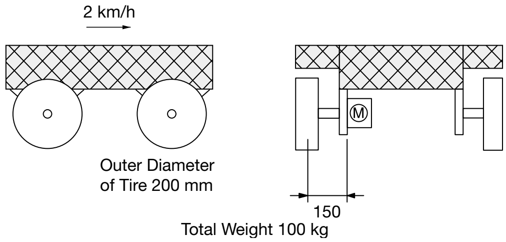
Technical Documentation

Selection Process Steps and Examples

Selection Examples Battery Powered Gearmotors (V Series)

Application .... Cart Drive (four wheels)
Maximum Speed .... 2 km/h
Outer Diameter of Tire .... 200 mm
Total Weight .... 100 kg
Load Point of O.H.L. .... 150 mm from the flange surface (Refer to the figure on the right)
Operation Time .... 10 hours or more/day
Frequency of Startup .... 70 times or less/day
Drag coefficient of Wheel 0.1



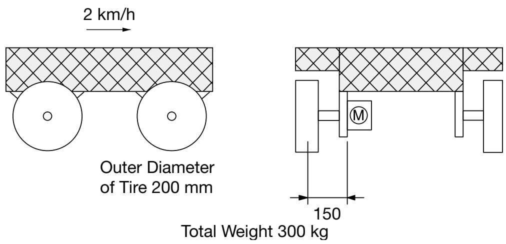
* The selection example shown here is an example when a dedicated drive separately sold is used.
Please utilize the calculation and selection tool on our website. (https://sentei.nissei-gtr.co.jp/english/calculation)
You may calculate the necessary power by inputting the usage conditions and the series on our website.

Selection Process Steps	Selection Examples
Determining the type (parallel shaft, right angle shaft, right angle hollow bore)	**Decide on the VF3S (concentric right angle hollow bore) based on axle mounting.**
Determining the reduction ratio	**2 km/h = 33333 mm/min** **Calculate the speed of the drive shaft at the maximum speed.** **33333 ÷ (200 × π) = 53.1 r/min** **Since the maximum speed of the motor shaft is 2500 r/min,** **2500 ÷ 53.1 = 47.1** **Since a variable speed motor is used, select a reduction ratio of 1/40, which is slightly smaller than the calculated value.**
Verifying the torque and the motor power	**100 kg × 0.1 × (200 mm ÷ 2 ÷ 1000) × Sf × 9.8** Assuming that the service factor (Sf) is 1.25, the value of the equation shown above is 12.25 N·m. * (For the service factor, refer to page 680.) A gearmotor with an allowable output shaft torque of 12.25 N·m or more at a reduction ratio of 1/40 has a power of 0.1 kW or more.
Verifying the converted load moment of inertia on motor shaft	**100 kg × (200 mm ÷ 2 ÷ 1000)^2× i^2× C** By substituting 1 into the correction coefficient (C) and 1/40 into i, the value of the equation shown above is 0.000625 kg·m^2. * (For the correction coefficient of the moment of inertia, refer to [Table-2] on page 681.) From the table of allowable moments of inertia, the tolerance of 100 W is 0.00125 kg,·m^{2}the value is within the tolerance. * (For the table of allowable moments of inertia, refer to [Table-3] on page 681.) * (The calculation shown above is a simple example and ignores the moment of inertia of the wheel, the shaft, etc.)
Verifying the O.H.L.	**The O.H.L. by the load torques is:** **12.25 ÷ (200 ÷ 2 ÷ 1000)** **The above formula is 122.5 N.** In addition, a load of 25 kg (245 N), which is 1/4 of the weight of the cart, is applied directly to the shaft. **Since two forces form an angle of 90 °, the resultant force is 274 N.** From the performance table, the allowable O.H.L. of a 0.1 kW 1/40 right angle hollow bore type is 830 N. In the case of a right angle hollow bore gearmotor of a flange mount type (one end is not borne by a pillow), the allowable O.H.L. needs to be corrected. * Refer to page 684. **In this case, (55 + 20) ÷ (55 + 150) × 830 = 303.** **Consequently, 303 > 274, which is within the tolerance.** * Please add values as needed if there are other factors that may affect the O.H.L. of the product, such as belt tension.
Result of model selection	**Assuming that the selected model is a gearmotor without a brake and with a supply voltage of 24 V,** the model that should be selected is the VF3SC15-40N100L2A.

Selection Process Steps and Examples

Selection Examples Battery Powered Gearmotors (SD Series)

Application	Cart Drive (four wheels)
Maximum Speed	2 km/h
Outer Diameter of Tire	200 mm
Total Weight	300 kg
Load Point of O.H.L.	150 mm from the flange surface (Refer to the figure on the right)
Operation Time	10 hours or more/day
Frequency of Startup	70 times or less/day
Drag coefficient of Wheel	0.1



* The selection example shown here is an example when a dedicated drive separately sold is used.
Please utilize the calculation and selection tool on our website. (https://sentei.nissei-gtr.co.jp/english/calculation)
You may calculate the necessary power by inputting the usage conditions and the series on our website.

Selection Process Steps	Selection Examples
Determining the type (parallel shaft, right angle shaft)	**Decide on the right angle shaft (F3S) based on axle mounting.**
Determining the reduction ratio	**2 km/h = 33333 mm/min** **Calculate the speed of the drive shaft at the maximum speed.** **33333 ÷ (200 × π) = 53.1 r/min** **Since the rated speed of the motor shaft is 3000 r/min,** **3000 ÷ 53.1 = 56.5** **Since a variable speed motor is used, select a reduction ratio of 1/50, which is slightly smaller than the calculated value.**
Checking the torque and the motor power	**300 kg × 0.1 × (200 mm ÷ 2 ÷ 1000) × Sf × 9.8** Assuming that the service factor (Sf) is 1.25, the value of the equation shown above is 36.75 N·m. * (For the service factor, refer to page 680.) A gearmotor with an allowable output shaft torque of 36.75 N·m or more at a reduction ratio of 1/50 has a power of 0.4 kW or more.
Verifying the converted load moment of inertia on motor shaft	**300 kg × (200 mm ÷ 2 ÷ 1000)^2× i^2× C** By substituting 1 into the correction coefficient (C) and 1/50 into i, the value of the equation shown above is 0.0012 kg·m^2. * (For the correction coefficient of the moment of inertia, refer to [Table-2] on page 681.) From the table of allowable moments of inertia, the tolerance of 0.75 kW is 0.00138 kg·m^{2}the value is within the tolerance. * (For the table of allowable moments of inertia, refer to [Table-4] on page 681.) * (The calculation shown above is a simple example and ignores the moment of inertia of the wheel, the shaft, etc.)
Verifying the O.H.L.	**The O.H.L. by the load torques is:** **36.75 ÷ (200÷2÷1000)** **The above formula is 367.5 N.** In addition, a load of 75 kg (735 N), which is 1/4 of the weight of the cart, is applied directly to the shaft. **Since two forces form an angle of 90 °, the resultant force is 822 N.** From the performance table, the allowable O.H.L. of a 0.75 kW, 1/50 right angle shaft (F3S) type is 2990 N. In the case of a right angle shaft gearmotor of a flange mount type (one end is not borne by a pillow), the allowable O.H.L. needs to be corrected. * Refer to page 685. **In this case, (91 + 20) ÷ (91 + 150) × 2990 = 1377.** **Consequently, 1377 > 822, which is within the tolerance.** * Please add values as needed if there are other factors that may affect the O.H.L. of the product, such as belt tension.
Result of model selection	**Assuming that the selected model is a gearmotor without a brake and with a supply voltage of 48 V,** Select the F3S30N50-SDM080L4AN.

Service Factor (Sf)

A gearmotor is designed under the condition of operating for ten hours/day under a light shock load. When you use a gearmotor under a condition of a longer operation time under a heavier shock load, correct the load torque based on the service factor shown in the table below.

[Table-1]

Load Condition	Service Factor (Sf)			Application Example
	Operating for less than three hours/day	Operating for three to ten hours/day	Operating for more than ten hours/day	
Uniform load	1	1	1	Conveyors (uniform load), screens, agitators (low viscosity), water treatment machines (light load), machine tools (feed shafts), elevators, extruders, distillers
Light shock load	1	1	1.25	Conveyors (nonuniform or heavy load), agitators (high viscosity), machines for vehicles, water treatment machines (moderate load), hoists (light load), paper mills, feeders, food machines, pumps, sugar making machines, textile machines
Severe shock load	1	1.25	1.5	Hoists (heavy load), hammer mills, metal working machines, crushers, tumblers

Allowable Moment of Inertia/Acceleration Torque, Braking Torque (Motor Shaft Equivalent) Tp

Allowable Moment of Inertia J (J_A)

If a gearmotor with a high inertia load is operated intermittently, high torque may be instantaneously produced when it starts operating or stops, resulting in an unexpected accident.
Keep the level of the inertia of the application within the allowable value shown in the table below in accordance with the connection method and the frequency of startup.

■ Allowable Moment of Inertia J by Motor Power

(Motor shaft equivalent) [Table-1]

Power	Allowable Moment of Inertia J (kg·m²)
50 W	2×10^{-4}
0.1 kW	12.5×10^{-4}
0.2 kW	15×10^{-4}
0.4 kW	15×10^{-4}
0.75 kW	13.8×10^{-4}

Note: Converted equivalent moment of inertia on motor shaft
= moment of inertia of output shaft J x (reduction ratio)^2

■ Correction Coefficient of Allowable Moment of Inertia J According to Operating Conditions

[Table-2]

Connection Method	Frequency of Startup	Correction Coefficient
When no looseness occurs because of direct coupling etc.	70 times or less/day	1
	More than 70 times/day	1.5
When looseness occurs because of chain fastening etc.	70 times or less/day	2
	More than 70 times/day	3

Moment of Inertia (Motor Shaft Equivalent) of the Gearmotor by Power Jr

V Series <VG/VH/VF3 Types>

[Table-3]

Motor Type	Non-Brake				Brakemotor			
Motor Power	50 W	0.1 kW	0.2 kW	0.4 kW	50 W	0.1 kW	0.2 kW	0.4 kW
Moment of Inertia (kg·m²)	0.11×10^{-4}	0.65×10^{-4}	1.3×10^{-4}	2.5×10^{-4}	0.12×10^{-4}	0.77×10^{-4}	1.4×10^{-4}	3.0×10^{-4}

SD Series <APG/F3 Types>

[Table-4]

Motor Type	Non-Brake			Brakemotor		
Motor Power	0.75 kW			0.75 kW		
Frame Size	Parallel Shaft (APG)		Right Angle Shaft (F3)	Parallel Shaft (APG)		Right Angle Shaft (F3)
	22	28	30	22	28	30
Moment of Inertia (kg·m²)	1.0×10^{-4}		1.2×10^{-4}	1.1×10^{-4}		1.3×10^{-4}

Acceleration Torque, Braking Torque (Motor Shaft Equivalent) T_P

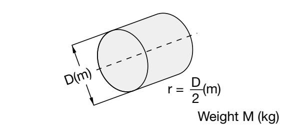
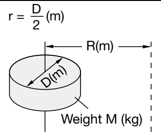
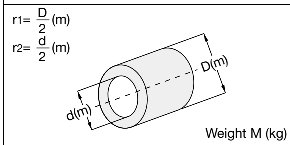
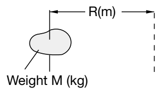
[Table-5]

Motor Type	Common to Motors with Brake and Motors without Brake				
Motor Power	50 W	0.1 kW	0.2 kW	0.4 kW	0.75 kW
Acceleration Torque (N·m)	0.32	0.66	1.24	2.61	4.77
Braking Torque (N·m)	0.32	0.66	1.24	2.61	4.77

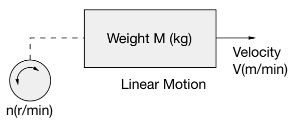
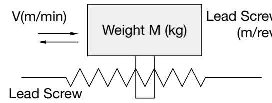
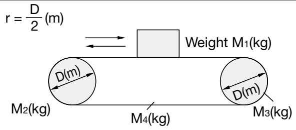
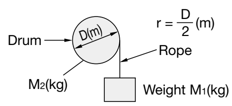
Note: The values shown in the table above are those when a dedicated drive sold separately is used.

Method for Calculating the Moment of Inertia

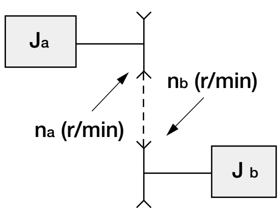
■ Rotor's Moment of Inertia J

When the center of rotation is aligned with the center of gravity		When the center of rotation is not aligned with the center of gravity	
	SI Units		SI Units
	$J = \frac{1}{2} Mr^2$ (kg·m²)		$J = \frac{1}{2} Mr^2 + MR^2$ (kg·m²)
	$J = \frac{1}{2} M(r_1^2 + r_2^2)$ (kg·m²)		(When the size is negligible) $J = MR^2$ (kg·m²)

■ Moment of Inertia J in Linear Motion

		SI Units
General case		$J = \frac{1}{4} M \cdot \left(\frac{V}{\pi \cdot n}\right)^2$ (kg·m²)
In the case of horizontal linear motion (When moving an object with a lead screw)		$J = \frac{1}{4} M \cdot \left(\frac{P}{\pi}\right)^2 = \frac{1}{4} M \cdot \left(\frac{V}{\pi \cdot n}\right)^2$ (kg·m²)
In the case of horizontal linear motion (Conveyor etc.)		$J = M_1r^2 + \frac{1}{2} M_2r^2 + \frac{1}{2} M_3r^2 + M_4r^2$ (kg·m²)
In the case of vertical linear motion (Crane, winch, etc.)		$J = M_1r^2 + \frac{1}{2} M_2r^2$ (kg·m²)

■ Conversion of the Moment of Inertia J When the Speed Ratio Is Available



Convert the load's moment of inertia J_b into the equivalent value on the n_a shaft.

$$J = J_a + \left(\frac{n_b}{n_a}\right)^2 \times J_b$$

Overhung Load (O.H.L.)

An overhung load (O.H.L.) is a suspending load imposed on a shaft. When a chain, belt, gear, etc. is used to couple the reducer shaft with the application, the resulting O.H.L. must be taken into consideration.

V Series <VG/VH/VF3 Types>

$$\text{O.H.L.} = \frac{T_{LE} \times K_1 \times K_2}{R} \ (\text{N})$$

T_{LE} : Equivalent output torque acting on the reducer shaft (N·m)
R : Pitch circle radius (m) of the sprocket, pulley, gear, etc. attached to reducer shaft
K_1 : Refer to the coefficient for the connection method [Table-1].
K_2 : Refer to the coefficient for the load point [Table-2].

Be sure to make the O.H.L. value calculated from the equation shown above smaller than the allowable O.H.L. value listed in the performance table.

■ Coefficient K_1

[Table-1]

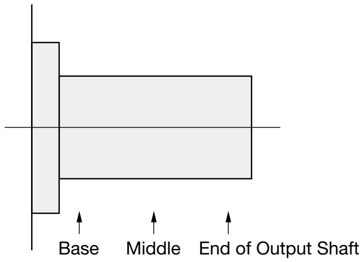
Connection method	K_1
Chain, timing belt	1.00
Gear	1.25
V-belt	1.50
Flat belt (with tension pulley)	2.25
Flat belt	3

■ Coefficient K_2

[Table-2]

Load Point	K_2
Base of the shaft	0.75
Middle of the shaft	1.00
End of Output Shaft	1.50

<Load Point>



SD Series <APG Types>

$$\text{O.H.L.} = \frac{T_{LE}}{R} \times fb \times fw (\text{N})$$

T_{LE} : Equivalent output torque acting on the reducer shaft (N·m)
R : Pitch circle radius (m) of the sprocket, pulley, gear, etc. attached to reducer shaft
fb : Coefficient for the connection method [Table-3]
fw : Coefficient for the load level [Table-4]

Be sure to make the O.H.L. value calculated from the equation shown above smaller than the corrected O.H.L. Fx. (Refer to page 684.)

■ Connection Coefficient fb

[Table-3]

Connection Method	fb
Timing belt	1.2
Gear, chain	1.3
V-belt	2
Flat belt (with tension pulley)	3
Flat belt	4

■ Load Co-efficient fw

[Table-4]

Load Level	fw
Smooth operation without shock	1.2
Ordinary operation	1.3
Operation with vibration or shock load	2

SD Series <F3 Type>

$$\text{O.H.L.} = \frac{T_{LE} \times K_1 \times K_2}{R} \ (\text{N})$$

T_{LE} : Equivalent output torque acting on the reducer shaft (N·m)
R : Pitch circle radius (m) of the sprocket, pulley, gear, etc. attached to reducer shaft
K_1 : Refer to the coefficient for the connection method [Table-5].
K_2 : Refer to the coefficient for the load point [Table-6].

Be sure to make the O.H.L. value calculated from the equation shown above smaller than the allowable O.H.L. value listed in the performance table.

■ Coefficient K_1

[Table-5]

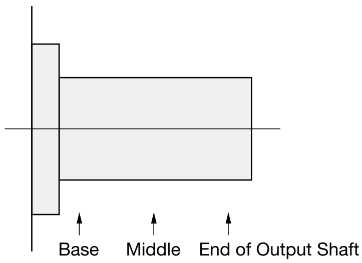
Connection method	K_1
Chain, timing belt	1.00
Gear	1.25
V-belt	1.50

■ Coefficient K_2

[Table-6]

Load Point	K_2
Base of the shaft	0.75
Middle of the shaft	1.00
End of Output Shaft	1.50

<Load Point>



Correction Based on the O.H.L. Position

VF3/F3 Type

(1) Load point of O.H.L.
The load point of the allowable O.H.L. is calculated at 20 mm from the end of the output shaft.

(2)-1 Correcting the O.H.L. when one end of the output shaft is not borne by a pillow
If the load point L of the O.H.L. is more than 20 mm, correct using:

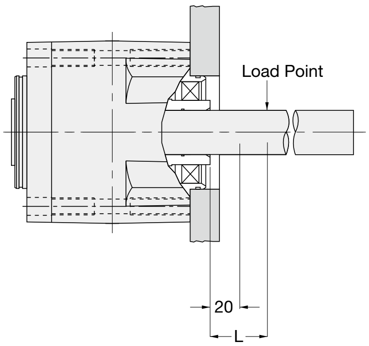
$$\text{Corrected O.H.L. (N)} = \frac{A+20}{A+L} \times \text{Allowable O.H.L. (N)}$$

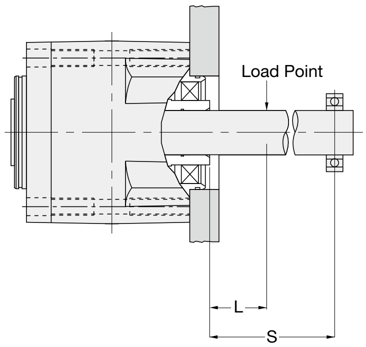
(2)-2 Correction of the O.H.L. when one end of the output shaft is borne by a pillow is:

$$\text{Corrected O.H.L. (N)} = \frac{S}{S-L} \times \text{Allowable O.H.L. (N)}$$

■ Parameter A

Frame Size	A (mm)
15	55
25	84.5
30	91
35	98





APG Type

(1) Point of O.H.L.
The allowable output shaft O.H.L. of a parallel shaft type (APG) is calculated at the middle of the shaft.
(2) Correcting the allowable output shaft O.H.L.
Correct the allowable output shaft O.H.L. with the equation shown below in accordance with the conditions under which the motor will be used.

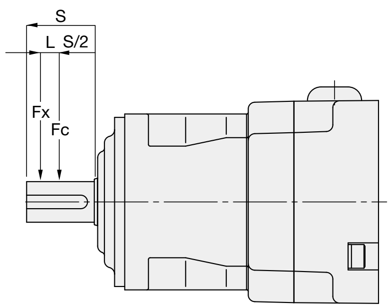
$$Fx = Fc \times \frac{A}{A+L}$$

Fx : Corrected O.H.L. (N)
Fc : Allowable output shaft O.H.L. (N)
A : Parameter (mm) [Table-1]
L : O.H.L. load point (amount of displacement from the middle of the shaft) (mm)

■ Parameter A

[Table-1]

Frame Size	A (mm)
22	38.5
28	43.5



Thrust Load

Use the motor under a condition that meets the equation shown below.

Thrust load (N) x fw ≤ Allowable output shaft thrust load (N) [fw: coefficient based on the load level]

■ Load Co-efficient fw

Load Level	fw
Smooth operation without shock	1.2
Ordinary operation	1.3
Operation with vibration or shock load	2

Conformance of Dedicated Drives to Global Standards

■ Compliance with CE Marking (EMC Command)

This drive was tested in accordance with EN61800-3:2004+A1:2012 and complies with the EMC Command.
Install a device containing a drive in accordance with the following method so that it conforms to the EMC Command:
- Insert a surge absorber on the input side of the drive.
- Insert the clamp filter shown in the table below in the motor power leads (U/V/W).

The EMC of the final machine or device varies depending on the configurations, wiring, arrangement states, degree of risk, etc. of other control systems/appliances and electric parts to be used with the motor/drive. Thus, it is necessary for you to confirm its EMC by conducting EMC tests of the machine or device.

■ Compliance with KC Mark

This drive complies with the radio law of South Korea.
When using this product in South Korea, pay attention to the following:

Class A equipment (business-purpose broadcast and communication equipment)

This device is business-purpose equipment that generates electromagnetic waves (Class A), and is intended for use in locations other than households.
Sellers and users must be mindful of this.

This product complies with the radio law of South Korea on condition that the following countermeasures for EMC will be taken. Correctly implement the countermeasures for EMC before use.
- Insert a surge absorber on the input side of the drive.
  Please use the recommended surge absorber listed in the table below. We have evaluated conformity to surge immunity with this combination.
- Shield power cable and signal cables. In this operation, minimize the length of these cables.
  Separate the power cable and the signal cables as far away from each other as possible, and avoid parallel wiring and bundling.
  If these cables cannot be separated for some inevitable reason, please cross them.
- Radiation noise can be further suppressed if the drive is installed inside a sealed metallic control panel.
  In addition, separate the metal plate and the control panel body from the power line, and securely ground them with the thickest and shortest possible wire.

Recommended surge absorber

Manufacturer	Model
OTOWA ELECTRIC CO., LTD.	LT-C12G801W

Clamp filter (option)

Manufacturer	Model
TDK Corporation	OP-ZCAT

Note: This clamp filter is available only for the SD Series.

Precautions for Use

Installation Locations

Series	V	SD	
Protective Structure	IP30	IP40/IP44	IP65
Ambient Temperature	0 °C to 40 °C	0 °C to 40 °C	0 °C to 40 °C
Ambient Humidity	85 % RH max (No Condensation)	85 % RH max (No Condensation)	100 % RH max (No Condensation)
Altitude	1,000 m max	1,000 m max	1,000 m max
Installation Environment	A well ventilated place free from corrosive gas, explosive gas, vapor and/or chemicals Not to be exposed to direct rain. Not to be exposed to direct sunlight. The brake should not be exposed to water, dust, oil/grease, or oil mist. Models with water protection rating IPX0 shall not be exposed directly to water.		A place free from corrosive gas, explosive gas, and/or vapor Not to be exposed to strong rain and wind. Not to be exposed to direct sunlight. Not to be used underwater, environments with exposure to high pressure water splashes, and exposure to cleansing chemicals.
Installation Place	Indoors	Indoors	Indoors/Outdoors

Installation Surface

Fasten a foot mount or flange mount type gearmotor to a vibration-free, machined, flat surface using four bolts. Adjust the flatness of the installation surface to 0.3 mm or less for the V Series, and to 0.1 mm or less for the SD Series. For the flatness of the installation surfaces for right angle hollow bore types, refer to page 921 as well.

Installation Orientation

All models adopt a grease lubrication method and can therefore be installed in any orientation.

Connection with an Application

V Series

1. H_7 fit is recommended for a hole for a coupling, sprocket, pulley, gear, etc. to be attached to the reducer shaft.
2. In direct coupling, accurately align the center of the reducer shaft and that of the mating shaft.
3. In chain or gear engagement, keep the reducer shaft and the mating shaft parallel accurately to each other, and install the device so that the line connecting the centers of both shafts is perpendicular to the shafts.
4. When attaching a coupling or application to the output shaft, do not apply strong impacts using a hammer or similar tool. The bearing may be damaged and may cause abnormal sound, vibrations, or damage.

SD Series

1. In direct coupling
   Install the gearmotor so that the center of its shaft and that of the shaft of the application are aligned with each other.
2. In chain, belt, or gear engagement etc.
   - In any connection method, install the gearmotor so that its shaft and the shaft of the application are accurately parallel to each other and the centerline of the sprocket or pulley is perpendicular to the shafts.
   - If a load acts on the end of the output shaft, excessive force may be applied to the output shaft and cause cracks in the case etc. Thus, slip a sprocket, pulley, gear, etc. over the output shaft all the way to the base of the output shaft to bring the point of action of the load as close to the reducer as possible.
   - When operating the gearmotor with a belt engaged, take care not to apply excessive force to the bearing by giving the belt more tension than necessary in order to prevent slippage.
   - When operating the gearmotor with a chain engaged, strong impact force may be produced at the start of operation and adversely affect the reducer and the application if the chain is loose. Thus, pay attention to the tension of the chain.

Precautions for Operation

1. Be sure to operate the gearmotor with the load torque, the load moment of inertia J {GD^2}, and the O.H.L. kept within the tolerances.
2. CW and CCW rotations by plucking adversely affects the gearmotor and the application. To prevent it, temporarily stop the gearmotor, and then start it in the reverse direction.
3. Do not perform withstand voltage tests that apply 12 V or a higher voltage to the built-in sensor of the motor.
4. Take care to keep the surface temperature of the drive below 80 °C.
5. Take care to keep the surface temperature of the motor below 90 °C.
6. Do not use the gearmotor in an explosive environment. Failure to follow this precaution may result in an explosion, ignition of fire, fire, electric shock, injury, or damage to the equipment.
7. Do not operate the product where it is exposed to water, corrosive or flammable gas, or near combustible material. Failure to follow this precaution may result in a fire or accident.
8. Take care not to allow water, oil, and grease to adhere to the brake. Failure to follow this precaution may result in falling or runaway accident due to the decrease of the brake torque.
9. Connect the wires to the input supply power, the motor, and the drive correctly and securely. Failure to follow this precaution may result in damage to the equipment.
10. Transportation, installation, piping, wiring, operation, handling, maintenance, and inspections must be performed by personnel having expertise and skills. Failure to follow this precaution may result in an explosion, ignition of fire, fire, electric shock, injury, or damage to the equipment.
11. When using the gearmotor for an application that may directly cause harm to human bodies, such as personnel transportation equipment, provide the equipment with a protective device to ensure safety. Failure to follow this precaution may result in an accident with casualties or damage to the equipment.
12. When using the gearmotor for lifting equipment, provide the equipment with a safety device to prevent falling. Failure to follow precaution may result in an accident with casualties or damage to the equipment.
13. Use our drive in combination with a designated motor. If the drive is used in combination with a motor other than a designated one, the equipment may get damaged, or a fire may occur.
14. Do not touch the drive and the motor during energization and soon after the power is turned off because they may be hot. Failure to follow this precaution may result in burns.
15. If an abnormality occurs, immediately stop the operation. Failure to follow this precaution may result in injury or fire.
16. Do not put combustible materials around the gearmotor. Failure to follow this precaution may result in a fire.
17. Do not touch the rotary parts of the motor. Failure to follow this precaution may result in injury.
18. Connectors are not waterproof. For the extension of motor cables and waterproof connectors, please contact us.
19. Before using the gearmotor, carefully read through the Instruction Manual and other attached documents to familiarize yourself with correct use.
20. Regenerative energy will be fed to the power supply unit through this drive.
    When using a load that generates regenerative energy, the customer is required to take appropriate measures for the power supply unit. Failure to follow this precaution may cause a malfunction of or damage to the drive or an accident.
21. During regenerative operation, such as lifting operation or deceleration, do not disconnect the gearmotor from the battery in a state where the main power supply (+) and the control power supply (⊕) are connected.
    Failure to follow this precaution may cause a malfunction of or damage to the drive or an accident.
    If it is necessary to turn off the power during operation for a reason such as power shutdown due to an emergency stop, turn off only the main power supply (+).

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