Armature coil   Brush holder
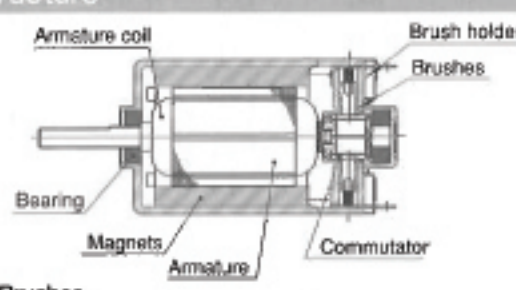   Brushes

Bearing
Magnets   Commutator
Fig. 1

- **Brushes**
  The brush is an important part that serves as a commutating mechanism. The brush's service life (in accordance with wear) will be the service life of the direct-current motor.
- **Commutator**
  In general, copper is the material used, but to counteract how it softens at high temperatures, a small amount of silver is mixed with it.
- **Armature coil**
  In general, electric wire known as magnet wire is used. Wire diameter is selected in accordance with the motor's specifications, and the wire is connected to the commutator bar by means of welding, soldering or other such methods.
- **Armature**
  For the armature, magnetic steel sheet is used to increase magnetic flux density.
- **Magnets**
  Broadly speaking, the magnets used in the motor can be classified in terms of whether they are ferrite, alnico, rare earth, etc. Magnets are selected in accordance with usage purpose, based on their features.
- **Bearing**
  There are ball bearings and sleeve bearings, and they are used in accordance with purpose.
  The ball bearing is the type that is appropriate for uses involving large bending loads.

Current and rotating torque characteristics

The magnet DC motor has dropping characteristics (rotating speed) and rising characteristics, as shown in Figure 2. When applied voltage V is changed, as shown in Figure 2, torque rotating speed characteristics will be proportional to the value for V, but current torque characteristics will only change very slightly. (For details, please refer to the relational expression for current and torque rotating speed.)
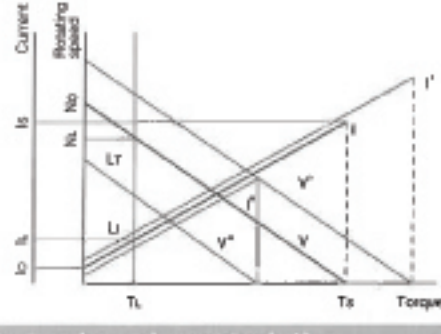

Fig. 2

How to view characteristics

As shown in Figure 2, at applied voltage V, when load torque T is added to the motor, rotating speed and current will be N₁ and I₁, respectively. When V has been changed to V'V', the result can be similarly sought. No-load rotating speed, No₀ and stalling (starting) torque, Ts, will be proportional to the applied voltage; thus, the values for when a 24V motor, for example, is used at 20V

or 18V will be on the order of those shown in Table 1. When changing the rated voltage substantially (from 24V to 6V, for example), it will be necessary to depend on actual measurement.
However, use at something other than the rated voltage could cause abnormal brush wear and startup malfunctions. Thus, we ask that you confirm the usage conditions.

Voltage	No-load rotating speed No	Stalling torque Ts	Stalling current Is
24V	5000r/min	40mN·m	1.0A
20V	20/24 × 5000 4166	20/24 × 40 33	20/24 × 1 0.83
18V	18/24 × 5000 3750	18/24 × 40 30	18/24 × 1 0.75

Table 1

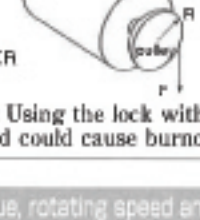### Explanation of Terminology

Term/Symbol	Content
No-load rotating speed No	Rotating speed with no load
No-load current Io	Input current with no load
Stalling torque Ts	Max. value for motor-generated torque. In general, a DC motor's stalling torque is equal to its starting torque.
Load torque TL	When a load with a pulley radius R is attached to the motor and force of F is applied to the pulley's circumference, the torque generated, TL, can be defined by multiplying F and R (F = R × TL).

Fig. 3

Note : Using the lock with low voltage applied could cause burnout.

Relational expressions for torque, rotating speed and current

Relational expressions are as follows.
To give an example from formula 1 is taken to be No₀ when load torque TL is zero, there will be no load. The no-load rotating speed No can be determined from the size of the motor's friction torque, Ts. If Ts is low, the no-load rotating speed from formula 3 will be roughly proportional to the applied voltage. In addition, stalling (starting) torque will equal the load torque when rotating speed N (rpm) from formula 1 is zero, resulting in the following.
Starting torque will be roughly proportional to the applied voltage. Current will be as follows.

From this formula, when load torque TL and friction torque are constant, the current will be constant with no relation to applied voltage. The no-load current will be the value that makes the load torque zero in formula 3, but friction torque Ts will change slightly, in accordance with rotating speed; thus, there will be some change caused by the applied voltage.
If motor output is designated as P (W), torque as T (N · m) and rotating speed as N (r/min), motor output P (W) will be as follows.

P = 6.16 × T × N .... Formula 6
N : Rotating speed   Ts : Motor's friction torque
V : Applied voltage   TL : Load torque
r : Armature-circuit resistance   K₁ and K₂: Motor-specific constant

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Technical Description:

Operating Precautions
DC motors are compact and display high output, and their speed is easy to control. They may be driven by battery or any other power supply and are therefore also easy to use. However, inappropriate power supply may lead to burnout or abnormal brush wear.
Problems with power supply, installation, and general precautions and problems with a motor installed in-circuit will be described.

- **Overload and lock-up**
  An excessive amount of load torque is applied during overloaded driving or when locked-up, causing an excessive current flow with heat damage being incurred by the motor. Therefore, overload or locked-up use is to be avoided. (Locking up for 5 or more seconds results in damage to a motor. Do not lock up a motor for 5 or more seconds.)

- **Applied voltage**
  Be sure to use a motor at its rated voltage (±8/V%), and avoid any surge voltage. We can specially manufacture motors designed with an electrical capacity for those with increased or reduced energy, and increased reversed polarity. Please contact us for details.

- **Applying non-rated supply voltages**
  Applying a voltage higher than the motor's rating results in a temperature increase, leading to heat damage or lowered service life. Scoring of the commutator surface by sparks and mechanical brush wear arising from vibration may also occur.
  Applying a voltage lower than the rated value may eventually result in the motor failing to start. This is due to the build-up of carbon powder on the commutator.
  Motors are manufactured for use within ±8/V% of their rated specifications.
  Please contact us if you need to use motors outside their ratings.

- **Brush wear promoted by power supply ripples**
  Brush wear may be mechanical wear due to brush and commutator abrasion or electrical wear due to sparking between the brush and commutator, the latter being the most common. Brush wear is therefore greatly affected by ripples in the power supply voltage, and use of general regulated DC is recommended. However, when rectifying AC for use by a motor, be sure to use full-wave rectification with a capacitor or similar element in a smoothing circuit.

- **Ambient conditions**
  The service life of a DC motor is dependant upon its rectifying action. Care must be taken to ensure good commutation, as dust, oil, gas, water, etc. Water, etc. on the commutator surface results in poor rectification and increases brush wear.

- **Changing the brush position**
  The brushes are generally fixed in position such that rotational speed and current characteristics are maintained equivalent in both clockwise and counter-clockwise directions. There are basically determined based on the position of the magnetic poles. Rotating the motor after not carefully relocating parts such as the brush holder (for fixing the brushes) or rear cover results in misalignment of the brushes and magnets. This will produce change in the above characteristics in the rotational direction or cause poor rectification, leading to abnormal brush wear. Therefore, changing of the brush positioning is to be avoided.

- **Installed orientation**
  Motors are generally designed for use with a horizontal output shaft. Special consideration must be given to components including bearings and grease washers when intended for an upward- or downward-facing output shaft. Please contact us for details.
  Further, avoid installing a motor in a manner in which grease from the gear head would tend to enter the motor (e.g., with an upward-facing output shaft).

- **Noise generation**
  Electrical noise is generated as a result of sparks from commutation between the brushes and commutation. Please contact us for assistance with lowering noise.

- **Gear heads for intermittent drive**

(Apolka to 38G, 43G, 5C, and L)
Fig. 5

  The gearhead is assembled with a fixed shaft about which a gear revolves and transmits power. It is not suited to continuous drive. You should maintain the duty ratio between ON and OFF states at no more than 50%, with the maximum ON state not exceeding 5 seconds.

- **Motor and gear head combination**
  When combining a gear head with a pinion shaft, gently fit the gear head on turning it right and left, being careful that the pinion and the gear in the gear head do not strongly clash with each other.
  Using force will cause noise-producing scratches in the pinion and the gear. Scratches are Failures by a decreased service life and are the cause of unforeseen accidents.

- **Load variation**
  Even with torque below the rated load, a motor will incur more damage than might be imagined if there is frequent load variation. Exercise caution with operating conditions and load restrictions.

- **Insulation resistance**
  The insulation resistance of a brush motor will naturally continue to decrease as its running time increases. The figures for resistance given in the catalog are for a new motor.

- **Service life**
  Service life depends greatly on operating conditions and environment. Please contact us for details.

- **Other aspects**
  Oil may seep out of the grease in the gear head depending on operating conditions, storage environment, etc.
  This does not present any problems in the use of the gear head. However, contamination of the machine or equipment to which the geared motor is fitted may occur.


DME

Motors with pulse generators:

There are two types of pulse generators that are featured in DME series motors : the magnetic and optical revolution sensor. (Note, the optical revolution sensor is available only in the DME34 model.) Both are incremental revolution sensor. And all the above generators can output Single Phase pulse signal only. When TWO Phase signal is required, contact our sales agent near you or directly to us. We may quote on case by case basis.
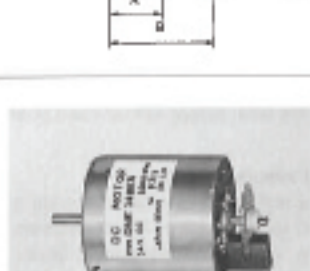
Magnetic Type   Optical Type

Magnetic Revolution Sensor
Compared to the optical revolution sensor, the magnetic revolution sensor is more resistant to high temperatures, dust contaminations, vibrations and impact shocks. The design of the magnetic revolution sensor type motor is also more simple. In incremental type revolution sensor, pulse output signals are sent to a counter wherein the incremented value is displayed. Signal noise, here, is hard to performance errors. Magnetic type revolution sensors are especially vulnerable to signal noise since the signal levels are usually very low (20mA to 30mA). Thus, make sure magnetic revolution sensor type motors are provided proper magnetic shielding, and signal lines are as short as possible (ideally within 5m).

● STANDARD SPECIFICATION OF REVOLUTION SENSOR

REVOLUTION SENSOR TYPE	MAGNETIC	OPTICAL
PULSE PER REVOLUTION	12P/rev.	24P/rev.
INPUT VOLTAGE	DC5V±10%	DC5V±10%
CURRENT CONSUMPTION	25mA nominal	25mA nominal
DUTY (50%)	50±20%	50±10%
OUTPUT WAVEFORM (COMMON)		

Optical Revolution Sensor:
Long-life LED is used as the light emitter, and a phototransistor is used as the light detector. When using optical revolution sensor type motors, special considerations are needed to protect against dust and extreme temperatures. The most frequent causes of trouble in optical revolution sensors are : dust build-ups impairing proper optical properties ; and extreme leading to deterioration in light emission performance. Japan Servo can thus ensure full rated performance only in ambient temperatures between 0 to 40 degrees centigrade, and in dust-free conditions.

● CONNECTION

DC SMALL MOTORS DME Series

The DME Series motor is a feasible and practical DC motor that is used popularly in many applications.
According to user demands, Japan Servo combines the DME motor with a wide variation of high-performance gearboxes to further increase the application possibilities for the DME Series.
Also, in response to demands for a simple, low-cost motor that has a certain amount of controllability, Japan Servo provides DME models that feature pulse generators (magnetic or optical PG).

For certain models of the DME Series, the motor and gearboxes can be ordered separately, allowing for much greater versatility by combining various type motors with a wide range of reduction gears. Please refer to the product line-up chart to select the DME Series motor that is just right for your specific needs.

● DME SERIES MOTOR'S CONSTRUCTION AND CHARACTERISTICS.

MODEL	BRUSH HOLDING	CORE SLOTS	BEARING	MAGNET	LIFE (hrs)	OUTPUT POWER (W) 1 3 5 10 15	PAGE
DME 25	Holder	3 slots	Sintered sleeve bearing	Anisotropic	1000	0.3	12
DME 33	Spring plate	3 slots	Sintered sleeve bearing	Isotropic Anisotropic	1000	0.3 / 0.7	15
DME 34	Spring plate	3 slots	Sintered sleeve bearing	Isotropic Anisotropic	1000 (500)	4.5 / 0.7 / 4.6 / 7.2	21
DME 37	Holder	7 slots	Sintered sleeve bearing	Anisotropic	2000	9.2 / 17.2	
DME 44	Holder	10 slots	Ball bearing	Isotropic Anisotropic	2000	9.2 / 14.8	
DME 60	Holder	12 slots	Sint. sleeve/Ball bearing	Isotropic Anisotropic	2000	13 / 26	38

FEATURE	BRUSH HOLDER		BEARING		MAGNET	
	Holder:Long-life	2000hours	Ball bearing	:Long-life	Anisotropic	:High output
	(1000 hours only for DME25, due to its high-speed operation)		Sintered sleeve bearing	:Standard	Isotropic	:Standard
	Spring plate:Standard	1000hours				

*Operated in motor alone, and single direction.

● GEAR-HEAD DESIGN

(GEAR RATIO) (Denominator)	38G	43G	50G	5C	L	6DG	6DGF	50G	60GF

○ : Output shaft rotates in the same direction with motor shaft.
● : Output shaft rotates reversed direction to motor shaft.

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