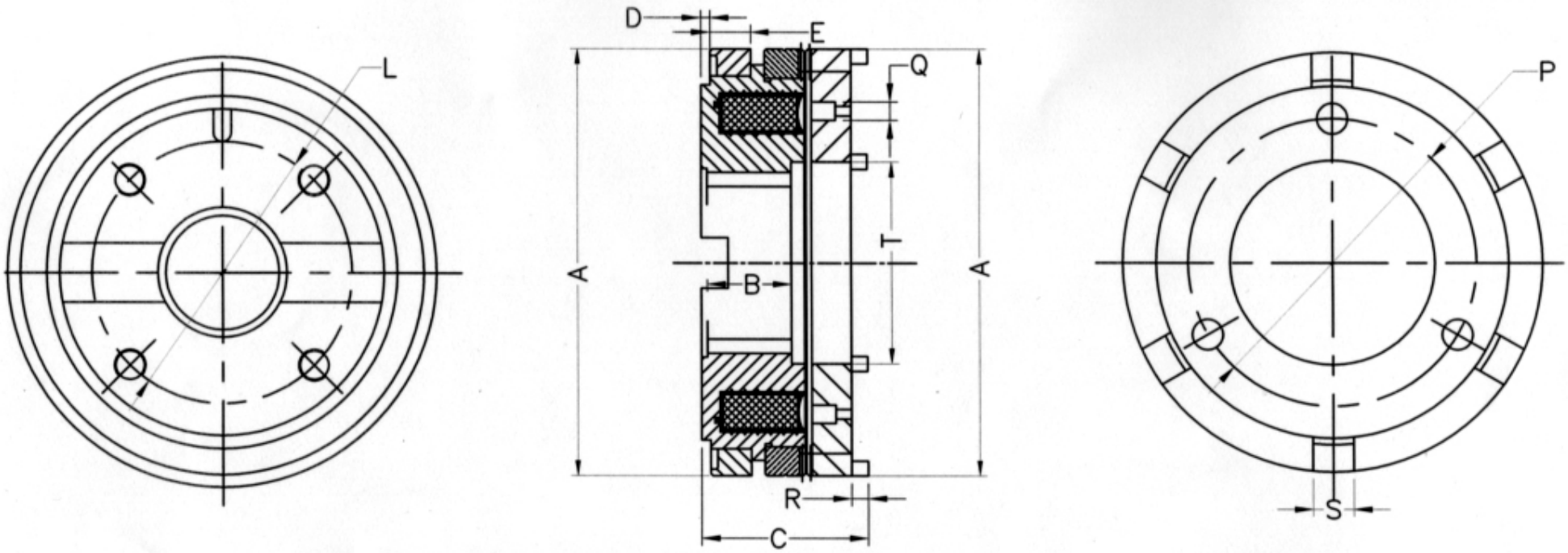


SR NO.	MODEL NO.	TORQUE IN (kg-m)	OVERALL DIMENSIONS (MM)															COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
			A	B	C	D	E	F	G	H	I x L x n	J	K	M	N	O	P			
1	01EXA	10	82	20	39	31	7.5	22.5	35	55	M5 5 3	2.5	50	35	12	0.5	M4	34	17	24 V
2	02EXA	20	95	20	40	37	7.5	22	45	65	M6 5 4	2.5	56	42	12	0.7	M4	24	24	
3	05EXA	35	114	22	47	45	11	25	53	80	M8 6 4	5	75	55	14	0.7	M4	14	42	
4	10EXA	60	140	22	54	60	11	28	70	100	M8 8 4	5	90	68	16	0.7	M5	12	49	
5	20EXA	120	166	25	60	65	13	30	80	120	M10 9 5	6	100	75	20	0.7	M6	8.3	69	
6	40EXA	220	195	28	67	100	13	34	110	150	M10 14 5	6	125	110	20	0.7	M6	7.4	77	
7	60EXA	300	210	31	77	90	14.5	39	100	150	M12 16 5	6	130	100	20	0.7	M6	6.6	87	
8	80EXA	400	240	40	84	100	14.5	40	112	150	M12 18 5	6	145	110	25	0.7	M6	5.9	100	

AVAILABLE ON REQUEST : EXA120 & 160 EXA

EX SERIES

Vortex

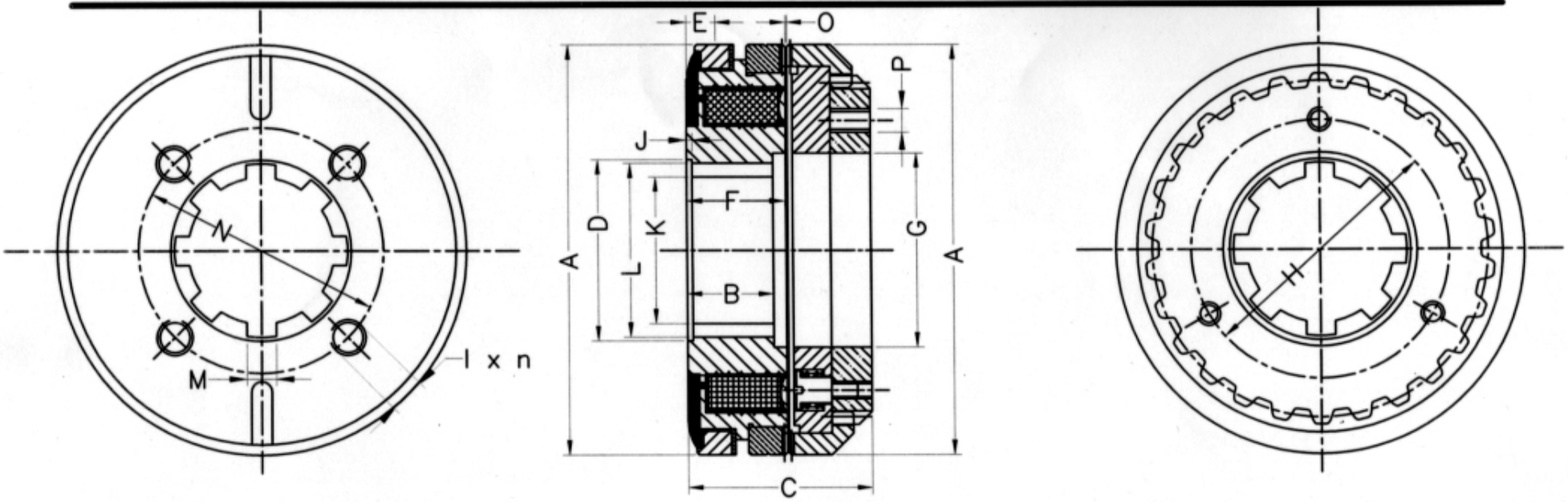


SR NO.	MODEL NO.	TORQUE IN (kg–m)	OVERALL DIMENSIONS (MM)							DRIVE END DIMENSIONS(mm)				DRIVE END DIMENSIONS(mm)				AIR GAP (mm)	COIL RESISTANCE at 25°C Ω (ohms)	POWER CONSUMP. at 25°C (WATTS)	VOLTAGE (VOLTS)
			A	B	C	D	E	F	G	J	K	L	SIZE OF HOLES	P	Q	R	S				
1	01EXB	10	82	35	20	35	39	8	3.5	41	2.5	50	M5	55	9	6	8	0.5	34	17	24 v
2	02EXB	20	95	42	20	45	40	10	3	50	2.5	56	M6	65	9	6	8	0.7	24	24	
3	05EXB	35	114	55	22	53	47	10	3	60	5	75	M8	80	9	6	8	0.7	14	42	
4	10EXB	60	140	68	22	70	54	10	6	80	5	90	M8	100	12	10	10	0.7	12	49	
5	20EXB	120	166	75	25	80	60	10	8	92	6	100	M10	120	12	12	12	0.7	8.3	69	
6	40EXB	220	195	110	28	110	67	10	8	110	6	125	M10	150	15	15	15	0.7	7.4	77	

NOTE : ALSO AVAILABLE WITH GEAR ADAPTER PLATES AND GEARED DRIVEN END (EXA SERIES)
ALSO AVAILABLE 60EXB, 80EXB AND 120EXB ON REQUEST
ALSO AVAILABLE SPECIAL BACKLASH FREE VERSIONS ON REQUEST

FX SERIES

Vortex

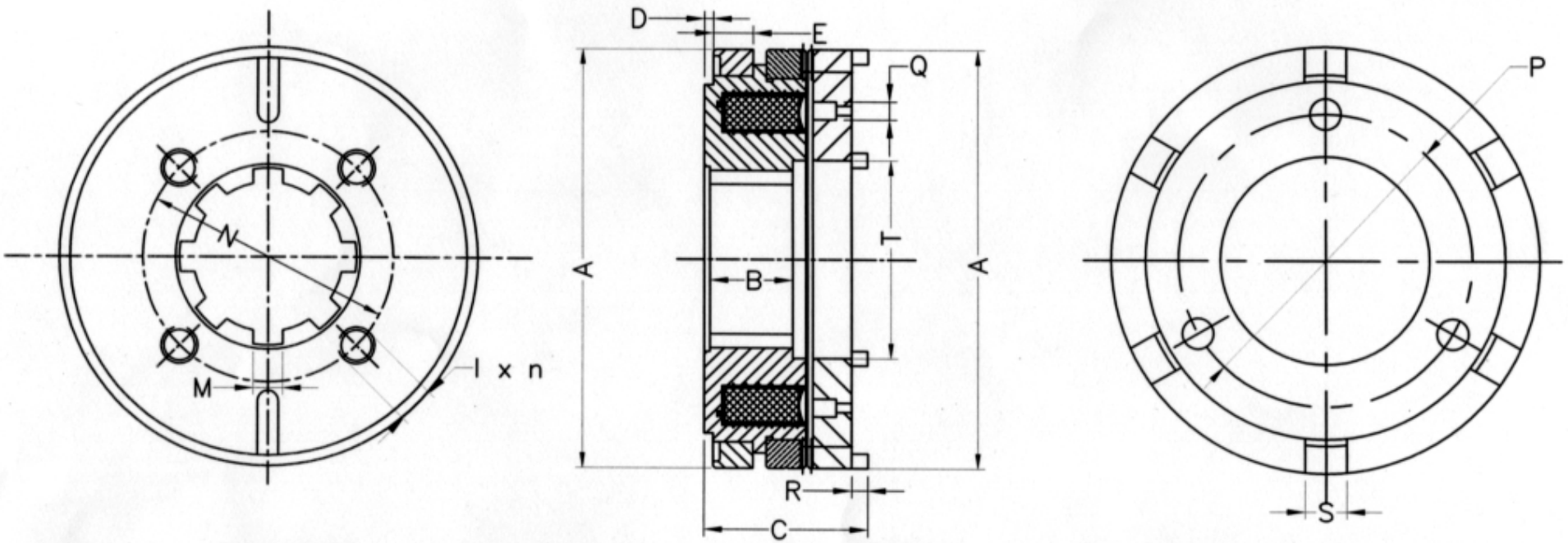


SR NO.	MODEL NO.	TORQUE IN (kg–m)	OVERALL DIMENSIONS (MM)																COIL RESISTANCE at 25° c (Ω ohms)	POWER at 25° c (Watt)	VOLTAGE (VOLTS)
			A	B	C	D	E	F	G	H	I x n	J	K	L	M x n	N	O	P			
1	01FXA	10	82	23	37	36	5.5	23	35	55	M4 3	1.5	34	36	6 3	41	0.5	M4	34	17	24 V
2	02FXA	20	95	20	38	42	5.5	23	45	65	M6 4	1.5	36	40	7 8	50	0.7	M4	24	24	
3	05FXA	35	114	23	43	52	6	26	53	80	M6 4	2	46	50	9 8	60	0.7	M4	14	42	
4	10FXA	60	140	26	51	70	7	30	70	100	M6 4	2	62	68	10 8	80	0.7	M5	12	49	
5	20FXA	120	166	30	60	80	7	35	80	120	M10 5	2.5	72	78	12 10	92	0.7	M6	8.3	69	
6	40FXA	220	195	33.5	68	90	7	38.5	89	150	M10 5	3	82	88	14 10	110	0.7	M6	7.4	77	
7	60FXA	300	210	35	73	100	8.5	38	100	150	M10 5	3	92	98	16 10	120	0.7	M6	6.6	87	
8	80FXA	400	240	42	81	110.5	8.5	42	112	150	M12 5	3	102	108	16 10	140	0.7	M6	5.9	100	

NOTE : AVAILABLE ON REQUEST, 120FXA &160FXA.

FX SERIES

Vortex

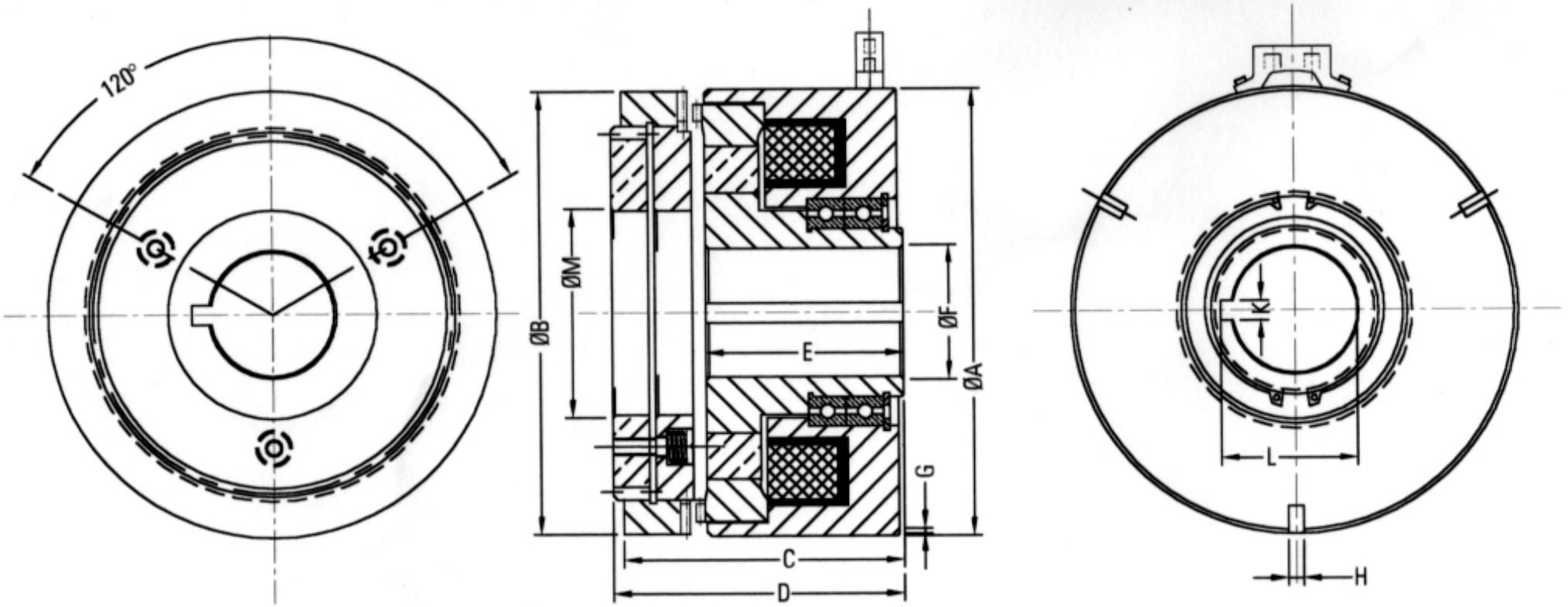


SR NO.	MODEL NO.	TORQUE IN (kg-m)	OVERALL DIMENSIONS					SPLINE / KEY (mm)	DRIVE END DIMENSIONS(mm)			DRIVE END DIMENSIONS(mm)					AIR GAP (mm)	COIL RESISTANCE at 25°C Ω (ohms)	POWER CONSUMP. at 25°C (WATTS)	VOLTAGE (VOLTS)
			A	B	C	D	E		F	NO.OF HOLES	SIZE	P	Q	T	R	S				
1	01FXB	10	82	23	37	2	8	34 x 36 x 6.3	41	3	M4	55	9	6	8	35	0.5	34	17	24 v
2	02FXB	20	95	20	38	1.5	8	40 x 36 x 7.8	50	4	M6	65	9	6	8	45	0.7	24	24	
3	05FXB	35	114	23	43	1.5	10	50 x 46 x 9.8	60	4	M6	80	9	6	8	53	0.7	14	42	
4	10FXB	60	140	26	51	2	10	68 x 62 x 10.8	80	4	M6	100	12	10	10	70	0.7	12	49	
5	20FXB	120	166	30	60	2	10	78 x 72 x 12.10	92	5	M10	120	12	12	12	80	0.7	8.3	69	
6	40FXB	220	195	33.5	63	2	10	88 x 82 x 14.10	110	5	M10	150	15	15	15	89	0.7	7.4	77	

NOTE : ALSO AVAILABLE WITH GEAR ADAPTER PLATES AND GEARED DRIVEN END (FXA Series)
ALSO AVAILABLE 60FXA, 80FXA AND 120FXA ON REQUEST
ALSO AVAILABLE SPECIAL BACKLASH FREE VERSIONS ON REQUEST

SX SERIES

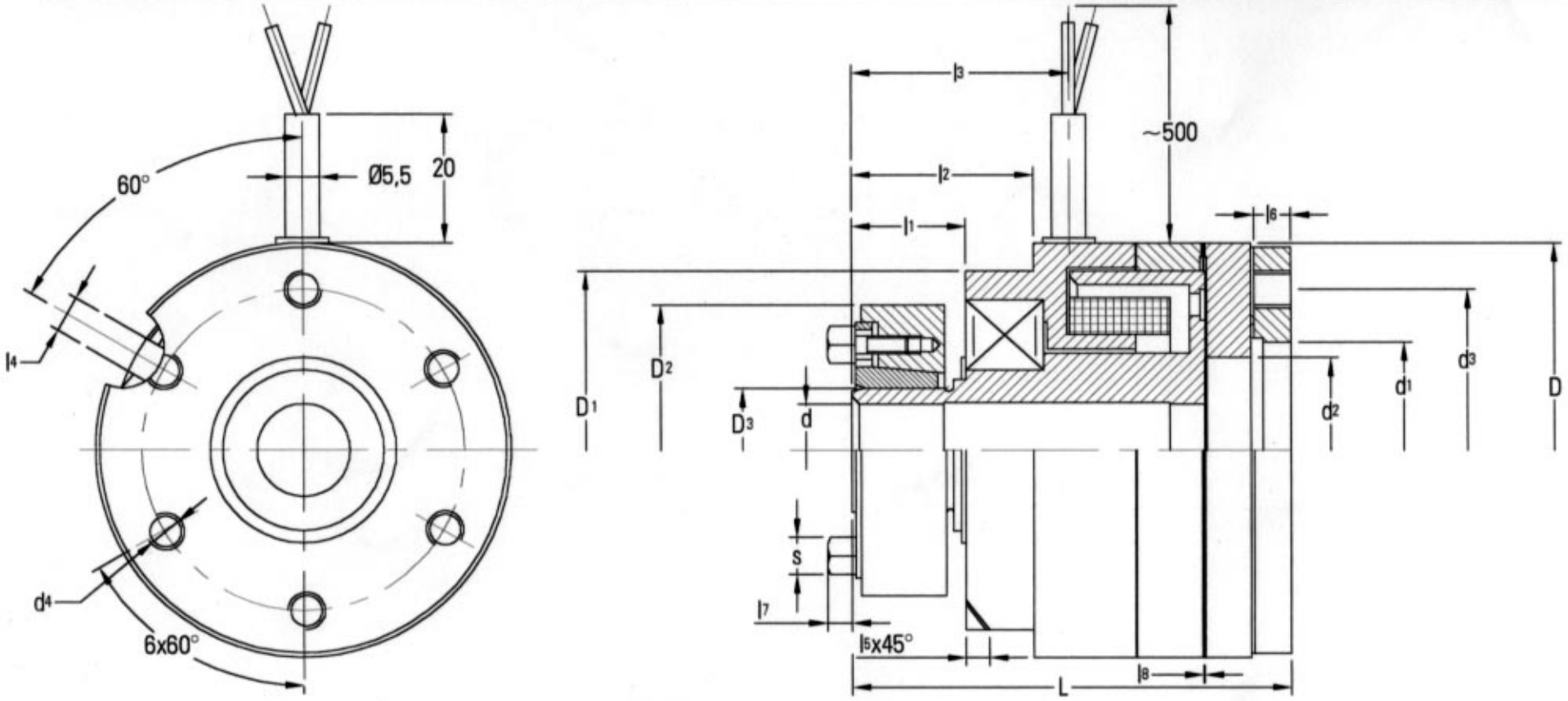
Vortex



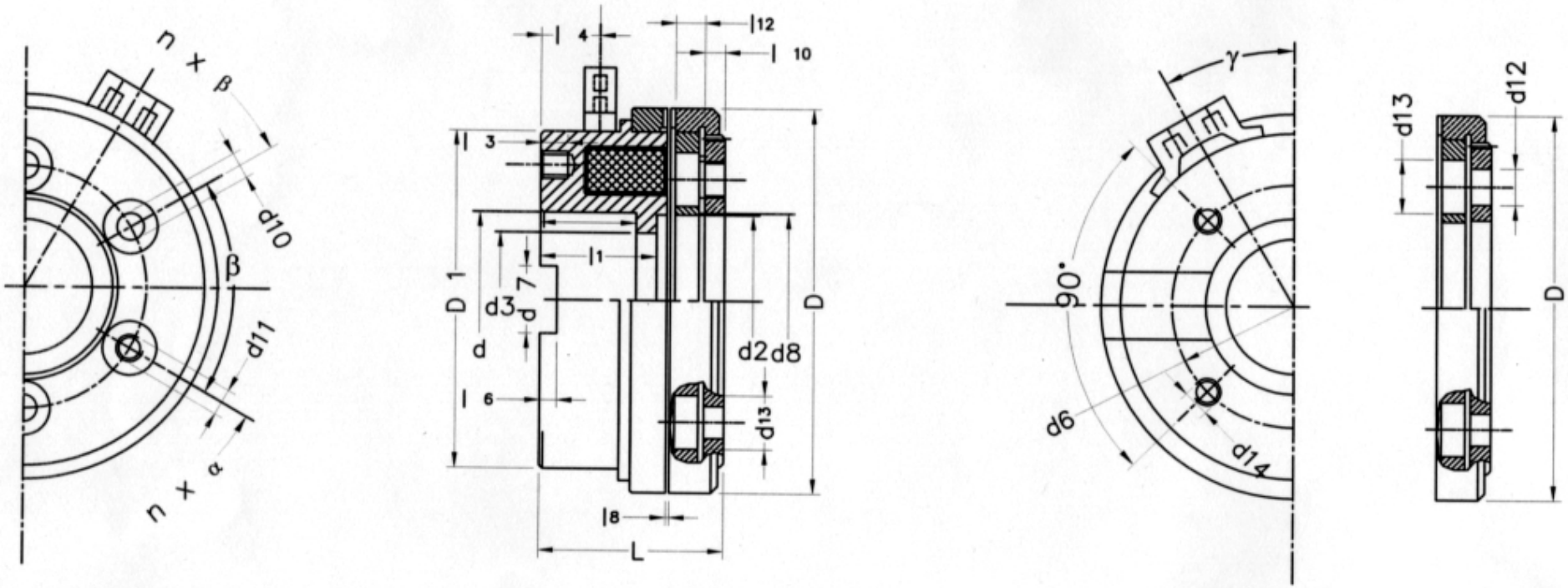
SR NO.	MODEL NO.	TORQUE IN (kg-m)	OVERALL DIMENSIONS (mm)						MOUNTING DIMENSIONS					AIR GAP (mm)	RESISTANCE at 25°C (ohms)	POWER CONSUMP. at 25°C (WATTS)	VOLTAGE (VOLTS)
			A	B	C	D	E	M	F	G	H	K	L				
1	01 SXA	10	82	80	54	57	37	38	25	3	6	8	26.7	0.5	14	42	
2	02 SXA	20	95	93	59	62	41	46	35	4	6	10	37.1	0.7	11	52	
3	05 SXA	30	114	109	66	69	44	56	38	4	8	10	40.1	0.7	9	64	24 v
4	10 SXA	60	134	127	80	83	54	62	46	5	8	14	48.6	0.7	7	85	
5	20 SXA	140	166	162	90	93.5	61	79	60	6	8	18	63.1	0.7	3	115	
6	40 SXA	200	195	195	96	99	65	100	65	8	12	18	68.1	0.4	4	140	
7	60 SXA	300	210	210	111	113	74	105	68	8	12	20	72.1	0.4	3	170	

SX SERIES

Vortex



SR. NO.	Size	Torque	Max. speed	Input power	bore (mm)	Torque for screws	s	Dimensions (mm)																	A.G
								D	D_1	D_2	D_3	d_1	d_2	d_3	d_4	L	l	l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8
1	02SXB	25	1500	19	15	5	8	67	58	47	20	35	30	52	M5	71	57	18.5	29.5	35.2	6	5	6.0	4	0.2
2	05SXB	50	1500	21	20	5	8	82	75	60	30	47	38	65	M6	84	67	26.5	38.5	44.5	8	6	7.5	4	0.2
3	10SXB	75	1500	27	25	12	10	95	88	72	36	52	48	75	M8	93	73	28	42	48	10	6	9.5	4	0.2
4	20SXB	150	1500	36	30	12	10	114	105	80	44	62	54	90	M10	104	81	30.8	48.8	54.8	10	6	11.5	4	0.2
5	40SXB	300	1500	57	40	12	10	134	127	100	55	68	67	105	M12	123	96	36	56	63	10	8	13.5	4	0.2



SR. NO.	SIZE	TORQUE Nm	INPUT POWER W	DIMENSIONS (mm)																									
				d	D	D_1	d_1	d_3	d_6	d_2	d_{10}	d_{12}	d_{14}	L	l_1	l_3	l_7	l_8	l	d_5	d_{11}	d_{13}	l_4	l_6	l_{10}	l_{11}	l_{12}
1	0.25RXA	20	10.5	15	57	50	26	20	40	22.5	–	4.8	M4	27	17	4	10	0.2	14	36	M4	8	6.5	2.5	3	1.4	4.3
2	0.5RXA	40	14.5	20	67	60	32	27	46	31	4.5	4.8	M5	31	19	5	10	0.3	14	46	M4	8	7	2.5	3.5	1.5	4.8
3	01RXA	100	22	25	82	74	42	31	50	36.5	4.5	5.8	M6	34.5	19	5	12	0.3	17	60	M5	10	6	2.5	4.8	2.3	6.1
4	02RXA	200	29	35	95	85.5	52	37	56	46	5.5	6.8	M8	43	22	5	12	0.4	20	70	M6	12	6	2.5	6	3	8.7
5	05RXA	350	40	42	114	95	62	45	75	55	7.8	6.8	M8	50	27	8	14	0.4	22	80	M8	12	11.5	5	6.5	3.5	9
6	10RXA	600	56	50	134	120	72	60	90	68	9.5	8.5	M12	57	29	8	16	0.4	22	95	M8	14	12.5	5	8.4	4.5	11
7	20RXA	1200	79	70	166	150	90	65	100	80	9.5	8.5	M12	63.5	30	10	20	0.5	25	120	M10	14	10	6	11.4	5.5	13.1
8	40RXA	2200	82	80	195	178	100	80	150	95	11.5	10.5	M12	68.5	34	12	20	0.5	28	150	M10	17.5	12.5	6	11.7	6.5	14