FANUC AC SPINDLE MOTOR βi series

DESCRIPTIONS

B-65312EN/05

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In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

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SAFETY PRECAUTIONS

This "Safety Precautions" section describes the precautions which must be observed to ensure safety when using FANUC spindle motors.
Users of any spindle motor model are requested to read this manual carefully before using the spindle motor.
The users are also requested to read this manual carefully and understand each function of the motor for correct use.
The users are basically forbidden to do any behavior or action not mentioned in this manual. They are invited to ask FANUC previously about what behavior or action is prohibited.

For matters that are not described in this manual, a machine must be designed and assembled in accordance with EN60204-1 to ensure the safety of the machine and compliance with European specifications. For details, refer to the specification.

This product is manufactured under strict quality control. To apply this product to a facility expected to cause a serious accident or damage due to a failure in this product, install a safety device.

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DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

⚠ **WARNING**
Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

⚠ **CAUTION**
Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE
The Note is used to indicate supplementary information other than Warning and Caution.

- Read this manual carefully, and store it in a safe place.

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WARNING

⚠ WARNING

- **Be safely dressed when handling a motor.**

Wear safety shoes or gloves when handling a motor as you may get hurt on any edge or protrusion on it or electric shocks.

- **Use a crane or lift to move a motor from one place to another.**

A motor is heavy. If you lift the motor by hand, you may get a backache, or you may be seriously injured when you drop the motor. A suitable crane or lift must be used to move the motor. (For the weight of motors, refer to this manual.)
When moving a motor using a crane or lift, use a hanging bolt if the motor has a corresponding tapped hole, or textile rope if it has no tapped hole. If a motor is attached with a machine or any other heavy stuff, do not use a hanging bolt to move the motor as the hanging bolt and/or motor may get broken.

- **Before starting to connect a motor to electric wires, make sure they are isolated from an electric power source.**

A failure to observe this caution is very dangerous because you may get electric shocks.

- **Be sure to secure power wires and short-bars.**

If operation is performed with a terminal loose, the terminal block may become abnormally hot, possibly causing a fire. Also, the terminal may become disconnected, causing a ground fault or short-circuit, and possibly giving you electric shocks. See the section in this manual that gives the tightening torque for attaching power wires to the terminal block.

- **Be sure to ground a motor frame.**

To avoid electric shocks, be sure to connect the grounding terminal in the terminal box to the grounding terminal of the machine.

- **Do not ground a motor power wire terminal or short-circuit it to another power wire terminal.**

A failure to observe this caution may cause electric shocks or a burned wiring.

- **Do not supply the power to the motor while any terminal is exposed.**

A failure to observe this caution is very dangerous because you may get electric shocks if your body or any conductive stuff touches an exposed terminal.

- **Do not bring any dangerous stuff near a motor.**

Motors are connected to a power line, and may get hot. If a flammable stuff is placed near a motor, it may be ignited, catch fire, or explode.

- **If an alarm is issued, the spindle may coast.**

If an alarm is issued during spindle operation, the spindle may coast. Do not get close to the spindle or touch it until it is decelerated and stopped by mechanical friction load because the stop command and emergency stop are disabled while the spindle is coasting.

- **Do not get close to a rotary section of a motor when it is rotating.**

You may get your clothes or fingers caught in a rotary section, and may be injured. Before starting a motor, ensure that there is no stuff that can fly away (such as a key) on the motor. Note that a motor with a through hole has a protruding shaft at its rear side and the shaft also rotates.

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- **Do not insert your finger or a stick into the cooling fan.**

A cover is mounted on the cooling fan, but a stick may get inside it. When the cooling fan is rotating, inserting your finger or a stick may injure you.

- **Do not touch a motor with a wet hand.**

A failure to observe this caution is very dangerous because you may get electric shocks.

⚠ WARNING

- **Before touching a motor, shut off the power.**

Even if a motor is not rotating, there may be a voltage across the terminals of the motor.
Especially before touching a power supply connection, take sufficient precautions.
Otherwise you may get electric shocks.

- **A voltage is applied for a while after the power is shut off. Before touching a motor, be sure to check the voltage to be 0V.**

There is a high voltage across power terminals for a while after the power is shut off. Do not touch a motor or connect the motor to another device before checking the voltage. Otherwise you may get electric shocks or the motor may get damaged. Be sure to check that the voltage is lowered to 0 V, then touch the motor.

- **To drive a motor, use a specified amplifier and parameters.**

An incorrect combination of a motor, amplifier, and parameters may cause the motor to behave unexpectedly. This is dangerous, and the motor may get damaged.

- **Before driving a motor, be sure to secure it.**

If a motor is driven without being secured, it may roll over during acceleration or deceleration, injuring the user.

CAUTION

⚠ CAUTION

- **Do not touch a motor when it is running or immediately after it stops.**

A motor may get hot when it is running. Do not touch the motor before it gets cool enough. Otherwise, you may get burned.

- **Be careful not get your hair or clothes caught in a cooling fan.**

Be careful especially for a cooling fan used to generate an inward air flow.
Be careful also for a cooling fan even when the motor is stopped, because it continues to rotate while the amplifier is turned on.

- **FANUC motors are designed for use with machines. Do not use them for any other purpose.**

If a FANUC motor is used for an unintended purpose, it may cause an unexpected symptom or trouble. If you want to use a motor for an unintended purpose, previously consult with FANUC.

- **Ensure that a base or frame on which a motor is mounted is strong enough.**

Motors are heavy. If a base or frame on which a motor is mounted is not strong enough, it is impossible to achieve the required precision.

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- **Ensure that motors and related components are mounted securely.**

If a motor or its component slips out of place or comes off when the motor is running, it is very dangerous.

- **Be sure to connect motor cables correctly.**

An incorrect connection of a cable cause abnormal heat generation, equipment malfunction, or failure. Always use a cable with an appropriate current carrying capacity (or thickness). For how to connect cables to motors, refer to their respective specification manuals.

- **Ensure that motors are cooled if they are those that require forcible cooling.**

If a motor that requires forcible cooling is not cooled normally, it may cause a failure or trouble. For a fan-cooled motor, ensure that it is not clogged or blocked with dust and dirt. For a liquid-cooled motor, ensure that the amount of the liquid is appropriate and that the liquid piping is not clogged. For both types, perform regular cleaning and inspection.

- **When attaching a component having inertia, such as a pulley, to a motor, ensure that any imbalance between the motor and component is minimized.**

If there is a large imbalance, the motor may vibrates abnormally, resulting in the motor being broken.

- **Be sure to attach a key to a motor with a keyed shaft.**

If a motor with a keyed shaft runs with no key attached, it may impair torque transmission or cause imbalance, resulting in the motor being broken. With the β*i* series, a shaft with no key is used as standard.

- **Do not step or sit on a motor.**

If you step or sit on a motor, it may get deformed or broken. Do not put a motor on another unless they are in packages.

- **When storing a motor, put it in a dry (non-condensing) place at room temperature (0°C to 40°C).**

If a motor is stored in a humid or hot place, its components may get damaged or deteriorated. In addition, keep a motor in such a position that its shaft is held horizontal and its terminal box is at the top.

- **Do not apply shocks to a motor or cause scratches to it.**

If a motor is subjected to shocks or is scratched, its components may be adversely affected, resulting in normal operation being impaired. Be very careful when handling plastic portions, sensors, and windings, because they are very liable to break. Especially, avoid lifting a motor by pulling its plastic portion, winding, or power cable.

- **Do not conduct dielectric strength or insulation test for a sensor.**

Such a test can damage elements in the sensor.

⚠ CAUTION

- **Do not disassemble a motor.**

Disassembling a motor may cause a failure or trouble in it.
If disassembly is in need because of maintenance or repair, please contact a service representative of FANUC.

- **Do not modify a motor.**

Do not modify a motor unless directed by FANUC. Modifying a motor may cause a failure or trouble in it.

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- **Use a motor under an appropriate environmental condition.**

Using a motor in an adverse environment may cause a failure or trouble in it. Refer to their respective specification manuals for details of the operating and environmental conditions for motors.

- **Do not apply a commercial power source voltage directly to a motor.**

Applying a commercial power source voltage directly to a motor may result in its windings being burned. Be sure to use a specified amplifier for supplying voltage to the motor.

NOTE

NOTE

- **Do not remove a nameplate from a motor.**

If a nameplate comes off, be careful not to lose it. If the nameplate is lost, the motor becomes unidentifiable, resulting in maintenance becoming impossible.

- **When testing the winding or insulation resistance of a motor, satisfy the conditions stipulated in IEC34.**

Testing a motor under a condition severer than those specified in IEC34 may damage the motor.

- **For a motor with a terminal box, make a conduit hole for the terminal box in a specified position.**

When making a conduit hole, be careful not to break or damage unspecified portions. Refer to an applicable specification manual.

- **Before using a motor, measure its winding and insulation resistances, and make sure they are normal.**

Especially for a motor that has been stored for a prolonged period of time, conduct these checks. A motor may deteriorate depending on the condition under which it is stored or the time during which it is stored. For the winding resistances of motors, refer to the appendix of this specification manual, or ask FANUC. For insulation resistances, see the following table.

- **To use a motor as long as possible, perform periodic maintenance and inspection for it, and check its winding and insulation resistances.**

Note that extremely severe inspections (such as dielectric strength tests) of a motor may damage its windings. For the winding resistances of motors, refer to the appendix of this specification manual, or ask FANUC. For insulation resistances, see the following table.

MOTOR INSULATION RESISTANCE MEASUREMENT

Measure an insulation resistance between each winding and motor frame using an insulation resistance meter (500 VDC). Judge the measurements according to the following table.

Insulation resistance	Judgment
100 MΩ or higher	Acceptable
10 MΩ to 100 MΩ	The winding has begun deteriorating. There is no problem with the performance at present. Be sure to perform periodic inspection.
1 MΩ to 10 MΩ	The winding has considerably deteriorated. Special care is in need. Be sure to perform periodic inspection.
Lower than 1 MΩ	Unacceptable. Replace the motor.

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CAUTION LABEL

The following label is attached to the motor.
Attach this label to a prominent place on the motor to call attention to the user.

Heat caution label
(compliance with the IEC standard)

Heat caution label

Since the motor is heated to a high temperature during operation or immediately after a stop, touching the motor may cause a burn.
So, attach this label to a prominent place to call attention when the surface is exposed and may be touched.

Remark:
The mark of this label conforms to the IEC standard, which is a global standard.
The mark has the meaning of heat caution, so the description is omitted.

Electric shock warning label
(compliance with the IEC standard)

Electric shock warning label

Before maintenance, please turn off and lockout main power disconnect and all circuits powered by an external source. A failure to observe this caution is vary dangerous because you may get electric shocks.
So, please attach this label to a prominent place(such as the lid of the terminal box).

Remark:
The mark of this label conforms to the IEC standard, which is a global standard.
The mark has the meaning of electric shock warning, so the description is omitted.

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PREFACE

The models covered by this manual, and their abbreviations are:

Series	Model
βiI series 200V type	βiI 3/12000, βiI 6/12000, βiI 8/12000, βiI 12/10000, βiI 15/8000
βiI series 400V type	βiI 6/12000HV, βiI 8/12000HV, βiI 12/10000HV
βiIP series	βiIP 12/6000, βiIP 15/8000, βiIP 18/8000, βiIP 22/8000, βiIP 30/8000, βiIP 40/6000
βiIT series	βiIT 12/10000, βiIT 15/8000
βiIC series	βiIC 3/6000, βiIC 6/6000, βiIC 8/6000

The spindle motor can be used for the spindle of a machine tool. The main part of this manual describes how to use the spindle motor and contains general notes. Understand this manual thoroughly before using the spindle motor correctly.

This manual describes the arrangement of power terminals and the outputs of detector signals, but does not describe the connections to the servo amplifier and the CNC unit. For an explanation of the connections, refer to the FANUC SERVO AMPLIFIER βi-B series DESCRIPTIONS (B-65422EN), the FANUC SERVO AMPLIFIER βi series DESCRIPTIONS (B-65322EN), the FANUC SERVO AMPLIFIER αi-B series DESCRIPTIONS (B-65412EN), the FANUC SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN), the MAINTENANCE MANUAL (B-65285EN), and the MAINTENANCE MANUAL (B-65325EN).

Related manuals

The following seven kinds of manuals are available for FANUC SPINDLE MOTOR βi series. In the table, this manual is marked with an asterisk (*).

Document name	Document number	Major contents	Major usage	
FANUC AC SERVO MOTOR βi series DESCRIPTIONS	B-65312EN	• Specification • Characteristics • External dimensions	• Selection of motor • Connection of motor	*
FANUC SERVO AMPLIFIER βi-B series DESCRIPTIONS	B-65422EN	• Specifications and functions • Installation • External dimensions and maintenance area • Connections	• Selection of amplifier • Connection of amplifier	
FANUC SERVO AMPLIFIER βi series DESCRIPTIONS	B-65322EN			
FANUC SERVO AMPLIFIER αi-B series DESCRIPTIONS	B-65412EN			
FANUC SERVO AMPLIFIER αi series DESCRIPTIONS	B-65282EN			
FANUC AC SERVO MOTOR αi series FANUC AC SPINDLE MOTOR αi series FANUC SERVO AMPLIFIER αi series MAINTENANCE MANUAL	B-65285EN	• Startup procedure • Troubleshooting • Maintenance of motor	• Startup of the system (Hardware) • Troubleshooting • Maintenance of motor	
FANUC AC SERVO MOTOR βi series FANUC AC SPINDLE MOTOR βi series FANUC SERVO AMPLIFIER βi series MAINTENANCE MANUAL	B-65325EN	• Startup procedure • Troubleshooting • Maintenance of motor	• Startup of the system (Hardware) • Troubleshooting • Maintenance of motor	

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FANUC AC SPINDLE MOTOR αi series FANUC SPINDLE MOTOR βi series FANUC BLUILT-IN SPINDLE MOTOR B*i*S series PARAMETER MANUAL	B-65280EN	• Initial setting • Setting parameters • Description of parameters	• Startup of the system (Software) • Tuning of the system (Parameters)	

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ADDITIONAL INFORMATION

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I. SPECIFICATION

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1 LINE-UP OF THE SERIES

This chapter describes the line-up of the FANUC AC Spindle Motor βi series.

This chapter, "LINE-UP OF THE SERIES", consists of the following sections:

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1.1 MOTOR LINE-UP

The FANUC AC Spindle Motor βi series consist of the following series, each of which has the listed characteristics.

Series	Voltage	Continuous rated output kW	Feature	Applicable machine example
βiI	200V	3.7 to 15	Model that offers sufficient basic performance as the spindle of a machine tool	Lathe Machining center
	400V	5.5 to 11		
βiIP	200V	5.5 to 15	Model that achieves high torque in the low-speed area	
βiIT	200V	11 to 15	Model for direct spindle connection used with machining centers	Machining center
βiIC	200V	3.7 to 7.5	Sensor-less model with a high cost performance ratio	Lathe

Spindle Motor βi series line-up

Continuous rated output kW	3.7	5.5	7.5	9	11	15	
βiI	βiI 3/12000	βiI 6/12000 βiI 6/12000HV	βiI 8/12000 βiI 8/12000HV		βiI 12/10000 βiI 12/10000HV	βiI15/8000	
βiIP		βiIP 12/6000	βiIP 15/8000	βiIP 18/8000	βiIP 22/8000	βiIP 30/8000	βiIP 40/6000
βiIT					βiIT 12/10000	βiIT 15/8000	
βiIC	βiIC 3/6000	βiIC 6/6000	βiIC 8/6000				

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1.2 FEATURES

(1)βiI series, βiIP series

The FANUC AC SPINDLE MOTOR βiI series and βiIP series is a highly cost-effective series having sufficient basic performance as the core machine tool.

Features

- High-output and high-torque are implemented defying its compact body.
- Spindle HRV control enables high-efficiency and low-heating driving.
- The built-in αiM sensor or αiMZ sensor enables synchronous spindle and Z-axis feed, rigid tapping, and Cs contouring.
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

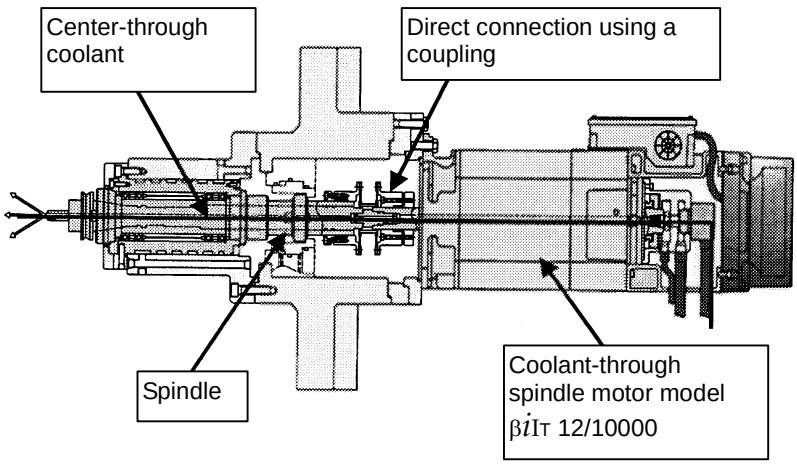
(2)βiIT series

Features

By directly connecting the spindle with a spindle motor with a through hole, higher-speed spindle rotation and highly efficient center-through coolant machining are enabled. A spindle of direct motor connection type is connected with a motor by using a coupling, so that this type of spindle has several advantages. For example, transfer of heat produced by the motor to the spindle is minimized, and each of the motor and spindle can be maintained separately.

Item of comparison	Belt driving, gear driving	Direct motor connection
Spindle rotation speed	△	○
Spindle vibration	△	○
Spindle heat-up	△	○

Example of spindle of direct motor connection structure



Features of a spindle of direct motor connection type

<1> Higher-speed spindle rotation can be achieved.
<2> Transfer of heat produced by the motor to the spindle is minimized.
<3> Each of the motor and spindle can be maintained separately.

Caution

(1) For attachment of this type of motor to a spindle, only coupling-based direct connection with the spindle is allowed. When a spindle of direct motor connection type is used, fretting can occur with the motor shaft in a short-time operation, or the bearing of the spindle or motor can be damaged if

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the spindle and motor are not aligned precisely. As the method of quantitatively determining whether a spindle and motor are aligned precisely, FANUC recommends the user to measure the vibration acceleration of the motor after connected with the spindle. For details, see Subsection 3.3.1, "Points about the Direct Connection Structure of Spindle Motors with a Through Hole" in Part III.

(2) Do not apply a thrust load onto the motor shaft. Select a coupling that does not apply a thrust load onto the motor shaft due to a cause such as coolant pressure when the temperature rises or cutting is performed.

(3)βiIc series

The FANUC AC spindle motor βiIc series improve spindle axis sensor-less control utilizing spindle speed information detected by αiBZ Sensor or αi Positioncoder.

Features

- Improvement of output characteristics at high speed and speed stability at low speed by spindle sensor-less control
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

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2 ORDERING SPECIFICATION NUMBER

The ordering specification number of the FANUC AC spindle motor β*i* series adheres to the notation below.

A06B-□□□□-B△○▽#abcd

□□□□ An ordering specification number are described on the tables after next page.
* Every combination does not exist.

△ 1 : Flange mounting
2 : Foot mounting
5 : Flange mounting
6 : Foot mounting

○ 0 : Standard, with no key
1 : High-speed, with no key
2 : High-precision and low-vibration, with no key (only for β*i*IT 12/10000, β*i*IT 15/8000)
5 : Standard, with a key
6 : High-speed, with a key
* Not all models have this number.

▽ 0 : α*i*M sensor, Rear exhaust fan
1 : α*i*M sensor, Front exhaust fan
3 : α*i*MZ sensor, Rear exhaust fan
4 : α*i*MZ sensor, Front exhaust fan
6 : Sensor-less, Rear exhaust fan
7 : Sensor-less, Front exhaust fan
* Not all models have this number.

abcd An ordering specification number are described on the tables after next page.
* Not all models have this number.

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The following lists the combinations of selectable numbers in symbols in specification number.

(1) βiI series

200V type A06B-□□□□-B△○▽#abcd

Symbol in specification No. / Model name	□□□□	△				○				▽				abcd	Shaft end seal
		1	2	5	6	0	1	5	6	0	1	3	4		
βiI 3/12000	1444	○	-	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P09	No seal
βiI 6/12000	1445	○	-	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P09	No seal
βiI 8/12000	1446	○	-	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P09	No seal
βiI 12/10000	1447	○	-	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P02	Oil seal
		-	○	-	-	-	○	-	○	○	○	○	○	0P09	No seal
βiI 15/8000	1498	-	-	○	-	○	-	○	-	○	○	○	○	0P02	Oil seal
		-	-	-	○	○	-	○	-	○	○	○	○	0P02	Oil seal
		-	-	-	○	○	-	○	-	○	○	○	○	0P09	No seal

400V type A06B-□□□□-B△○▽#abcd

Symbol in specification No. / Model name	□□□□	△		○		▽				abcd	Shaft end seal
		1	2	1	6	0	1	3	4		
βiI 6/12000HV	1545	○	-	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P09	No seal
βiI 8/12000HV	1546	○	-	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P09	No seal
βiI 12/10000HV	1547	○	-	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P02	Oil seal
		-	○	○	○	○	○	○	○	0P09	No seal

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(2) βiIP series A06B-□□□□-B△○▽#abcd

Symbol in specification No. / Model name	□□□□	△				○		▽				abcd	Shaft end seal
		1	2	5	6	0	5	0	1	3	4		
βiIP 12/6000	1458	○	-	-	-	○	○	○	○	○	○	-	Oil seal
		-	○	-	-	○	○	○	○	○	○	0002	Oil seal
		-	○	-	-	○	○	○	○	○	○	-	No seal
βiIP 15/8000	1442	-	-	○	-	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0109	No seal
βiIP 18/8000	1443	-	-	○	-	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	-	○	○	○	○	0102	Oil seal
		-	-	-	○	○	-	○	○	○	○	0109	No seal
βiIP 22/8000	1459	-	-	○	-	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0109	No seal
βiIP 30/8000	1499	-	-	○	-	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0102	Oil seal
		-	-	-	○	○	○	○	○	○	○	0109	No seal
βiIP 40/6000	1480	○	-	-	-	○	○	○	○	○	○	-	Oil seal
		-	○	-	-	○	○	○	○	○	○	0002	Oil seal
		-	○	-	-	○	○	○	○	○	○	-	No seal

(3) βiIT series A06B-□□□□-B△○▽#abcd

Symbol in specification No. / Model name	□□□□	△	○	▽	abc	Shaft end seal	Distance block (*1)	
		1	2	3			Distance block	Distance block with windows
βiIT 12/10000	1490	○	○	○	0P21	Simplified labyrinth	A06B-1466-K560	A06B-1466-K580
βiIT 15/8000	1491	○	○	○	0P21	Simplified labyrinth	A06B-1469-K560	A06B-1469-K580

(*1) Order the distance block separately. (Separately packed.)

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(4) βiIc series A06B-□□□□-B△○▽#abcd

Symbol in specification No. / Model name	□□□□	△		○		▽		abcd	Shaft end seal
		1	2	0	5	6	7		
βiIc 3/6000	1415	○	○	○	○	○	○	0009	No seal
βiIc 6/6000	1416	○	○	○	○	○	○	0009	No seal
βiIc 8/6000	1417	○	○	○	○	○	○	0009	No seal

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3 MOTOR SPECIFICATIONS

This chapter describes the motor specifications of the FANUC AC Spindle Motor β*i* series.

This chapter, "MOTOR SPECIFICATIONS", consists of the following sections:

3.1 TERMS 10
3.2 CURVES AND DATA SHEET 12
3.3 EXTERNAL DIMENSIONS 38
3.4 COOLING FAN 68

3.1 TERMS

The key terms used in this manual are described below.

Correspondence table

This version (Edition 05)		Unit (SI)	Description
Term	Symbol		
S1 continuous rated output	Pc	kW	Output capable of operating the motor continuously
S2 ○-minute rated output(*1)	-	kW	Output capable of operating the motor for ○ minutes
S3 ○-percent rated output(*2)		kW	Output capable of operating the motor continuously for ○% of a cycle (10 minutes) in intermittent use
Steady-state maximum output(*3)	P_{max}	kW	Maximum output in the steady state
Maximum output at acceleration for PS selection	-	kW	Maximum output at acceleration. Data used to select a power supply (α*i*PS), and not a guaranteed value.
S1 continuous rated current	I_C	A(rms)	Maximum value of the current necessary for outputting the S1 rated output Pc
S2 ○-minute rated current(*1)	-	A(rms)	Maximum value of the current necessary for outputting the S2 ○-minute rated output
Moment of inertia	-	kg▪m^2	Amount representing the magnitude of the inertia of a rotating object. It represents the magnitude of the property to resist a change in rotation when that change is made. It is expressed by the product of the weight of a portion of the object and the square of the distance from the rotation axis to that portion.
Rotor moment of inertia or Moment of inertia of rotor	Jm	kg▪m^2	Moment of inertia of the rotor of the motor
Load moment of inertia	-	kg▪m^2	Moment of inertia coupled to the rotor

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(*1) ○ is replaced by a time such as 15 or 30.
(*2) ○% is replaced by a percentage such as 15% or 25%.
(*3) Guideline for the maximum output in rated power voltage, not a guaranteed value.

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3.2 CURVES AND DATA SHEET

For the specifications and characteristics of FANUC AC Spindle Motor β*i* series, characteristic curves and data sheets are described for each motor.

This chapter, "CURVES AND DATA SHEET", consists of the following sections:

3.2.1 About Characteristic Curves and Data Sheet 13
3.2.2 βiI series 200-V type 18
Model βiI 3/12000 18
Model βiI 6/12000 19
Model βiI 8/12000 20
Model βiI 12/10000 21
Model βiI 15/8000 22
3.2.3 βiI series 400-V type 23
Model βiI 6/12000HV 23
Model βiI 8/12000HV 24
Model βiI 12/10000HV 25
3.2.4 βiIP series 26
Model βiIP 12/6000 26
Model βiIP 15/8000 27
Model βiIP 18/8000 28
Model βiIP 22/8000 29
Model βiIP 30/8000 30
Model βiIP 40/6000 31
3.2.5 βiIT series 32
Model βiIT 12/10000 32
Model βiIT 15/8000 33
3.2.6 βiIC series 34
Model βiIC 3/6000 34
Model βiIC 6/6000 35
Model βiIC 8/6000 36

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3.2.1 About Characteristic Curves and Data Sheet

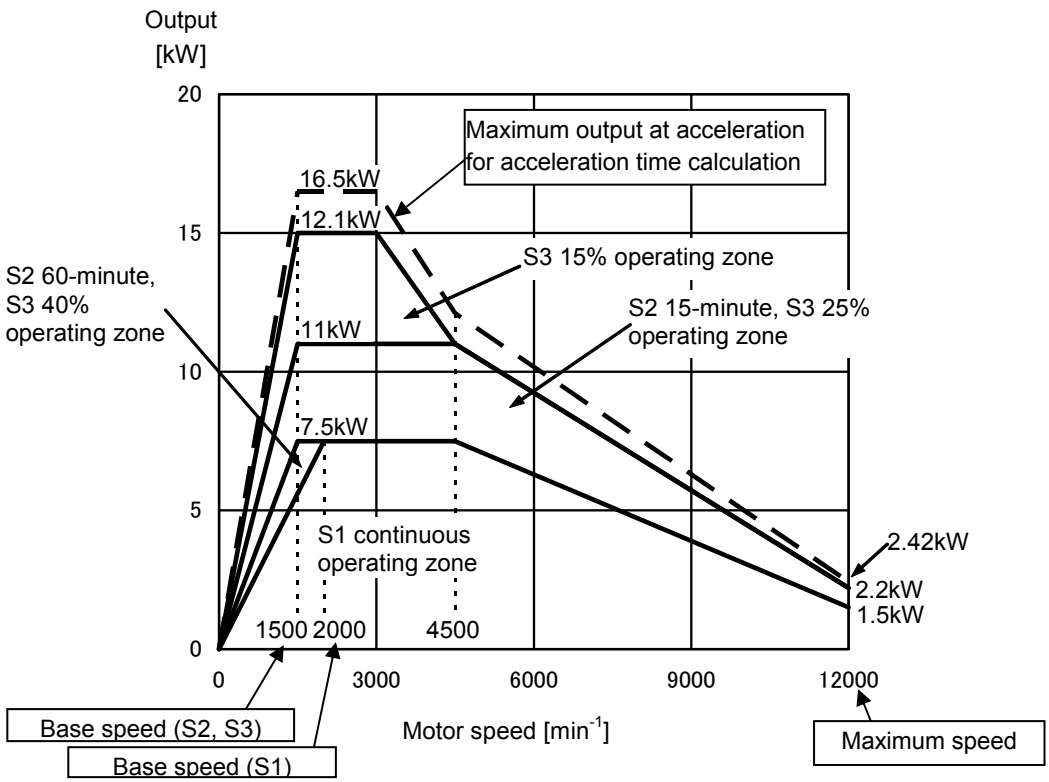
The specifications of each motor are described by the characteristic curves and data sheet given below.

(1) Characteristic curves

As characteristic curves, "speed-output characteristics" and "speed-torque characteristics" are provided for each motor.

Speed-output characteristics

Speed-output characteristics show the relations between motor output and speed.
In the S1 continuous operating zone, the motor can be used continuously with any combination of speed and output.
The S2 ○-minute operating zone is a zone in which the motor can be used at room temperature for the indicated time.
The S3 ○% operating zone is a zone in which the motor can output the indicated percentage in a single cycle (10 minutes) in intermittent use.
A data sheet shows values when the input voltage is 200 V or 400 V.



Speed-output characteristics chart
Example) βiI 8/12000

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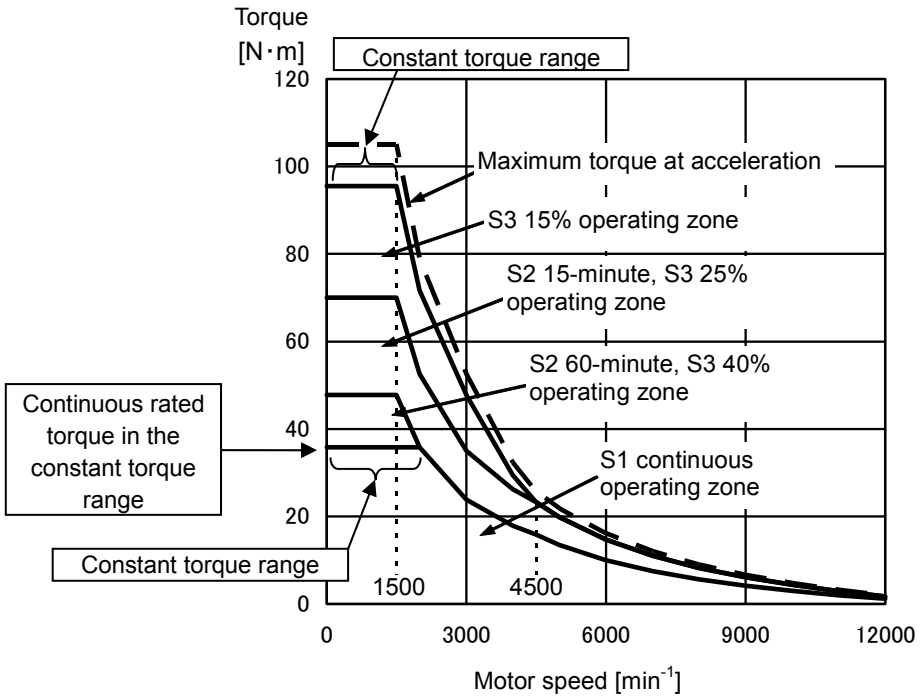
Speed-torque characteristics

Speed-torque characteristics show the relations between motor torque and speed.
The definitions of S1, S2, and S3 are the same as those for speed-output characteristics.
A data sheet shows values when the input voltage is 200 V or 400 V.



Speed-torque characteristics chart

Example) βiI 8/12000

Reference: Torque calculation

The torque T for any motor speed can be determined from the formula below.

$T[N\cdot m]=P[kW]\times 1000/0.1047/N[min^{-1}]$

P[kW] :Motor output

$N[min^{-1}]$:Motor speed

Assuming that T is in units of [kgf·m]

$T[kgf\cdot m]=P[kW]\times 1000/1.0269/N[min^{-1}]$

(2) Data sheet

A data sheet lists parameters related to motor performance.
Parameters contained in a data sheet are as below.

S1 continuous rated output: P_C [kW]

The S1 continuous rated output is the rating at which the motor can be used continuously with the indicated output.

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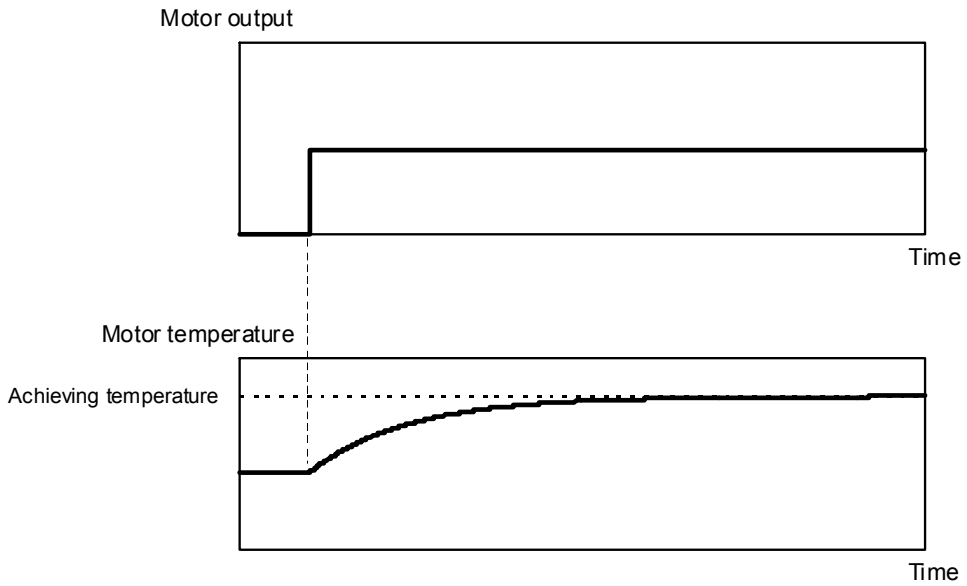
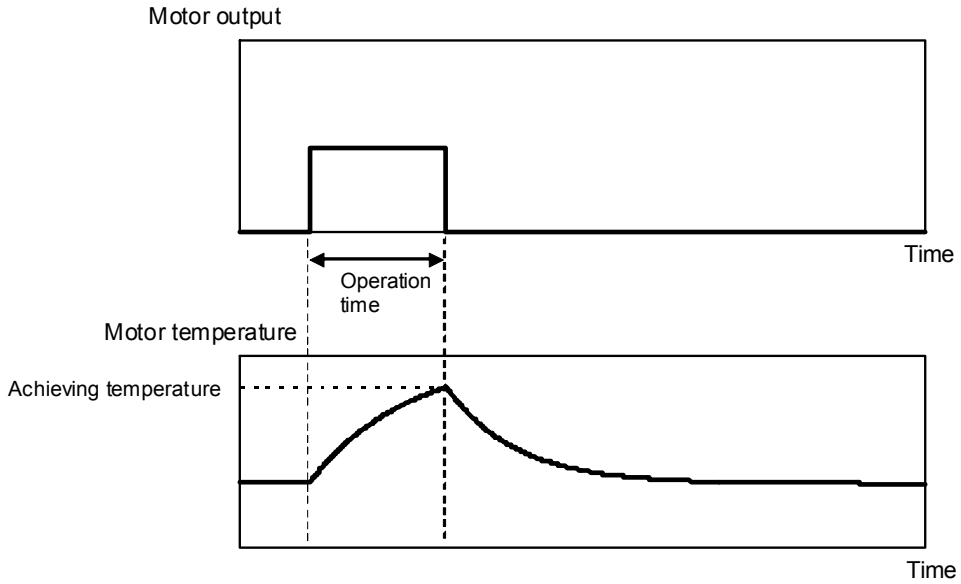


The rated output is guaranteed at the rated power voltage (amplifier input: 200 or 400 VAC, 50/60Hz). If the input power voltage fluctuates, the rated output may not be achieved even within the permissible range.

S2 ○-minute rated output: [kW]

Output that can be used for the indicated time (○ minutes) with the motor being at room temperature.
If the output is to be used again, the motor must return to room temperature beforehand.



The rated output is guaranteed at the rated power voltage (amplifier input: 200 or 400 VAC, 50/60Hz). If the input power voltage fluctuates, the rated output may not be achieved even within the permissible range.

S3 ○-% rated output: [kW]

Output that can be used for the indicated cycle retention percentage (○%) in 10 minutes.
Example)

If the S3 25% rated output is 11 kW, the output of 11 kW can be used for 2 minutes and 30 seconds in a 10-minute cycle, and the output stops for the remaining time of 7 minutes and 30 seconds.

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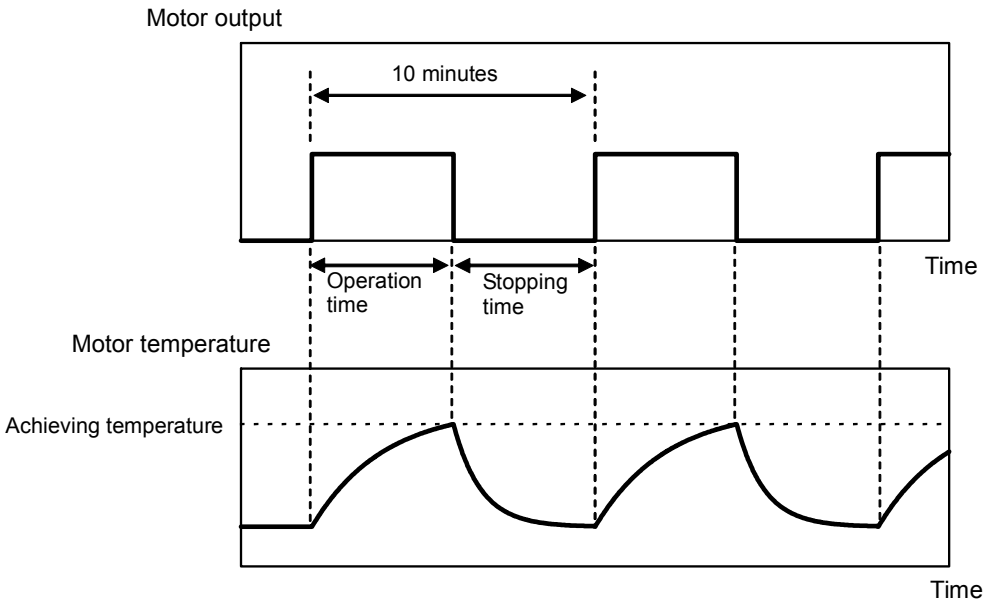

$$\text{Cycle retention percentage} = \frac{\text{Operation time}}{\text{10 minutes}} \times 100[\%]$$

The rated output is guaranteed at the rated power voltage (amplifier input: 200 or 400 VAC, 50/60Hz). If the input power voltage fluctuates, the rated output may not be achieved even within the permissible range.

S1 continuous rated current: I_C [A]

Maximum current value (RMS value) necessary for obtaining the S1 continuous rated output.

S2 ○-minute rated current: [A]

Maximum current value (RMS value) necessary for obtaining the S2 ○-minute rated output.

S3 ○-% rated output: [A]

Maximum current value (RMS value) necessary for obtaining the S3 ○-% rated output.

Base speed (S1 rating): [min^{-1}]

Speed necessary for the S1 rated output to reach a maximum.

Base speed (S2 rating): [min^{-1}]

Speed necessary for the S2 rated output to reach a maximum.

Base speed (S3 rating): [min^{-1}]

Speed necessary for the S3 rated output to reach a maximum.

Max. speed: N_m [min^{-1}]

Maximum speed at which the motor can be operated.

Steady-state maximum output: P_{max} [kW]

Maximum output in the steady state. The maximum output at the rated power voltage is not a guaranteed value but a guideline.

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Maximum output at acceleration for PS selection: [kW]

Maximum output at acceleration. It is data used to select a power supply (α*i*PS), and is not a guaranteed value.

Continuous rated torque in the constant torque range: [Nm]

S1 continuous rated torque that becomes constant in the speed range before the S1 continuous rated output is reached.

Moment of inertia of the rotor: J_m [kg·m^2][kgf·cm·s^2]

Moment of inertia of the rotor of the motor.

Weight: w [kg]

Weight of the motor.

Winding resistance (U-V, V-W, and W-U): Ra [mΩ]

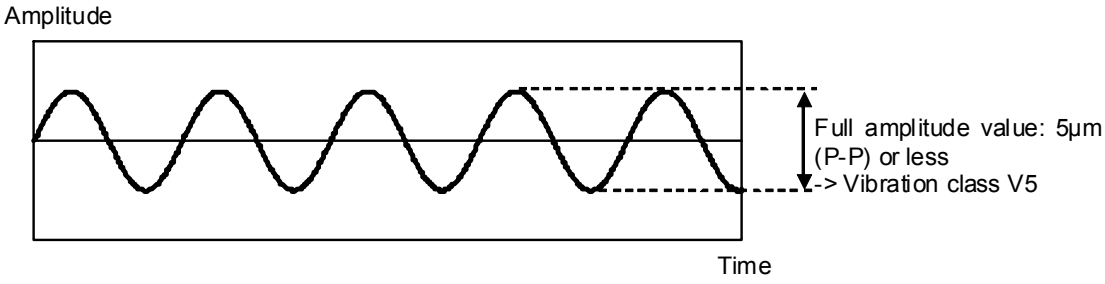
Resistance value between motor terminals. The value is a standard value at 20°C. (±10%)

Number of teeth for speed detection

Number of teeth of the built-in sensor of the motor.

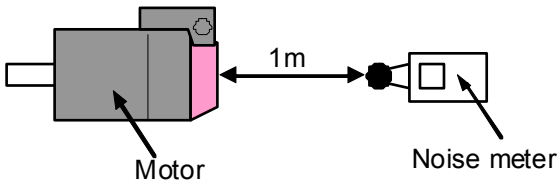
Vibration

Vibration class (rotation direction) of the motor (model without a key way). The vibration class is determined by measuring the full amplitude (P-P) of the motor when the motor is driven with no load and at the maximum speed. If, for example, the vibration class is V5, the full amplitude of the motor with no load and at the maximum speed is 5μm (P-P) or less.



Noise

Noise level of the motor. It is measured at a position 1 m apart from the motor, by using a frequency filter with the A characteristic.



* A characteristic.....Characteristic corrected to approximate human senses

Cooling system

Cooling system of the motor. The definition is as per IEC60034-6, and the IC code is as per IEC 34-6.

Rated power of the cooling fan

Rated power of the cooling fan.

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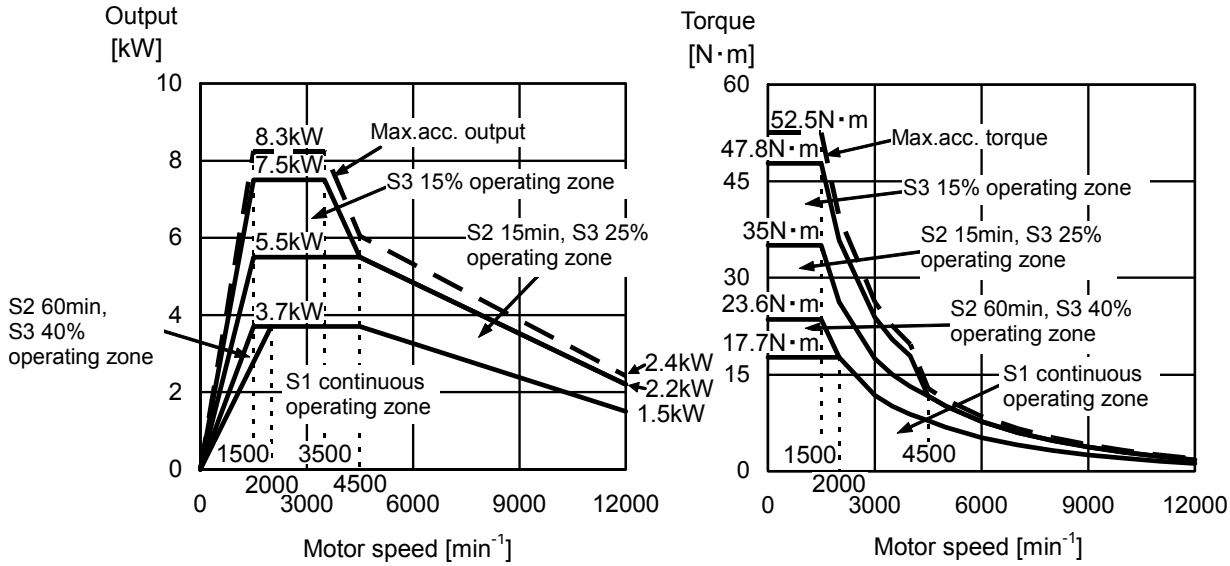
3.2.2 βiI series 200-V type

Model βiI 3/12000 Ordering specification number: A06B-1444-B□□□#0P□□

Applicable amplifier βiSVSP*-7.5-B
αiSP 11-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	3.7 (5.0)	kW (HP)
	S2 15 min rated, S3 25% rated			5.5 (7.4)	kW (HP)
	S3 15% rated			7.5 (10.1)	kW (HP)
Rated current	S1 continuous rated		I_C	18	A
	S2 60 min rated, S3 40% rated			22	A
	S2 15 min, S3 25% rated			29	A
	S3 15% rated			41	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	12000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				8.3	kW
Continuous rated torque in the constant torque range			T_b	17.7 (180)	N・m (kgf・cm)
Moment of inertia of the rotor			J_m	0.0078 (0.08)	$kg・m^2$ ($kgf・cm・s^2$)
Weight			w	27	kg
Winding resistance (U-V, V-W, and W-U)			Ra	466	mΩ
Number of teeth for speed detection				128	λ /rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				38	W

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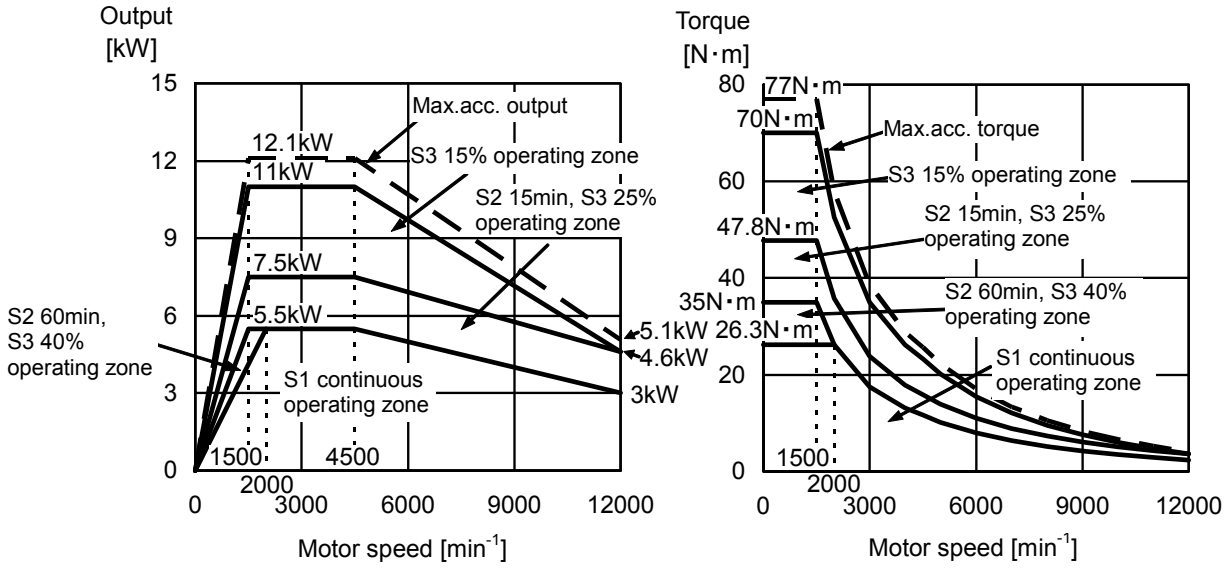
Model βiI 6/12000 Ordering specification number: A06B-1445-B□□□#0P□□

Applicable amplifier βiSVSP*-15-B
αiSP 15-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	5.5 (7.4)	kW (HP)
	S2 15 min rated, S3 25% rated			7.5 (10)	kW (HP)
	S3 15% rated			11 (14.7)	kW (HP)
Rated current	S1 continuous rated		I_C	40	A
	S2 60 min rated, S3 40% rated			47	A
	S2 15 min, S3 25% rated			56	A
	S3 15% rated			80	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_{max}	12000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				12.1	kW
Continuous rated torque in the constant torque range			T_b	26.3 (268)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0148 (0.15)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	46	kg
Winding resistance (U-V, V-W, and W-U)			Ra	102	mΩ
Number of teeth for speed detection				128	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				38	W

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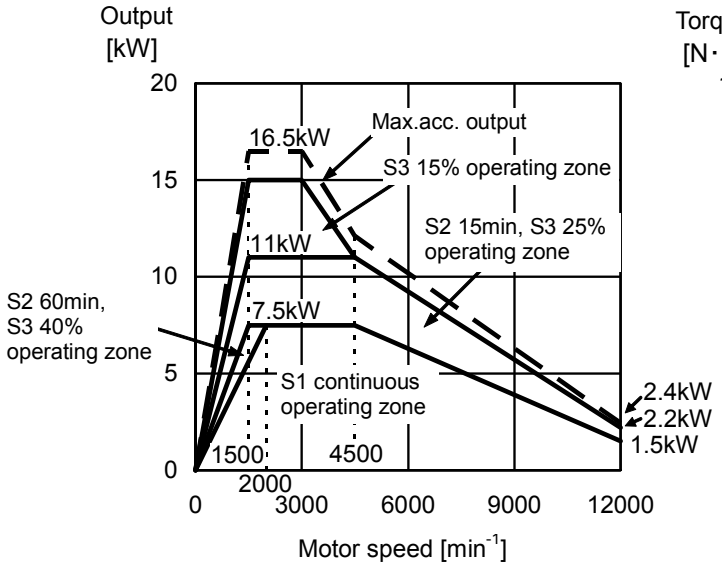
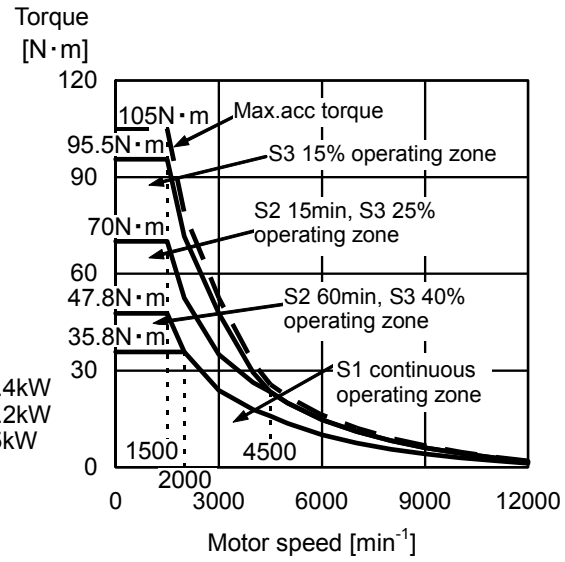
Model βiI 8/12000 Ordering specification number: A06B-1446-B□□□#0P□□

Applicable amplifier βiSVSP*-15-B
αiSP 15-B





Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	7.5 (10)	kW (HP)
	S2 15 min rated, S3 25% rated			11 (14.7)	kW (HP)
	S3 15% rated			15 (20.1)	kW (HP)
Rated current	S1 continuous rated		I_C	36	A
	S2 60 min rated, S3 40% rated			42	A
	S2 15 min, S3 25% rated			56	A
	S3 15% rated			78	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	12000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				16.5	kW
Continuous rated torque in the constant torque range			T_b	35.8 (365)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0179 (0.18)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	51	kg
Winding resistance (U-V, V-W, and W-U)			Ra	146	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				50	W

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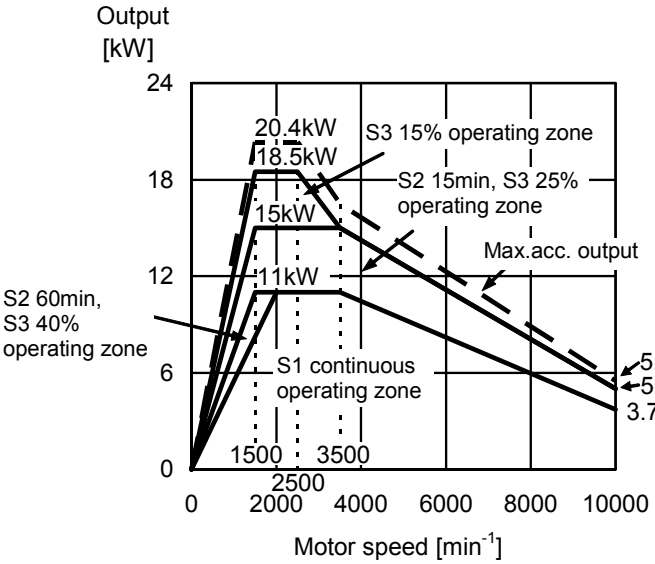
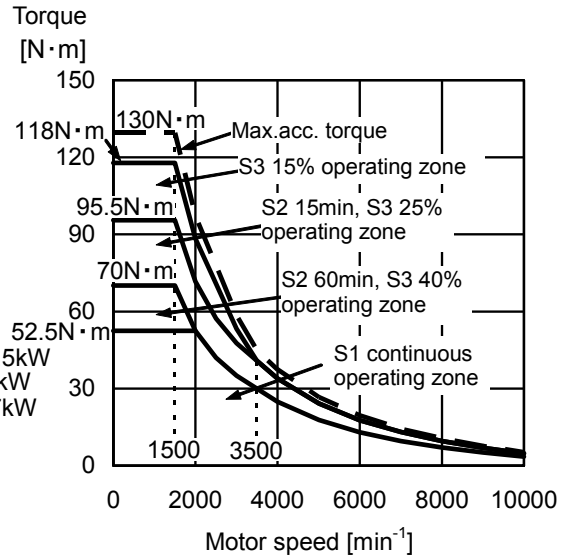
Model βiI 12/10000 Ordering specification number: A06B-1447-B□□□#0P□□

Applicable amplifier βiSVSP*-18-B
αiSP 15-B





Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	11 (14.7)	kW (HP)
	S2 15 min rated, S3 25% rated			15 (20.1)	kW (HP)
	S3 15% rated			18.5 (24.8)	kW (HP)
Rated current	S1 continuous rated		I_C	43	A
	S2 60 min rated, S3 40% rated			49	A
	S2 15 min, S3 25% rated			63	A
	S3 15% rated			75	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	10000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				20.4	kW
Continuous rated torque in the constant torque range			T_b	52.5 (536)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0275 (0.28)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	80	kg
Winding resistance (U-V, V-W, and W-U)			Ra	142	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				50	W

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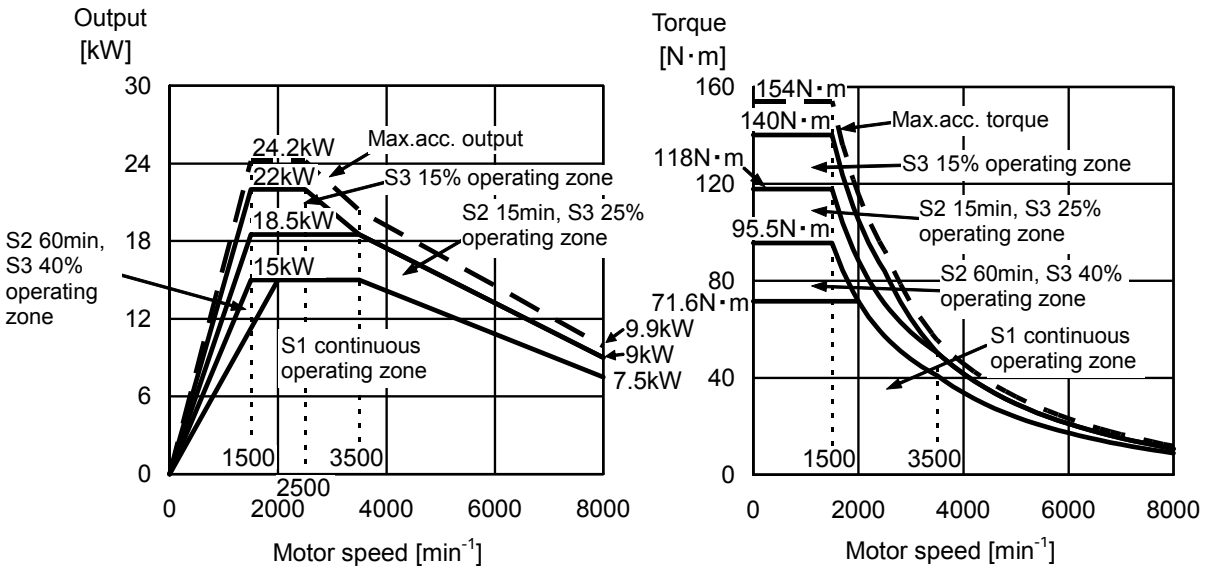
Model βiI 15/8000 Ordering specification number: A06B-1498-B□□□#0P□□

Applicable amplifier αiSP 22-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	15 (20.1)	kW (HP)
	S2 15 min rated, S3 25% rated			18.5 (24.8)	kW (HP)
	S3 15% rated			22 (29.5)	kW (HP)
Rated current	S1 continuous rated		I_C	69	A
	S2 60 min rated, S3 40% rated			75	A
	S2 15 min, S3 25% rated			80	A
	S3 15% rated			86	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				24.2	kW
Continuous rated torque in the constant torque range			T_b	71.6 (730)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.07 (0.71)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	95	kg
Winding resistance (U-V, V-W, and W-U)			Ra	161.6	mΩ
Number of teeth for speed detection				256	λ /rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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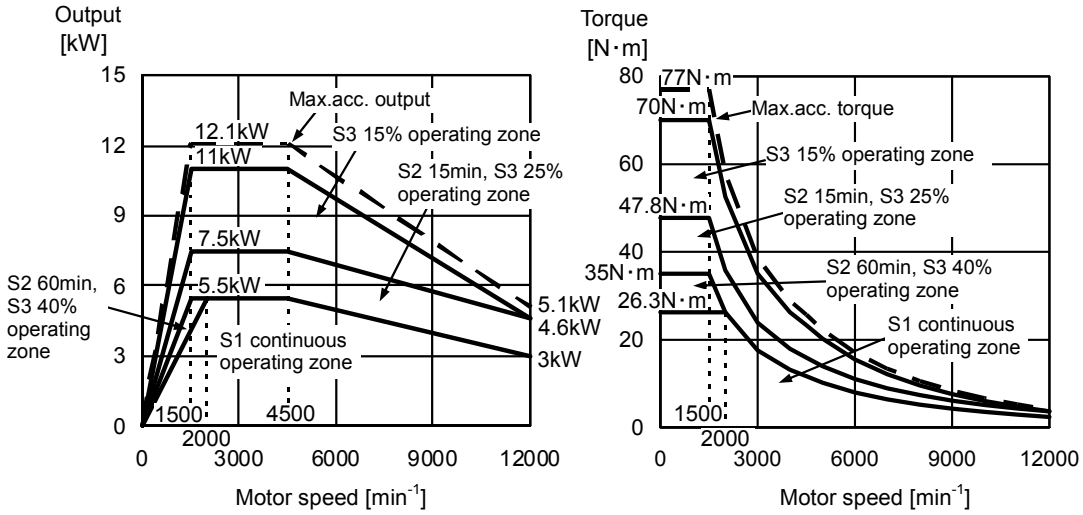
3.2.3 βiI series 400-V type

Model βiI 6/12000HV

Ordering specification number: A06B-1545-B□□□#0P□□

Applicable amplifier βiSVSP*-15HV-B
αiSP 15HV-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	5.5 (7.4)	kW (HP)
	S2 15 min rated, S3 25% rated			7.5 (10)	kW (HP)
	S3 15% rated			11 (14.7)	kW (HP)
Rated current	S1 continuous rated		I_C	20	A
	S2 60 min rated, S3 40% rated			24	A
	S2 15 min rated, S3 25% rated			28	A
	S3 15% rated			40	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	12000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				12.1	kW
Continuous rated torque in the constant torque range			T_b	26.3 (268)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0148 (0.15)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	46	kg
Winding resistance (U-V, V-W, and W-U)			Ra	102	mΩ
Number of teeth for speed detection				128	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				34	W

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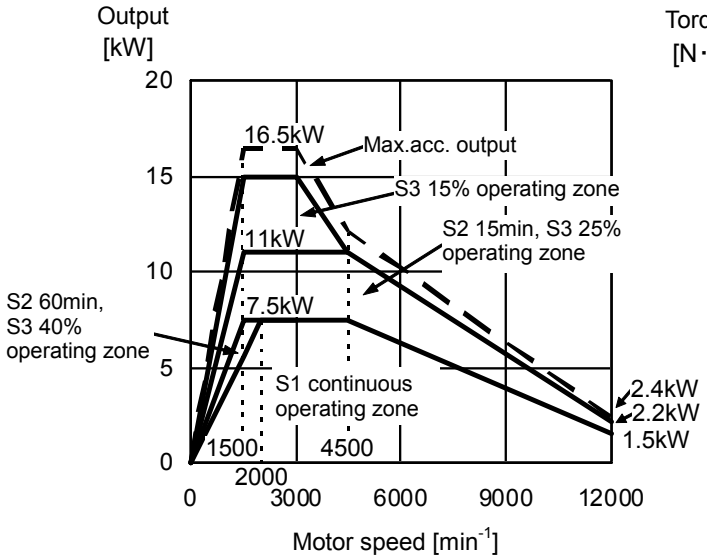
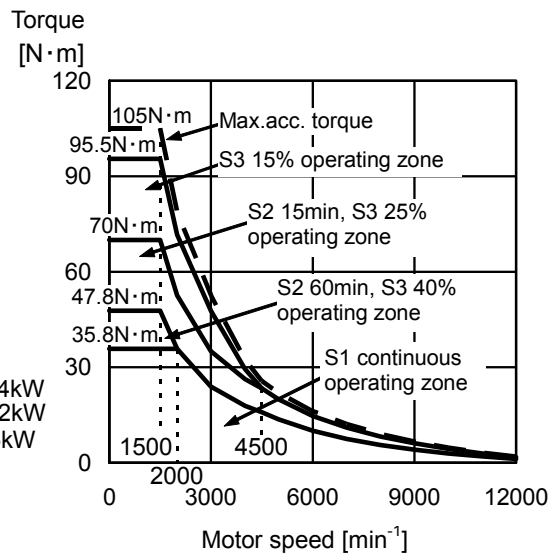
Model βiI 8/12000HV

Ordering specification number: A06B-1546-B□□□#0P□□

Applicable amplifier βiSVSP*-15HV-B
αiSP 15HV-B





Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	7.5 (10.1)	kW (HP)
	S2 15 min rated, S3 25% rated			11 (14.7)	kW (HP)
	S3 15% rated			15 (20.1)	kW (HP)
Rated current	S1 continuous rated		I_C	24	A
	S2 60 min rated, S3 40% rated			22	A
	S2 15 min rated, S3 25% rated			36	A
	S3 15% rated			38	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	12000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				16.5	kW
Continuous rated torque in the constant torque range			T_b	35.8 (365)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0179 (0.18)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	51	kg
Winding resistance (U-V, V-W, and W-U)			Ra	600	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				80	W

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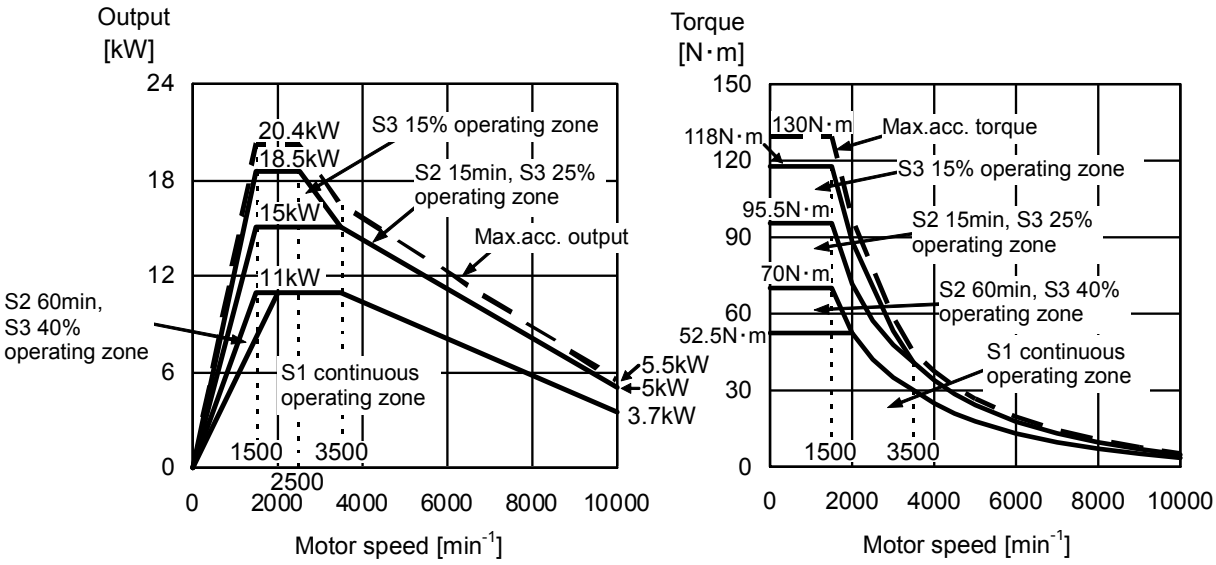
Model βiI 12/10000HV

Ordering specification number: A06B-1547-B□□□#0P□□

Applicable amplifier βiSVSP*-18HV-B
αiSP 22HV-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	11 (14.7)	kW (HP)
	S2 15 min rated, S3 25% rated			15 (20.1)	kW (HP)
	S3 15% rated			18.5 (24.8)	kW (HP)
Rated current	S1 continuous rated		I_C	25	A
	S2 60 min rated, S3 40% rated			26	A
	S2 15 min rated, S3 25% rated			34	A
	S3 15% rated			40	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	10000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				20.4	kW
Continuous rated torque in the constant torque range			T_b	52.5 (536)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0275 (0.28)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	80	kg
Winding resistance (U-V, V-W, and W-U)			Ra	549	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				80	W

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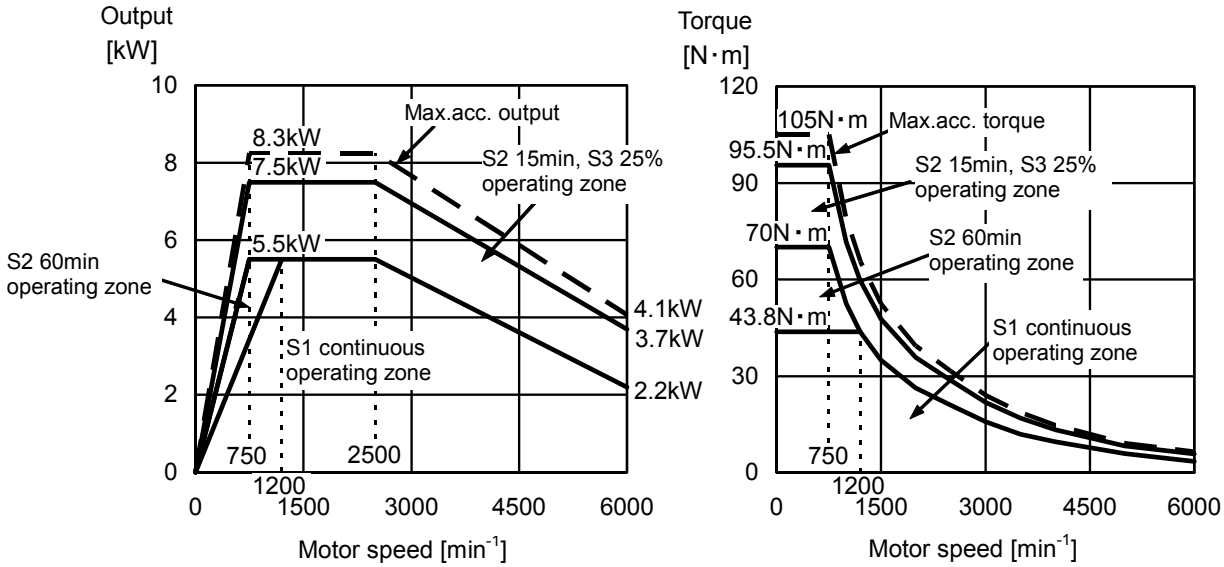
3.2.4 βiIP series

Model βiIP 12/6000

Ordering specification number: A06B-1458-B□□□

Applicable amplifier βiSVSP*-7.5-B
αiSP 11-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated		P_C	5.5 (7.4)	kW (HP)
	S2 15 min rated, S3 25% rated			7.5 (10.1)	kW (HP)
Rated current	S1 continuous rated		I_C	25	A
	S2 60 min rated			30	A
	S2 15 min rated, S3 25% rated			38	A
Speed	Base speed	S1 continuous rated		1200	min^{-1}
		S2 60 min rated, S2 15 min rated, S3 25% rated	N_b	750	min^{-1}
	Max. speed		N_m	6000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				8.3	kW
Continuous rated torque in the constant torque range			T_b	43.8 (446)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0275 (0.28)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	80	kg
Winding resistance (U-V, V-W, and W-U)			Ra	397	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				50	W

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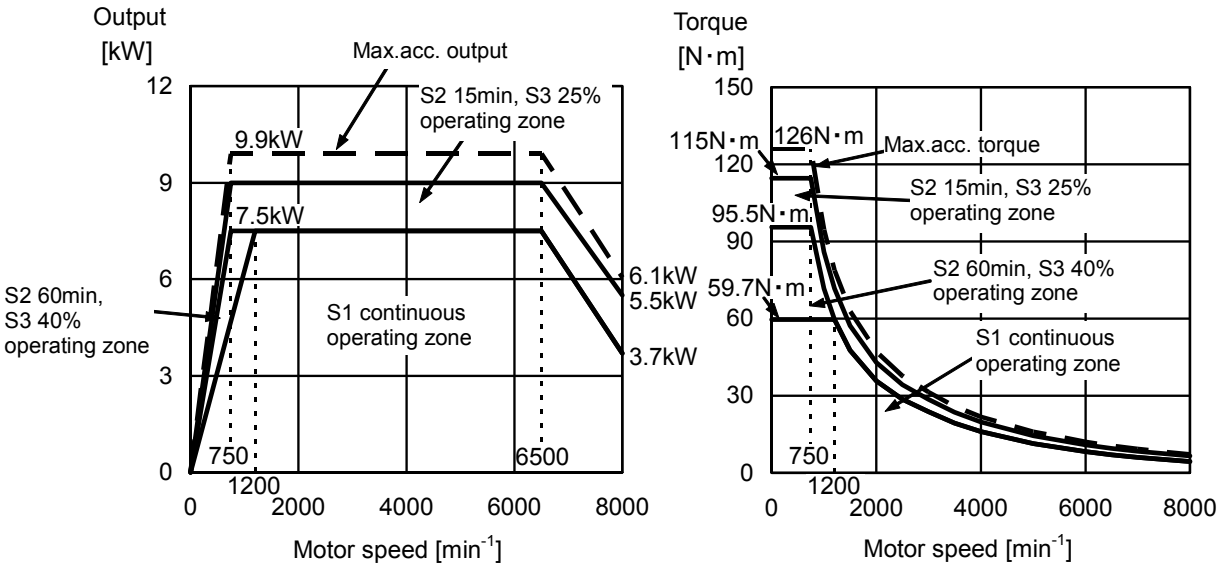
Model βiIP 15/8000 Ordering specification number: A06B-1442-B□□□#01□□

Applicable amplifier βiSVSP*-11-B
αiSP 11-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated, S3 40% rated		P_C	7.5 (10.1)	kW (HP)
	S2 15 min rated, S3 25% rated			9 (12.1)	kW (HP)
Rated current	S1 continuous rated		I_C	36	A
	S2 60 min rated, S3 40% rated			50	A
	S2 15 min rated, S3 25% rated			59	A
Speed	Base speed	S1 continuous rated		1200	min^{-1}
		S2 60 min rated, S3 40% rated S2 15 min rated, S3 25% rated	N_b	750	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				9.9	kW
Continuous rated torque in the constant torque range			T_b	59.7 (609)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.07 (0.71)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	95	kg
Winding resistance (U-V, V-W, and W-U)			Ra	301	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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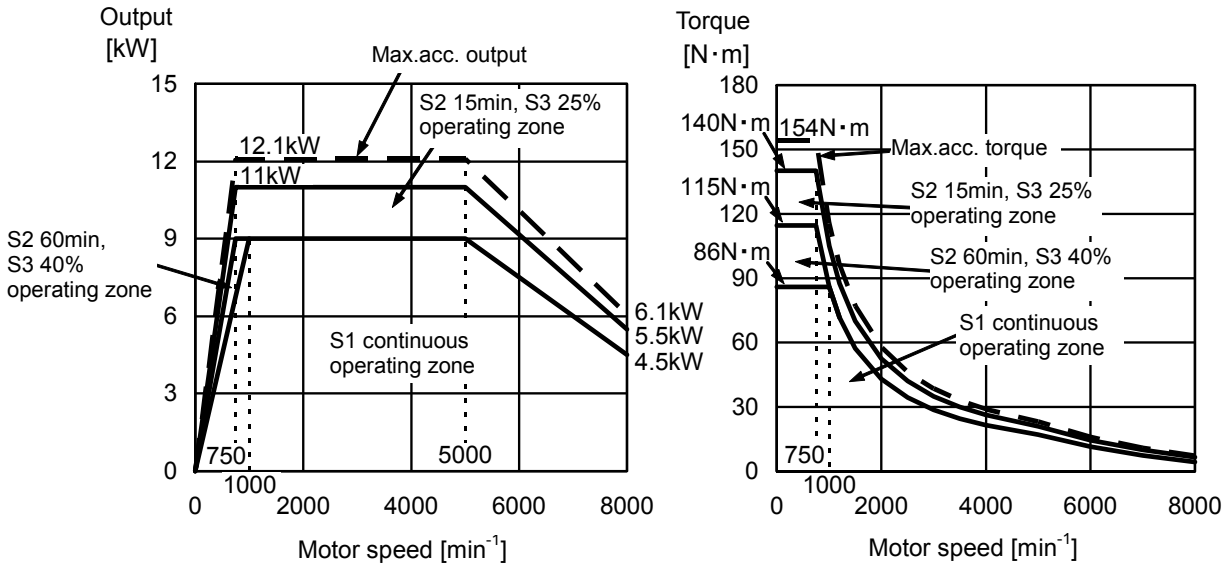
Model βiIP 18/8000 Ordering specification number: A06B-1443-B□□□#01□□

Applicable amplifier βiSVSP*-11-B
αiSP 11-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated, S3 40% rated		P_C	9 (12.1)	kW (HP)
	S2 15 min rated, S3 25% rated			11 (14.7)	kW (HP)
Rated current	S1 continuous rated		I_C	39	A
	S2 60 min rated, S3 40% rated			49	A
	S2 15 min rated, S3 25% rated			57	A
Speed	Base speed	S1 continuous rated		1000	min^{-1}
		S2 60 min rated, S3 40% rated S2 15 min rated, S3 25% rated	N_b	750	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				12.1	kW
Continuous rated torque in the constant torque range			T_b	86 (877)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.09 (0.92)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	110	kg
Winding resistance (U-V, V-W, and W-U)			Ra	208	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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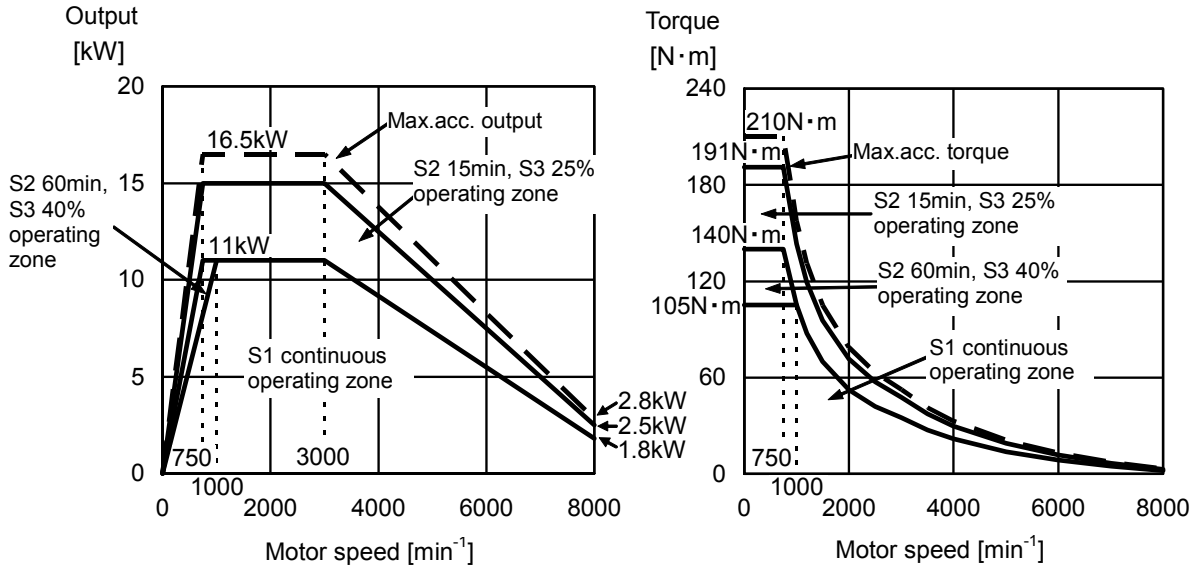
Model βiIP 22/8000 Ordering specification number: A06B-1459-B□□□#01□□

Applicable amplifier βiSVSP*-15-B
αiSP 15-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated, S3 40% rated		P_C	11 (14.7)	kW (HP)
	S2 15 min rated, S3 25% rated			15 (20.1)	kW (HP)
Rated current	S1 continuous rated		I_C	44	A
	S2 60 min rated, S3 40% rated			53	A
	S2 15 min rated, S3 25% rated			67	A
Speed	Base speed	S1 continuous rated		1000	min^{-1}
		S2 60 min rated, S3 40% rated S2 15 min rated, S3 25% rated	N_b	750	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				16.5	kW
Continuous rated torque in the constant torque range			T_b	105 (1071)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.105 (1.07)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	125	kg
Winding resistance (U-V, V-W, and W-U)			Ra	242	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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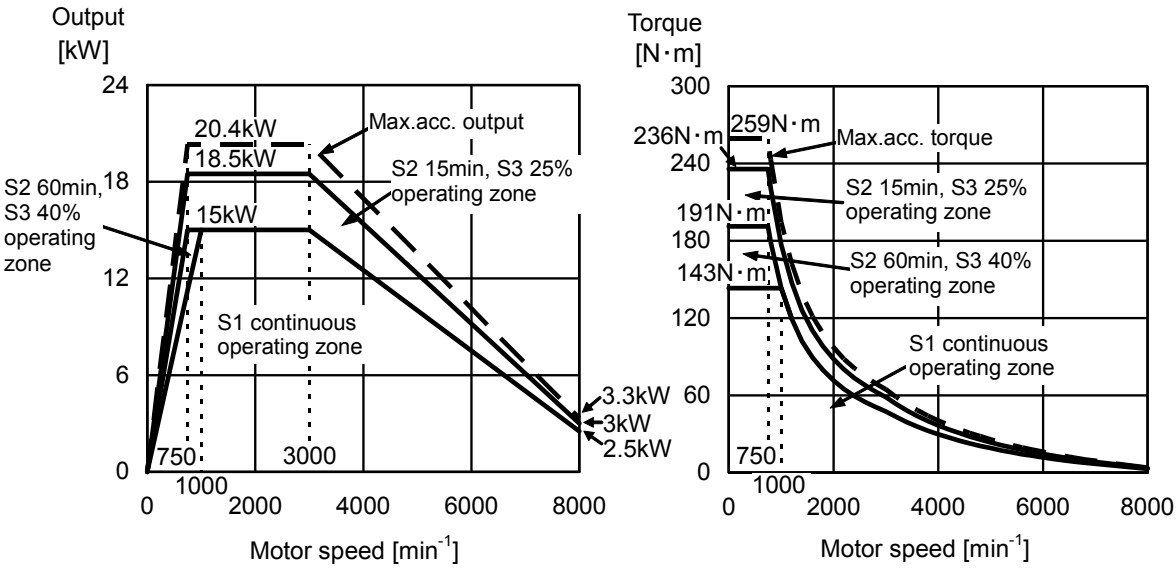
Model βiIP 30/8000 Ordering specification number: A06B-1499-B□□□#01□□

Applicable amplifier βiSVSP*-18-B
αiSP 22-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated, S3 40% rated		P_C	15 (20.1)	kW (HP)
	S2 15 min rated, S3 25% rated			18.5 (24.8)	kW (HP)
Rated current	S1 continuous rated		I_C	61	A
	S2 60 min rated, S3 40% rated			69	A
	S2 15 min rated, S3 25% rated			83	A
Speed	Base speed	S1 continuous rated		1000	min^{-1}
		S2 60 min rated, S3 40% rated S2 15 min rated, S3 25% rated	N_b	750	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				20.4	kW
Continuous rated torque in the constant torque range			T_b	143.2 (1461)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.128 (1.31)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	143	kg
Winding resistance (U-V, V-W, and W-U)			Ra	192.4	mΩ
Number of teeth for speed detection				256	λ /rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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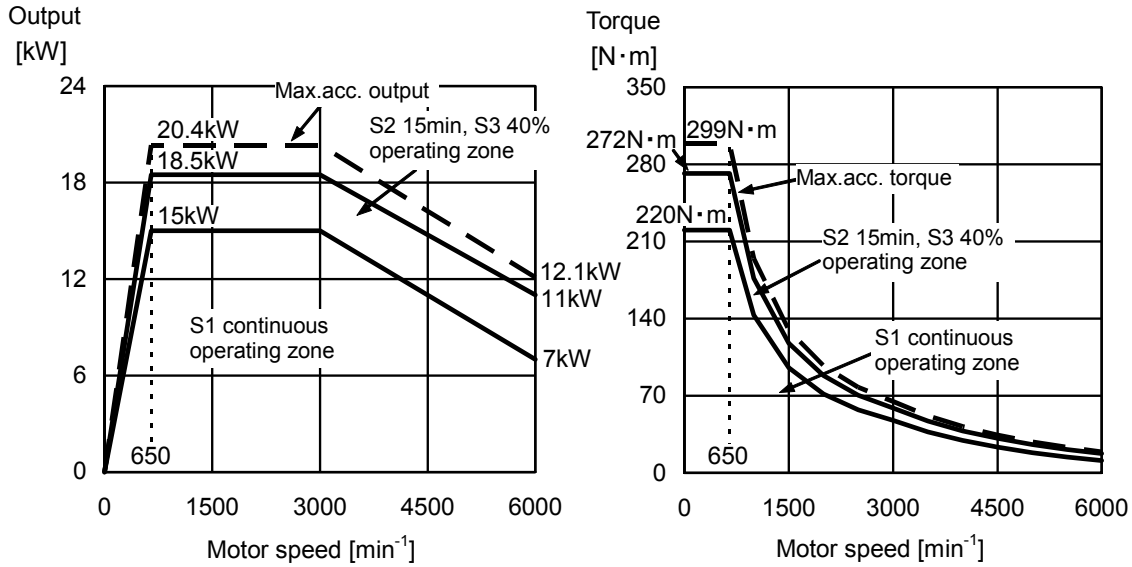
Model βiIP 40/6000

Ordering specification number: A06B-1480-B□□□

Applicable amplifier βiSVSP*-18-B
αiSP 22-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated		P_C	15 (20.1)	kW (HP)
	S2 15 min rated, S3 40% rated			18.5 (24.8)	kW (HP)
Rated current	S1 continuous rated		I_C	69	A
	S2 15 min, S3 40% rated			79	A
Speed	Base speed	S1 continuous rated, S2 15 min rated, S3 40% rated	N_b	650	min^{-1}
	Max. speed		N_m	6000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				20.4	kW
Continuous rated torque in the constant torque range			T_b	220.4 (2247)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.295 (3.01)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	250	kg
Winding resistance (U-V, V-W, and W-U)			Ra	77.8	mΩ
Number of teeth for speed detection				256	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				160	W

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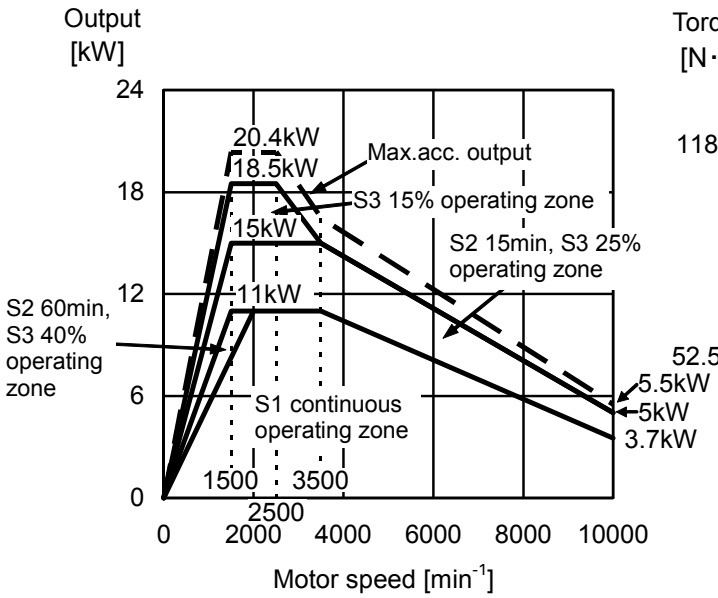
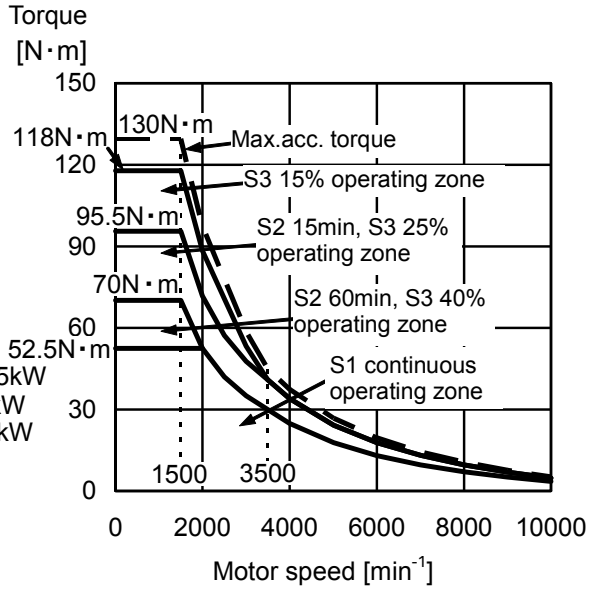
3.2.5 βiIT series

Model βiIT 12/10000

Ordering specification number: A06B-1490-B123#0P21

Applicable amplifier βiSVSP*-18-B
αiSP 15-B





Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	11 (14.7)	kW (HP)
	S2 15 min rated, S3 25% rated			15 (20.1)	kW (HP)
	S3 15% rated			18.5 (24.8)	kW (HP)
Rated current	S1 continuous rated		I_C	43	A
	S2 60 min rated, S3 40% rated			49	A
	S2 15 min, S3 25% rated			63	A
	S3 15% rated			75	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	10000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				20.4	kW
Continuous rated torque in the constant torque range			T_b	52.5 (536)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0275 (0.28)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	80	kg
Winding resistance (U-V, V-W, and W-U)			Ra	142	mΩ
Built-in detector				αiMZ sensor contained	
Number of teeth for speed detection				256	λ /rev.
Vibration				V3	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				50	W

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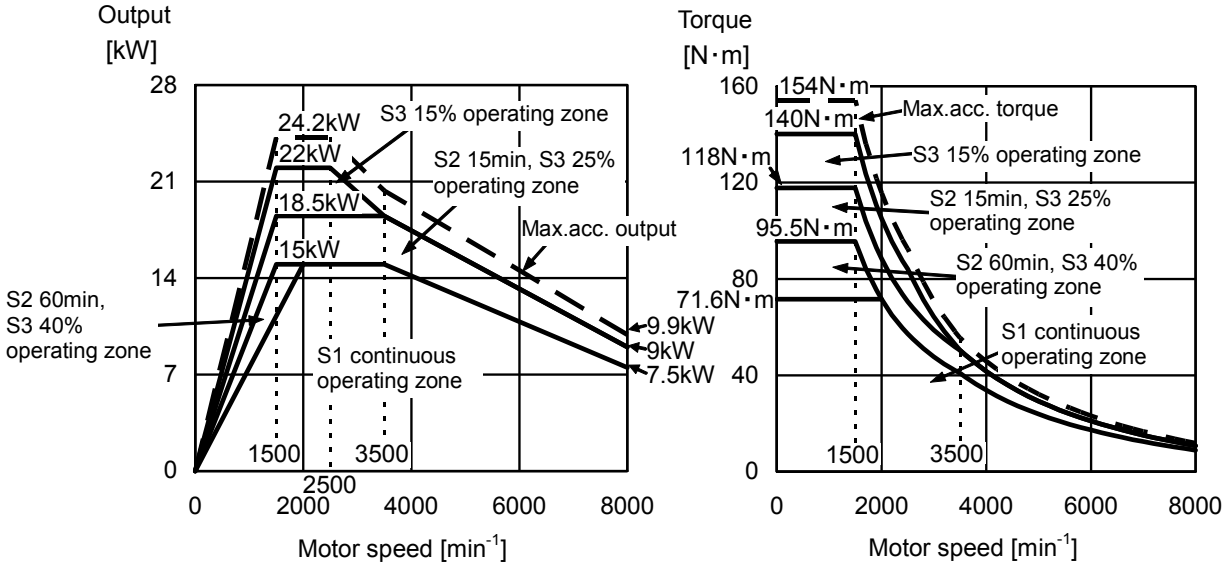
Model βiIT 15/8000 Ordering specification number: A06B-1491-B123#0P21

Applicable amplifier αiSP 22-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated S3 40% rated		P_C	15 (20.1)	kW (HP)
	S2 15 min rated, S3 25% rated			18.5 (24.8)	kW (HP)
	S3 15% rated			22 (29.5)	kW (HP)
Rated current (*3)	S1 continuous rated		I_C	69	A
	S2 60 min rated, S3 40% rated			75	A
	S2 15 min, S3 25% rated			80	A
	S3 15% rated			86	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S3 40% rated, S2 15 min rated, S3 25% rated S3 15% rated	N_b	1500	min^{-1}
	Max. speed		N_m	8000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				24.2	kW
Continuous rated torque in the constant torque range			T_b	71.6 (730)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.07 (0.71)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	95	kg
Winding resistance (U-V, V-W, and W-U)			Ra	161.6	mΩ
Built-in detector				αiMZ sensor contained	
Number of teeth for speed detection				256	λ /rev.
Vibration				V3	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				100	W

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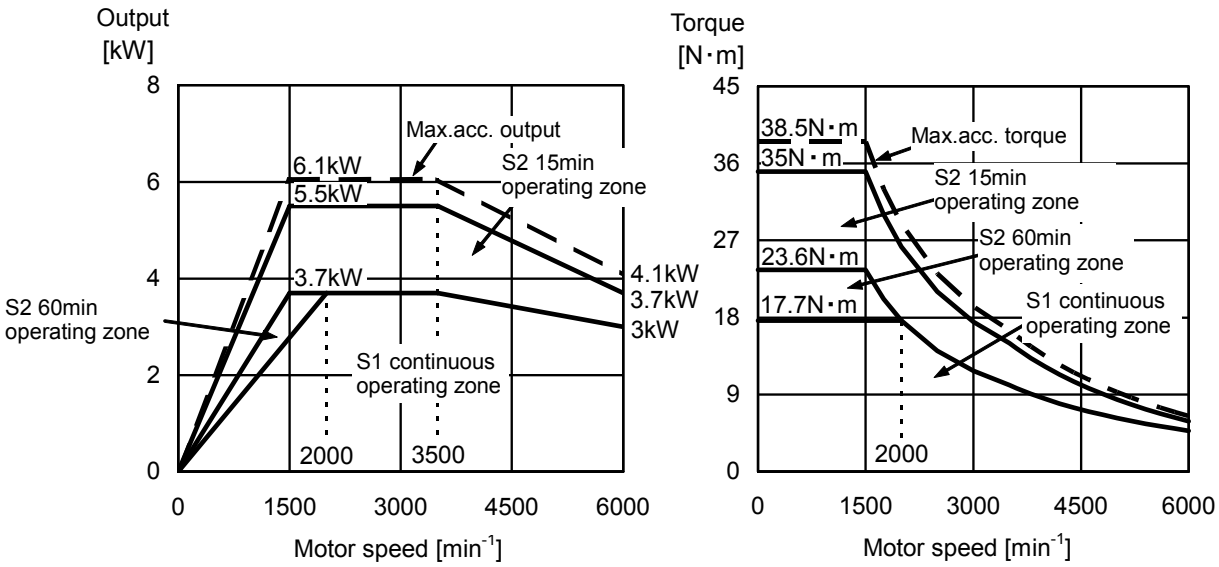
3.2.6 βiIc series

Model βiIc 3/6000 Ordering specification number: A06B-1415-B□□□#0009

Applicable amplifier βiSVSP*-7.5-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated		P_C	3.7 (5.0)	kW (HP)
	S2 15 min rated			5.5 (7.4)	kW (HP)
Rated current	S1 continuous rated		I_C	22	A
	S2 60 min rated			23	A
	S2 15 min rated			30	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S2 15 min rated	N_b	1500	min^{-1}
	Max. speed		N_m	6000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				6.1	kW
Continuous rated torque in the constant torque range			T_b	17.7 (180)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0078 (0.08)	$kg·m^2$ $(kgf·cm·s^2)$
Weight			w	27	kg
Winding resistance (U-V, V-W, and W-U)			Ra	466	mΩ
Number of teeth for speed detection				-	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				38	W

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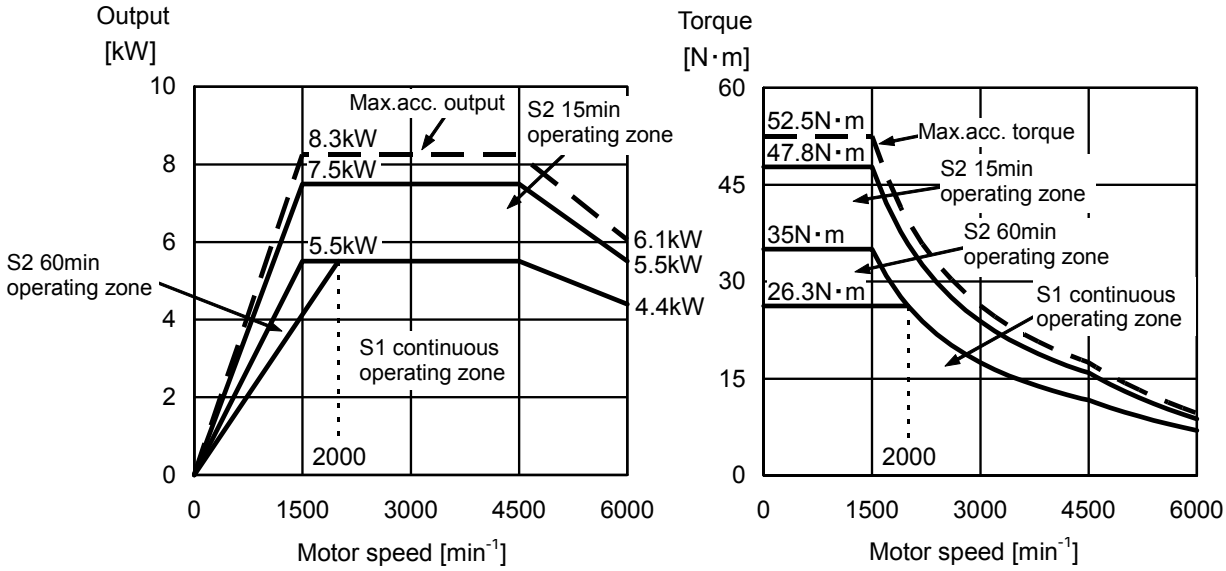
Model βiIc 6/6000 Ordering specification number: A06B-1416-B□□□#0009

Applicable amplifier βiSVSP*-7.5-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated		P_C	5.5 (7.4)	kW (HP)
	S2 15 min rated			7.5 (10.1)	kW (HP)
Rated current	S1 continuous rated		I_C	27	A
	S2 60 min rated			29	A
	S2 15 min rated			37	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S2 15 min rated	N_b	1500	min^{-1}
	Max. speed		N_m	6000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				8.3	kW
Continuous rated torque in the constant torque range			T_b	26.3 (268)	N·m (kgf·cm)
Moment of inertia of the rotor			J_m	0.0148 (0.15)	$kg·m^2$ ($kgf·cm·s^2$)
Weight			w	46	kg
Winding resistance (U-V, V-W, and W-U)			Ra	289	mΩ
Number of teeth for speed detection				-	λ/rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				38	W

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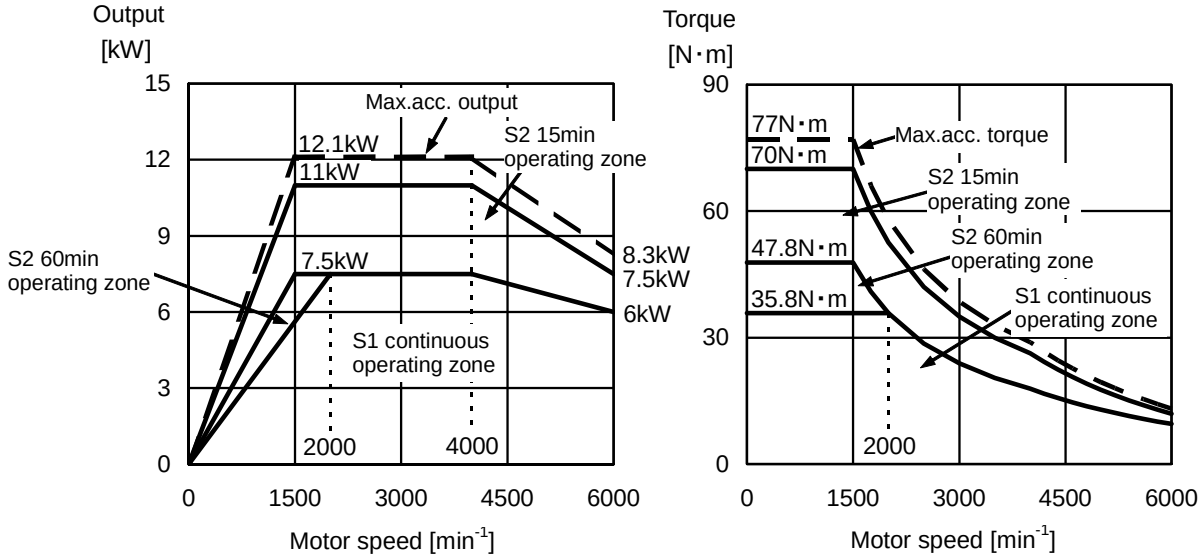
Model βiIc 8/6000 Ordering specification number: A06B-1417-B□□□#0009

Applicable amplifier βiSVSP*-11-B



Item			Symbol	Value	Unit
Rated output	S1 continuous rated, S2 60 min rated		P_C	7.5 (10.1)	kW (HP)
	S2 15 min rated			11 (14.7)	kW (HP)
Rated current	S1 continuous rated		I_C	41	A
	S2 60 min rated			44	A
	S2 15 min rated			57	A
Speed	Base speed	S1 continuous rated		2000	min^{-1}
		S2 60 min rated, S2 15 min rated	N_b	1500	min^{-1}
	Max. speed		N_m	6000	min^{-1}
Steady-state maximum output			P_{max}	110% of maximum rated output	kW
Maximum output at acceleration for PS selection				12.1	kW
Continuous rated torque in the constant torque range			T_b	35.8 (365)	N・m (kgf・cm)
Moment of inertia of the rotor			J_m	0.0179 (0.18)	$kg・m^2$ $(kgf・cm・s^2)$
Weight			w	51	kg
Winding resistance (U-V, V-W, and W-U)			Ra	146	mΩ
Number of teeth for speed detection				-	λ /rev.
Vibration				V5	
Noise				75 or less	dB(A)
Cooling system				Totally enclosed and fan cooled IC0A6	
Rated power of the cooling fan				50	W

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(*1) The applicable amplifier contained is a standard one.
For βiI 3/12000 and βiIP 12/6000, βiSVSP*-11-B, βiSVSP*-15-B, and βiSVSP*-18-B are also applicable;
For βiIP 15/8000 and βiIP 18/8000, βiSVSP*-15-B and βiSVSP*-18-B are also applicable;
For βiI 6/12000, βiI 8/12000, and βiIP 22/8000, βiSVSP*-18-B is also applicable; and
for βiI 6/12000HV and βiI 8/12000HV, βiSVSP*-18HV-B is also applicable.

(*2) The protection class is IP54 if an oil seal is provided and IP40 if no oil seal is provided.
The protection class of the motor is IP40 when a simplified labyrinth is provided. The class is IP54, however, when the labyrinth seal on the front side of the output shaft and the flinger seal on the rear side are excluded. Ensure that the labyrinth seal and flinger seal are not directly exposed to coolant or mist.
For the shaft end seal, see Chapter 2, "ORDERING SPECIFICATION NUMBER" in Part I.

(*3) When assembling a motor with the machine, align the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 49 m/s^2 (5G) (at maximum speed).
(Before shipping machines, check that the vibration acceleration is 49 m/s^2 (5G) or less for all motors.)

(*4) Select a coupling that does not apply a thrust load onto the motor shaft due to a cause such as temperature rise or coolant pressure.
Note that in the direction in which the motor shaft is pushed toward the inside of the motor, the allowable load is 0 kgf.
(When the motor shaft is inserted into the spindle to connect the motor shaft and spindle using a coupling, the motor shaft may remain pushed inside the motor. After connecting the spindle and motor shaft with a coupling, check whether the motor shaft is pushed inside the motor. For details, see Section 3.3, "WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A COUPLING" in Part III.)

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3.3 EXTERNAL DIMENSIONS

The external dimensions of the FANUC AC spindle motor β*i* series are given below.
In addition, shaft figure, allowable radial load, axial run-out accuracy, and power terminals are also provided.

This section, "EXTERNAL DIMENSIONS", consists of the following.

3.3.1 Models β*i*I 3/12000, β*i*I 6/12000, β*i*I 6/12000HV, β*i*Ic 3/6000, β*i*Ic 6/6000 39
3.3.2 Models β*i*I 8/12000, β*i*I 12/10000, β*i*I 8/12000HV, β*i*I 12/10000HV, β*i*Ip 12/6000, β*i*Ic 8/6000 44
3.3.3 Models β*i*I 15/8000, β*i*Ip 15/8000, β*i*Ip 18/8000, β*i*Ip 22/8000, β*i*Ip 30/8000 49
3.3.4 Models β*i*Ip 40/6000 54
3.3.5 Models β*i*IT 12/10000 58
3.3.6 Models β*i*IT 15/8000 63

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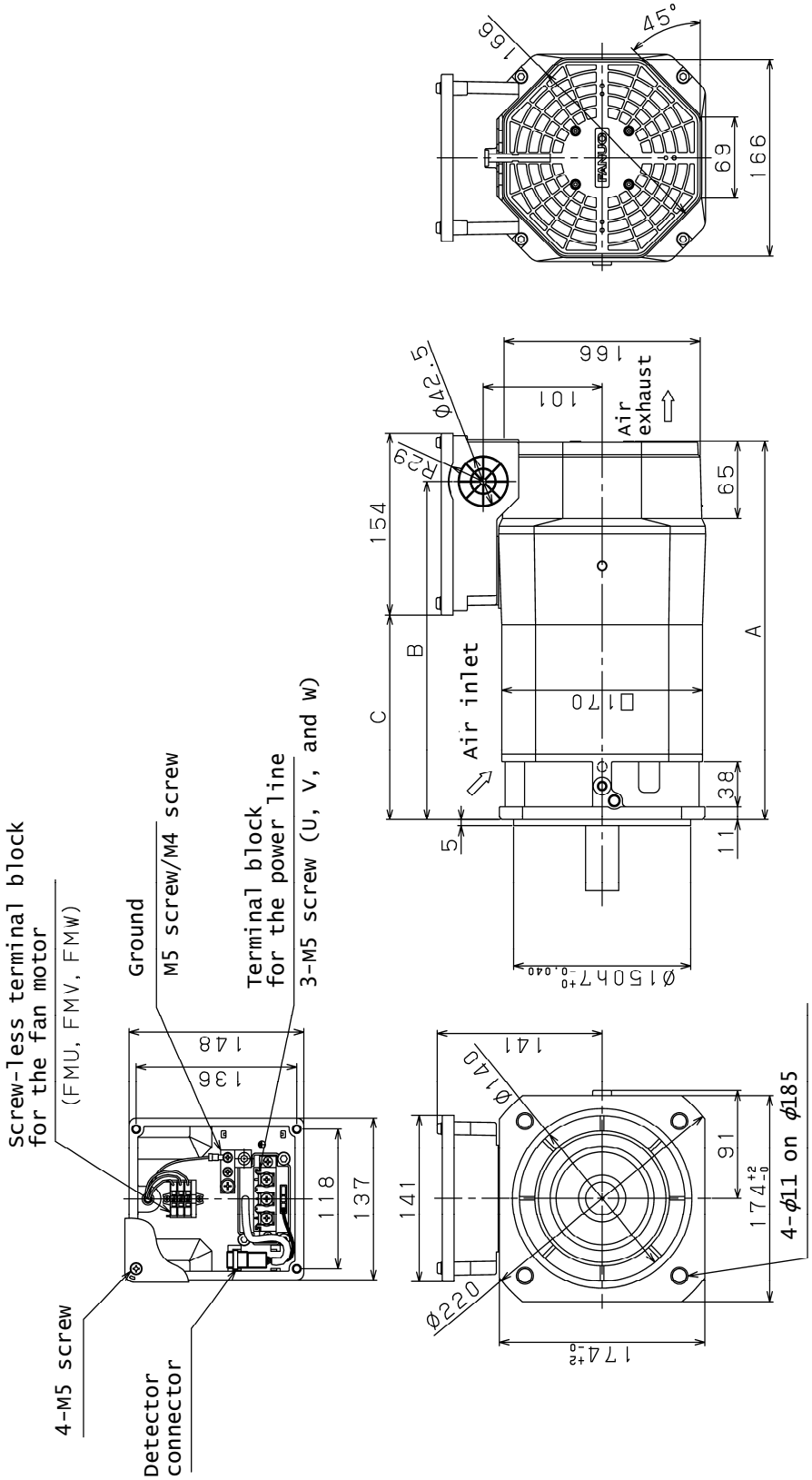
3.3.1 Models βiI 3/12000, βiI 6/12000, βiI 6/12000HV, βiIc 3/6000, βiIc 6/6000

3.3.1.1 External Dimensions

(1) Flange mounting type



MODEL	A	B	C
βiI 3/12000, βiIc 3/6000	320	287	173
βiI 6/12000, βiI 6/12000HV, βiIc 6/6000	420	387	273

(Notes)
1. Use M10 hexagon head bolts not longer than 35 mm for mounting.
2. The reversed air flow direction is also available.

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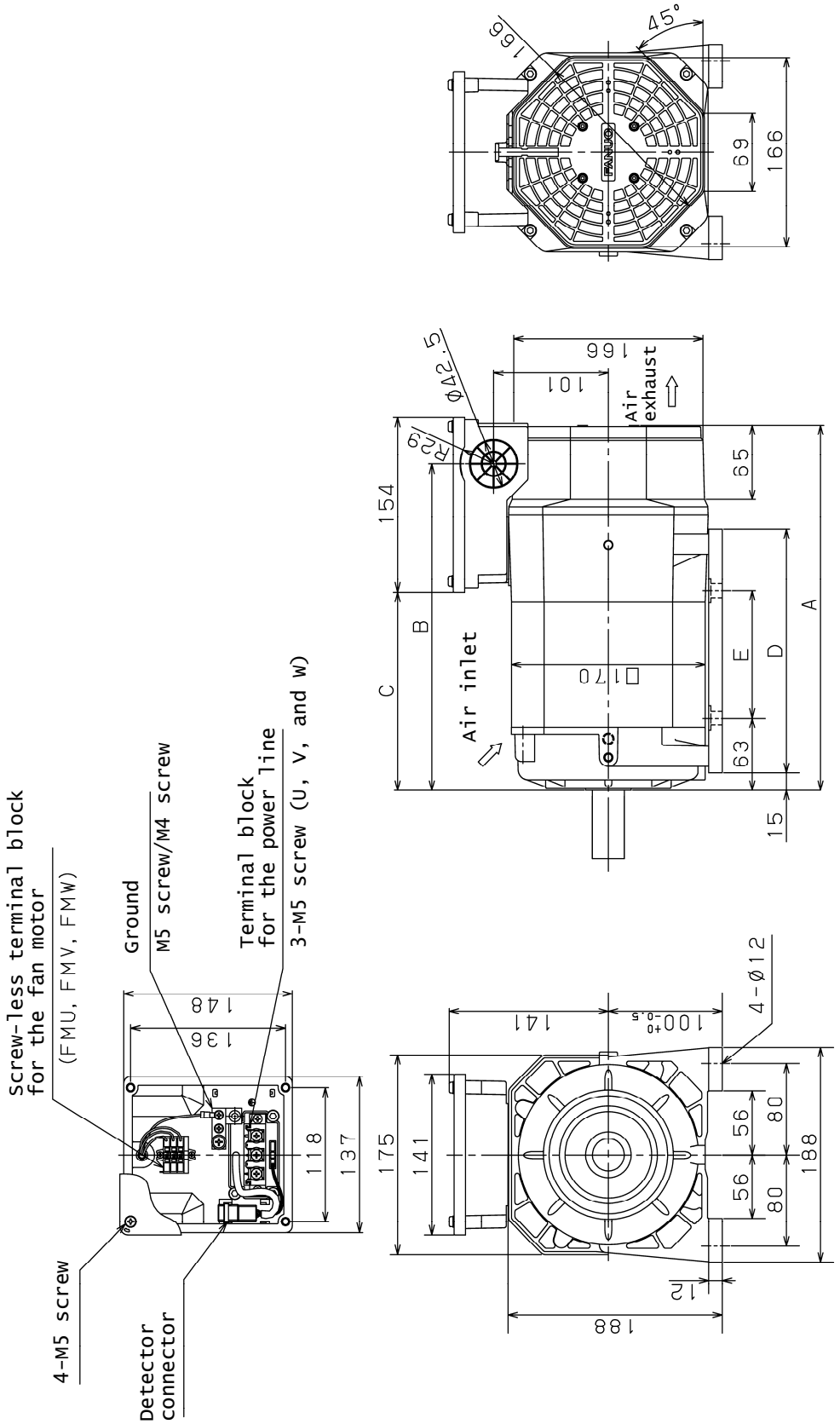
(2) Foot mounting type



MODEL	A	B	C	D	E
βiI 3/12000, βiIc 3/6000	320	287	173	214	112
βiI 6/12000, βiI 6/12000HV, βiIc 6/6000	420	387	273	314	159

(Notes)
1. Use M10 hexagon head bolts not longer than 20 mm for mounting.
2. The reversed air flow direction is also available.

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3.3.1.2 Shaft figure

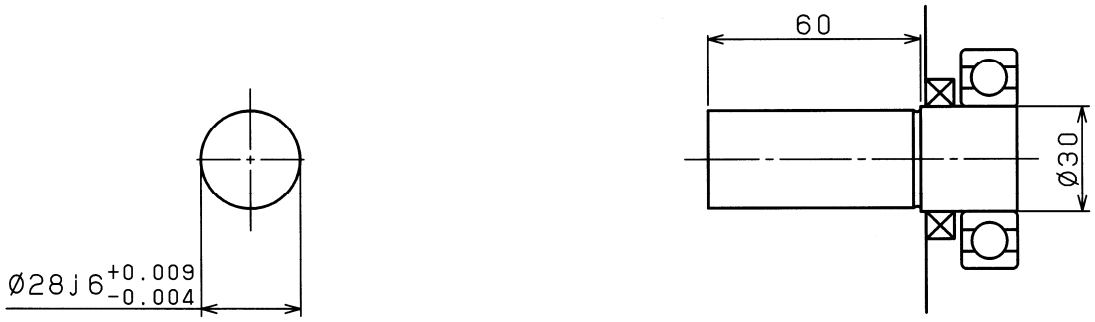
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

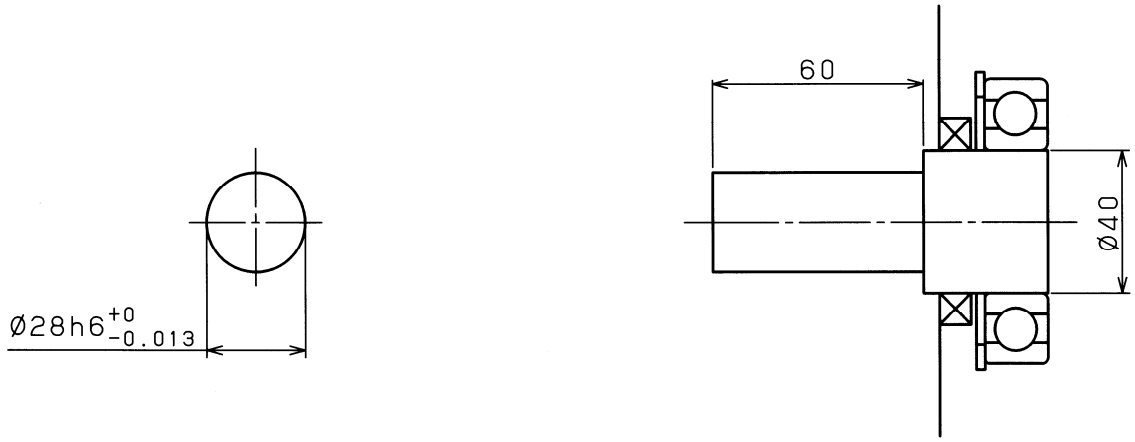
Model	Shaft with no key		Shaft with a key	
	Shaft diameter	Details	Shaft diameter	Details
βiI 3/12000	ϕ28	(2) (a)	ϕ28	(2) (c)
βiI 6/12000, βiI 6/12000HV	ϕ28	(2) (b)	ϕ28	(2) (d)
βiIc 3/6000	ϕ28	(2) (a)	ϕ28	(2) (c)
βiIc 6/6000	ϕ28	(2) (b)	ϕ28	(2) (d)

(2) Shaft details

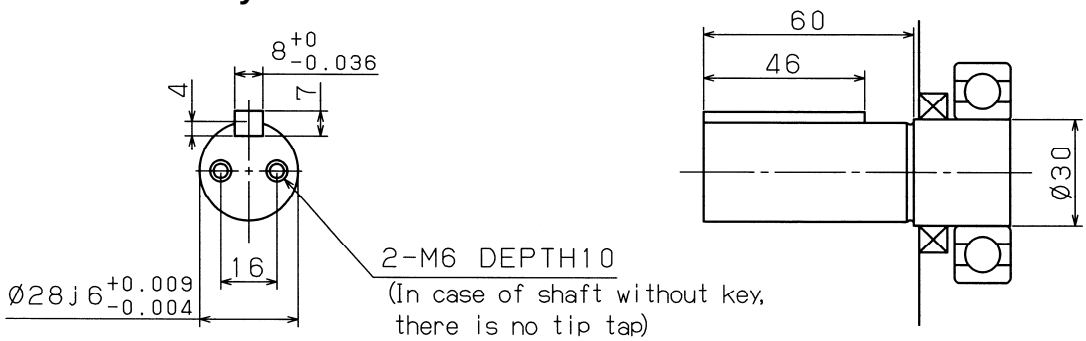
(a) ϕ28 Shaft with no key



(b) ϕ28 Shaft with no key



(c) ϕ28 Shaft with a key



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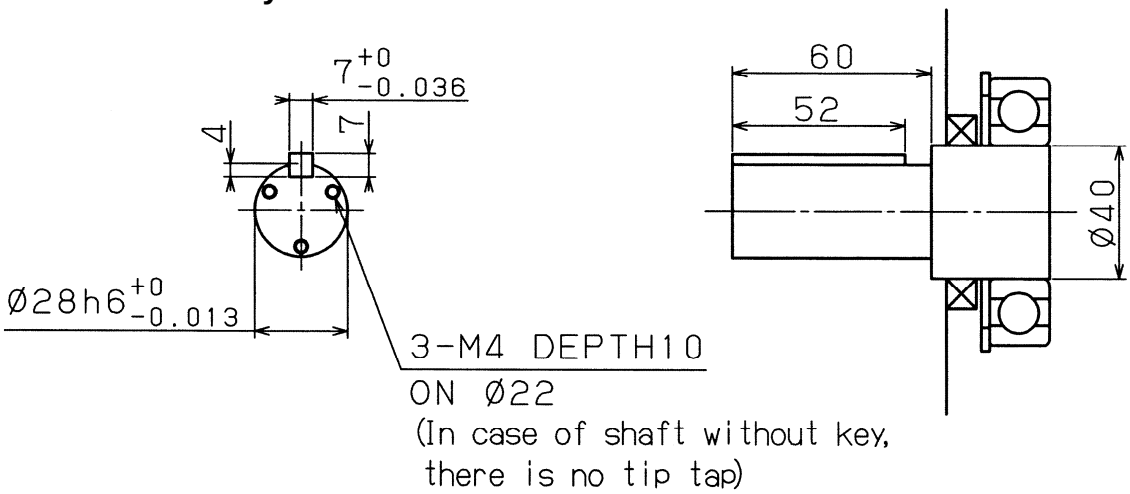
(d) ϕ28 Shaft with a key



3.3.1.3 Allowable radial load

Use the motor output shaft below the allowable radial loads shown in the table below.

Model	Allowable radial load	
	At output shaft end	At output shaft center
βiI 3/12000, βiIc 3/6000	1274N (130kgf)	1445N (147kgf)
βiI 6/12000, βiI 6/12000HV, βiIc 6/6000	1470N (150kgf)	1607N (164kgf)

NOTE

1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, abnormal sound may also occur.)

2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.

3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

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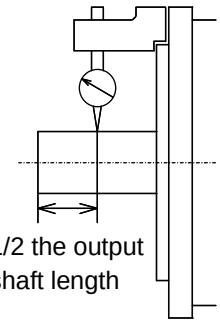
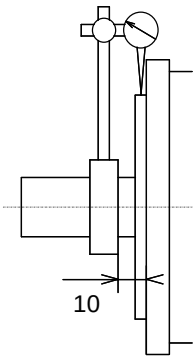
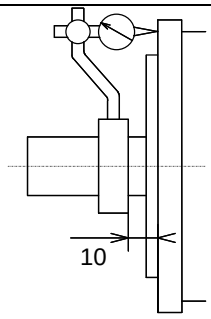
3.3.1.4 Axial run-out accuracy

Axial run-out accuracy assumes the values below.

Item \ Model	βiI 3/12000, βiI 6/12000, βiI 6/12000HV, βiIc 3/6000, βiIc 6/6000	Measuring method
Shaft run-out	20μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	

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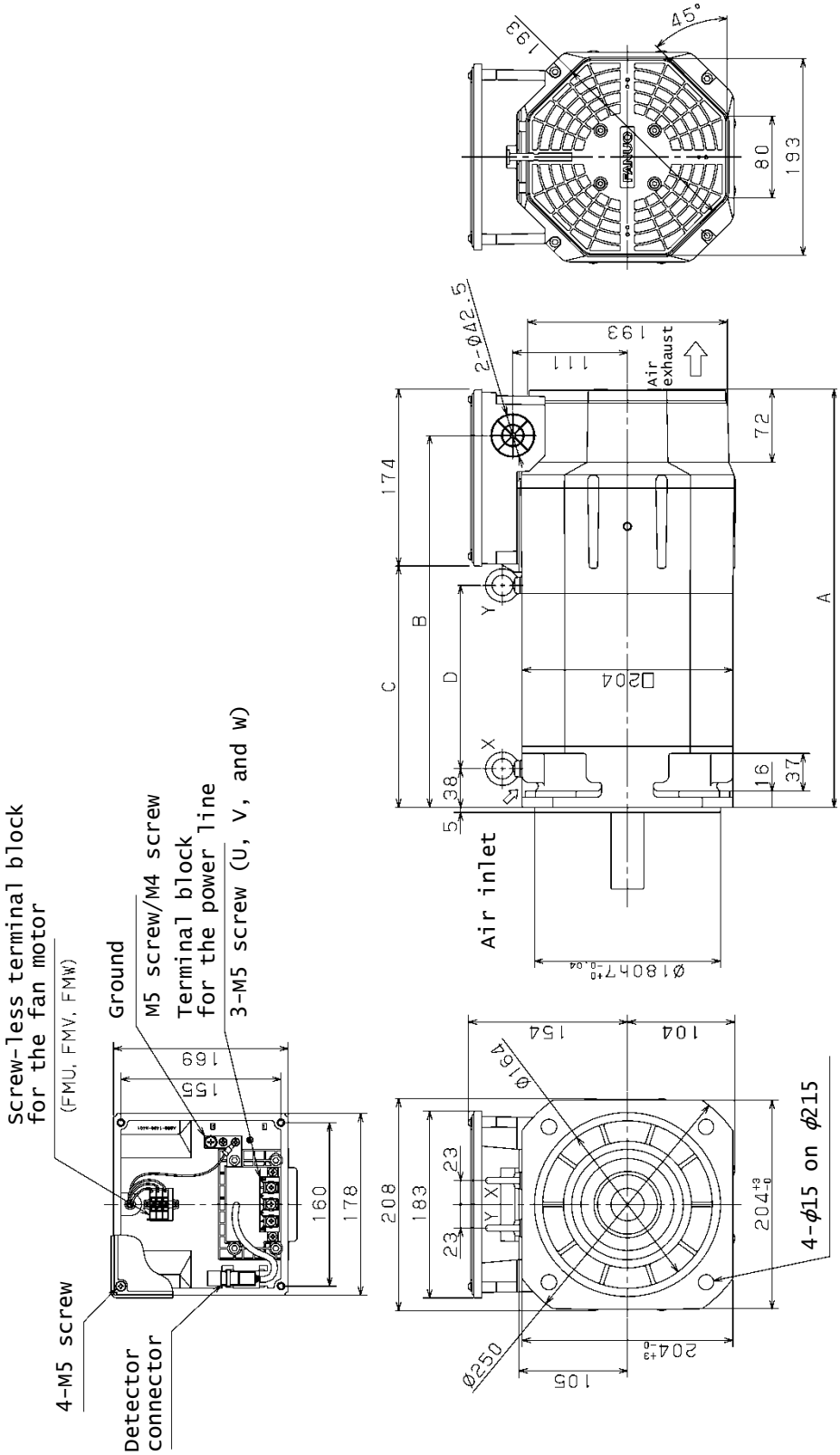
3.3.2 Models βiI 8/12000, βiI 12/8000, βiI 8/12000HV, βiI 12/10000HV, βiIP 12/6000, βiIC 8/6000

3.3.2.1 External Dimensions

(1) Flange mounting type



MODEL	A	B	C	D
βiI 8/12000, βiI 8/12000HV, βiIC 8/6000	412	366	237	180
βiI 12/10000, βiI 12/10000HV, βiIP 12/6000	488	442	313	256

(Notes) 1. Use M12 hexagon head bolts not longer than 35 mm for mounting.
2. The reversed air flow direction is also available.

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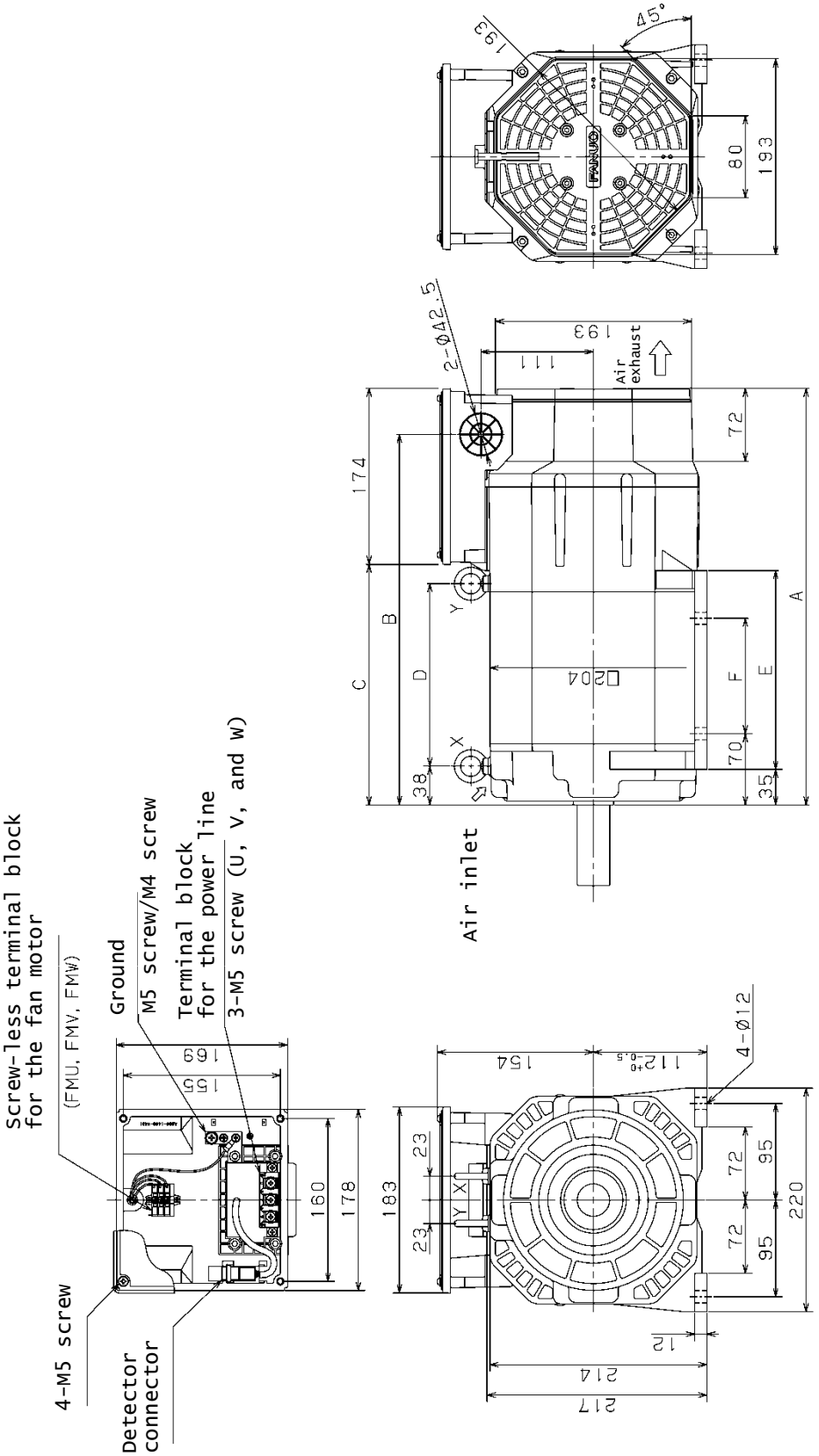
(2) Foot mounting type



MODEL	A	B	C	D	E	F
βiI 8/12000, βiI 8/12000HV, βiIc 8/6000	412	366	237	180	196	114
βiI 12/10000, βiI 12/10000HV, βiIP 12/6000	488	442	313	256	272	178

(Notes)
1. Use M10 hexagon head bolts not longer than 30 mm for mounting.
2. The reversed air flow direction is also available.

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3.3.2.2 Shaft figure

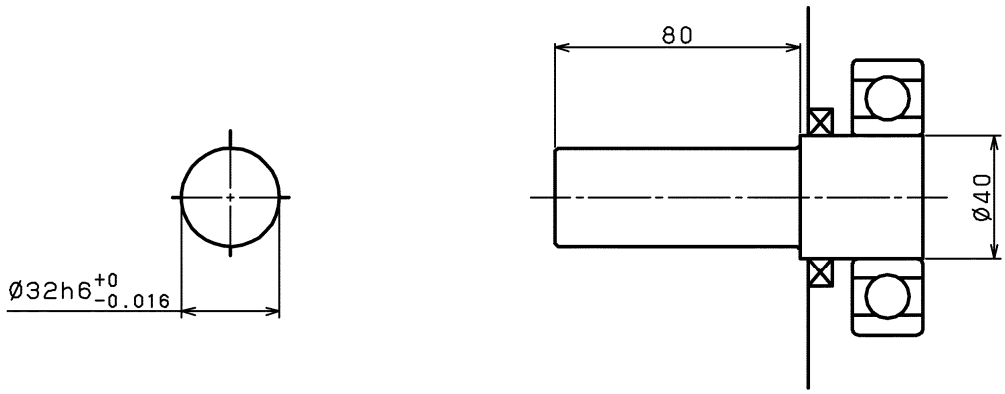
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

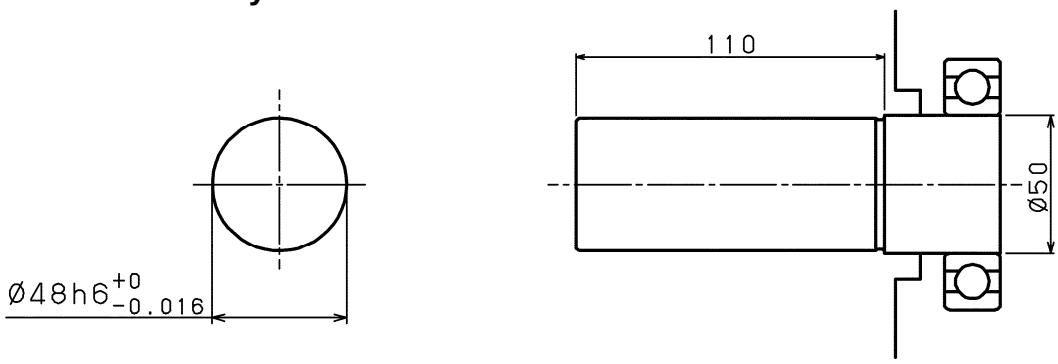
Model	Shaft with no key		Shaft with a key	
	Shaft diameter	Details	Shaft diameter	Details
βiI 8/12000, βiI 8/12000HV	ϕ32	(2) (a)	ϕ32	(2) (c)
βiI 12/10000, βiI 12/10000HV	ϕ48	(2) (b)	ϕ48	(2) (d)
βiIP 12/6000	ϕ48	(2) (b)	ϕ48	(2) (d)
βiIC 8/6000	ϕ32	(2) (a)	ϕ32	(2) (c)

(2) Shaft details

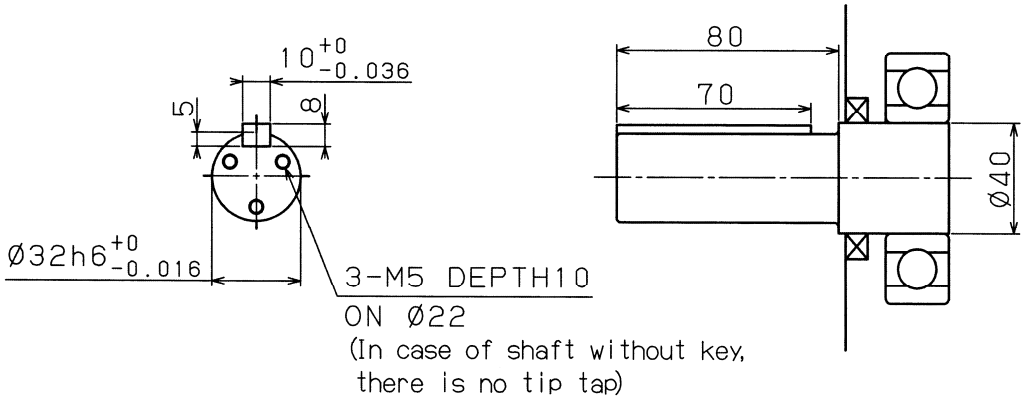
(a) ϕ32 Shaft with no key



(b) ϕ48 Shaft with no key



(c) ϕ32 Shaft with a key



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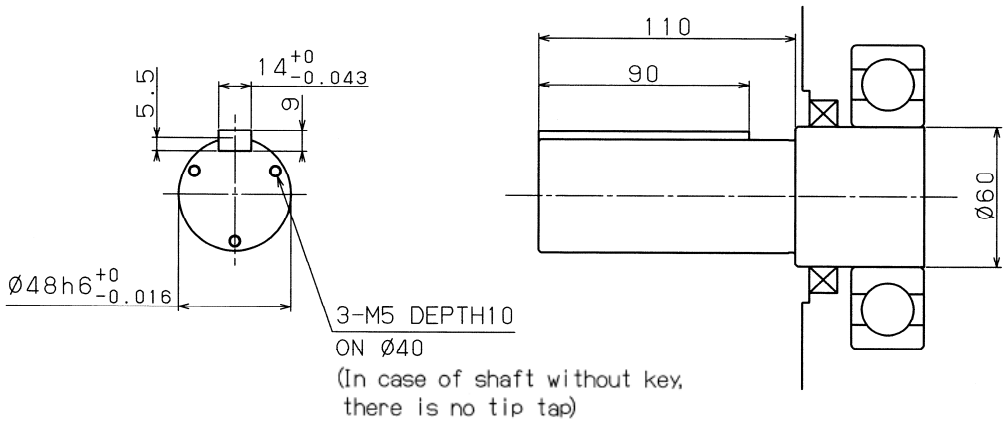
(d) ϕ48 Shaft with a key



3.3.2.3 Allowable radial load

Use the motor output shaft below the allowable radial loads shown in the table below.

Model	Allowable radial load	
	At output shaft end	At output shaft center
βiI 8/12000, βiI 8/12000HV, βiIc 8/6000	1960N (200kgf)	2205N (225kgf)
βiI 12/10000, βiI 12/10000HV, βiIP 12/6000	2940N (300kgf)	3371N (344kgf)

NOTE

1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, abnormal sound may also occur.)

2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.

3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

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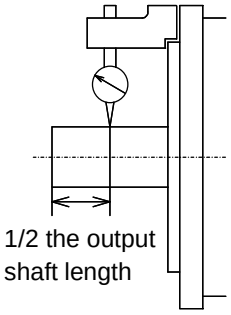
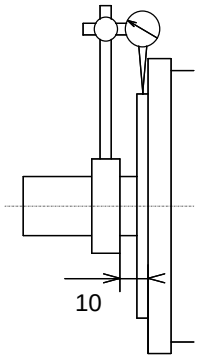
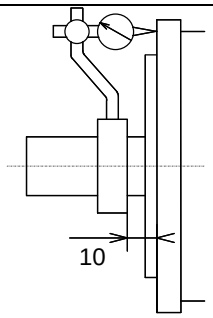
3.3.2.4 Axial run-out accuracy

Axial run-out accuracy assumes the values below.

Item \ Model	βiI 8/12000, βiI 12/10000, βiI 8/12000HV, βiI 12/10000HV βiIP 12/6000, βiIC 8/6000	Measuring method
Shaft run-out	20μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	

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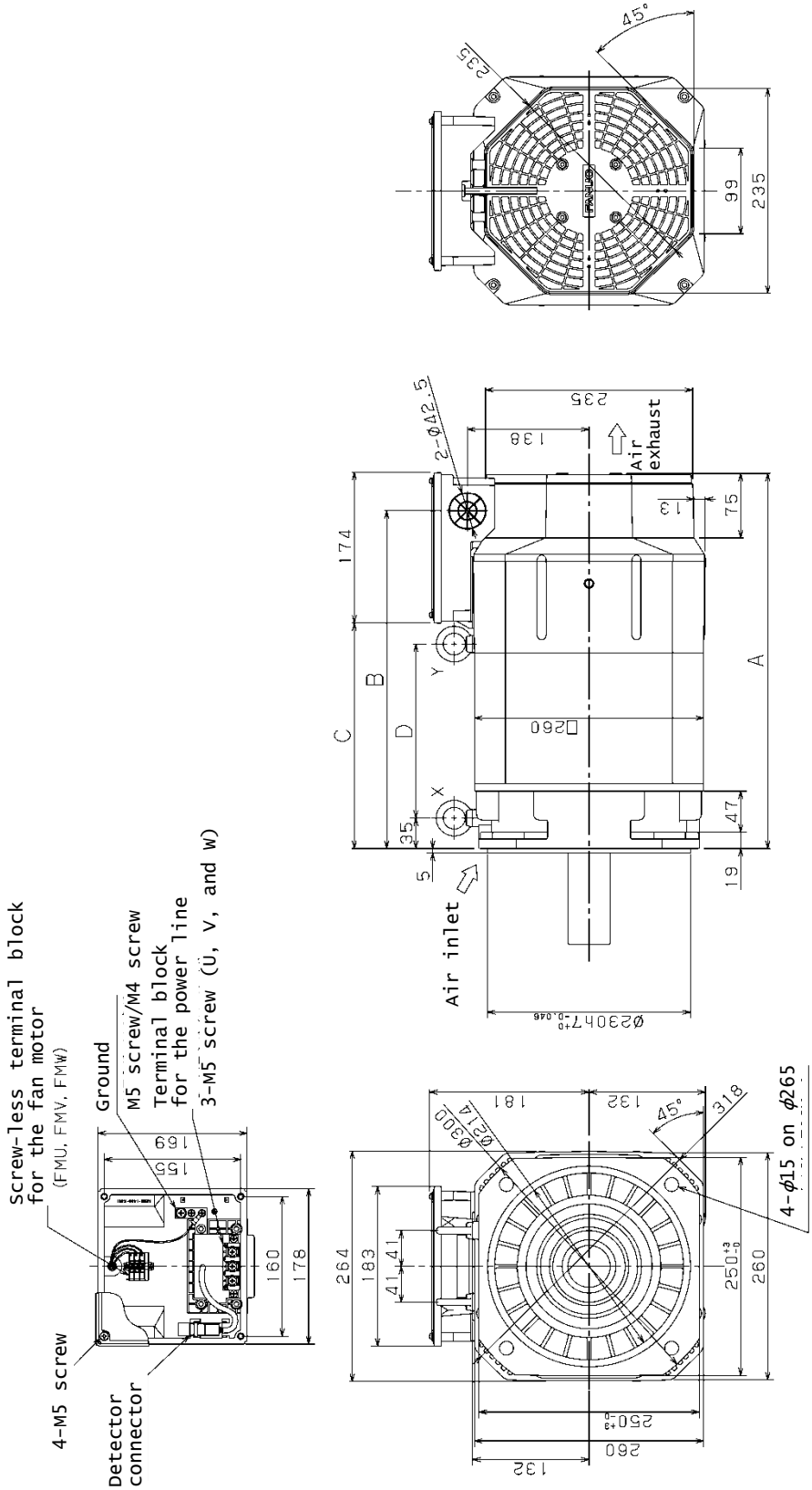
3.3.3 Models βiI 15/8000, βiIP 15/8000, βiIP 18/8000, βiIP 22/8000, βiIP 30/8000

3.3.3.1 External Dimensions

(1) Flange mounting type



MODEL	A	B	C	D
βiI 15/8000, βiIP 15/8000	432	388	259	200
βiIP 18/8000	464	420	291	232
βiIP 22/8000	494	450	321	262
βiIP 30/8000	534	490	361	302

(Notes) 1. Use M12 hexagon head bolts not longer than 45 mm for mounting.
2. The reversed air flow direction is also available.

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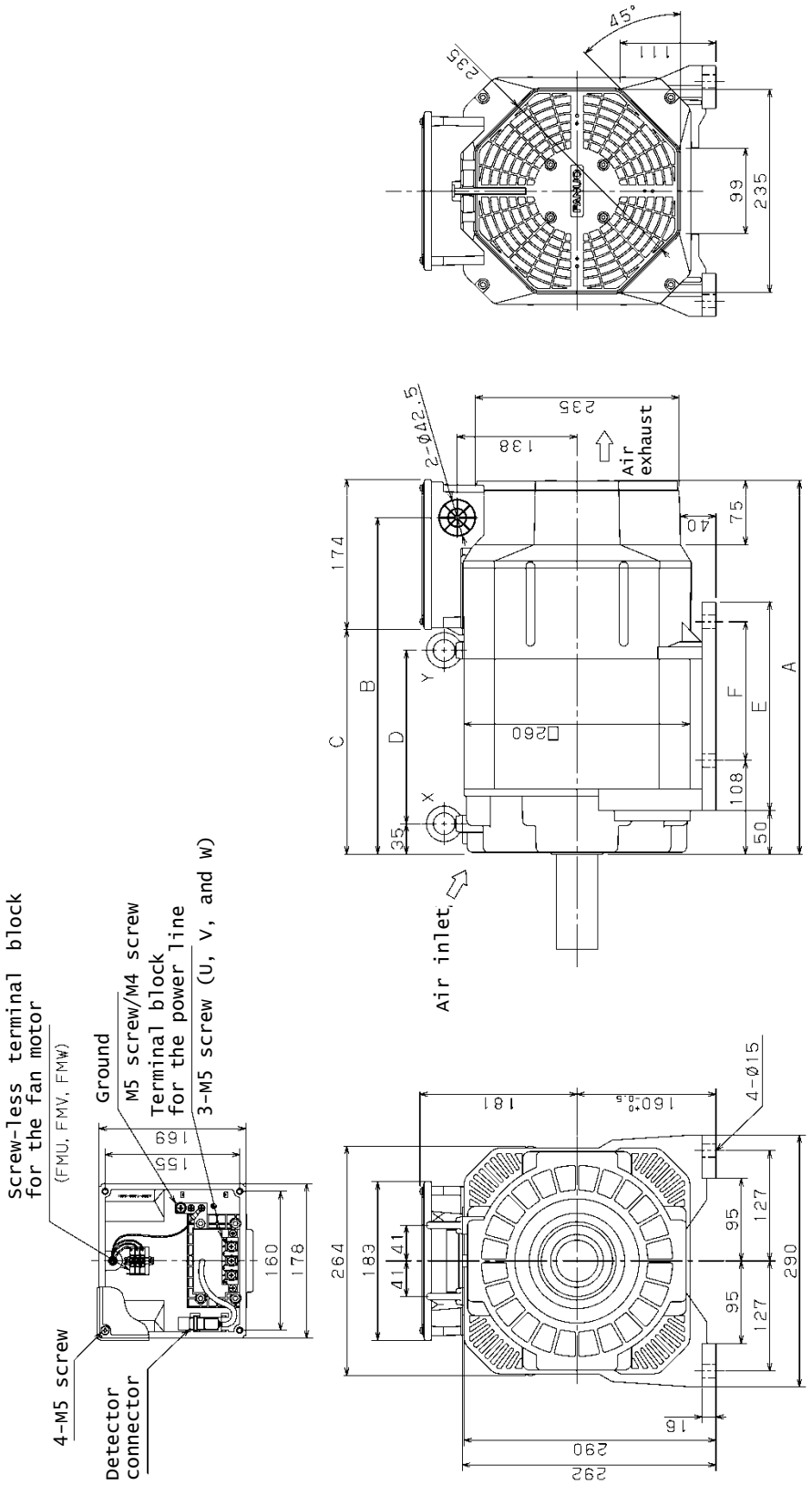
(2) Foot mounting type



MODEL	A	B	C	D	E	F
βiI 15/8000, βiP 15/8000	432	388	259	200	241	160
βiP 18/8000	464	420	291	232	259	178
βiP 22/8000	494	450	321	262	259	140
βiP 30/8000	534	490	361	302	299	178

(Notes)
1. Use M12 hexagon head bolts not longer than 45 mm for mounting.
2. The reversed air flow direction is also available.

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3.3.3.2 Shaft figure

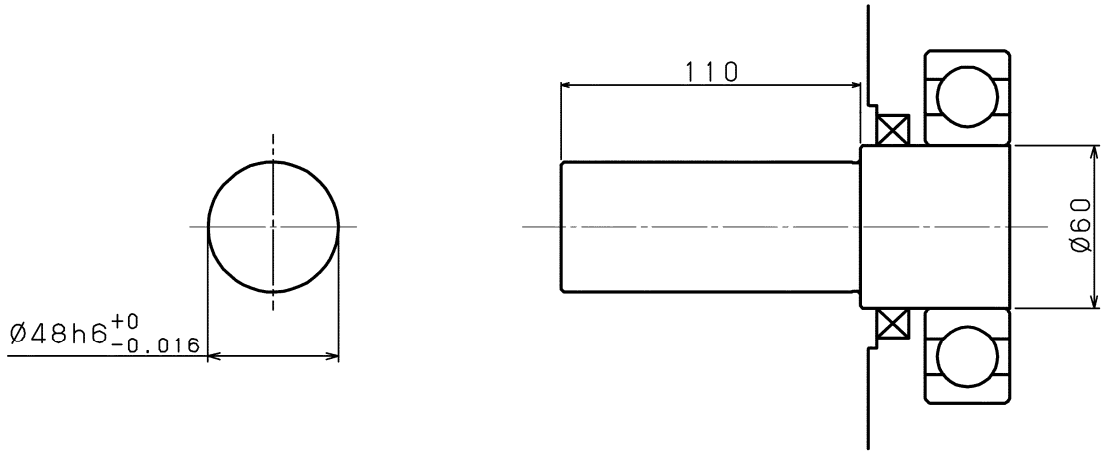
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

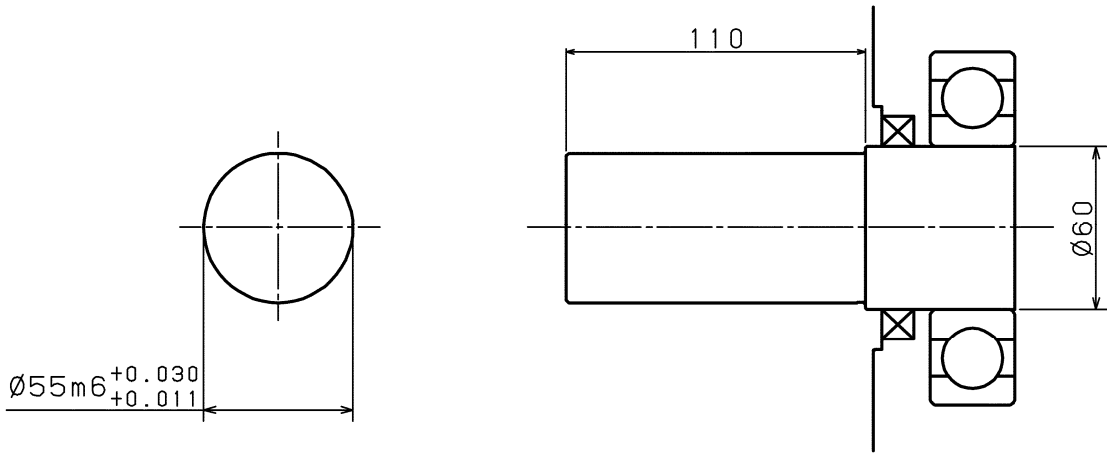
Model	Shaft with no key		Shaft with a key	
	Shaft diameter	Details	Shaft diameter	Details
βiI 15/8000	ϕ48	(2) (a)	ϕ48	(2) (c)
βiIP 15/8000	ϕ48	(2) (a)	ϕ48	(2) (c)
βiIP 18/8000	ϕ48	(2) (a)	ϕ48	(2) (c)
βiIP 22/8000	ϕ55	(2) (b)	ϕ55	(2) (d)
βiIP 30/8000	ϕ55	(2) (b)	ϕ55	(2) (d)

(2) Shaft details

(a) ϕ48 Shaft with no key



(b) ϕ55 Shaft with no key



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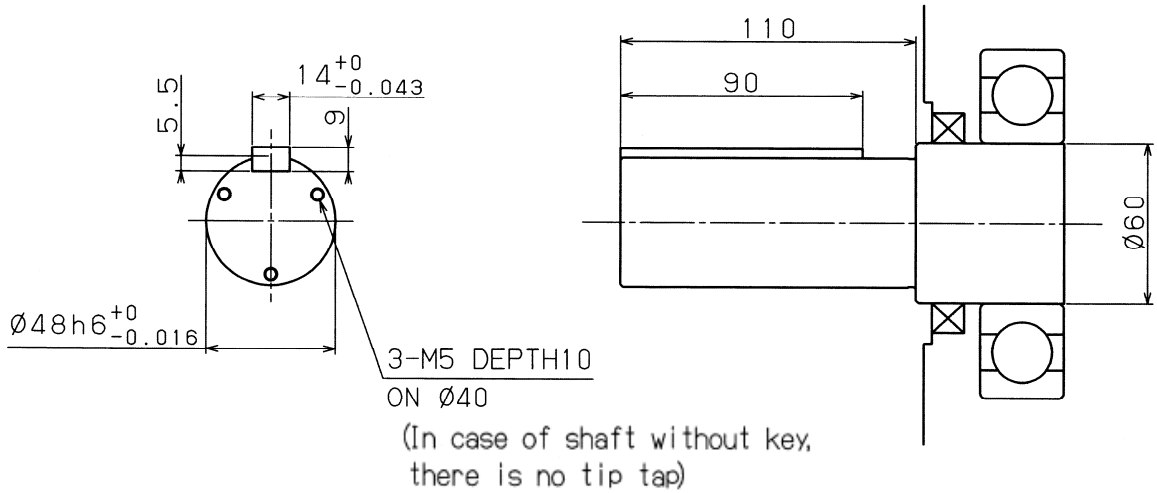
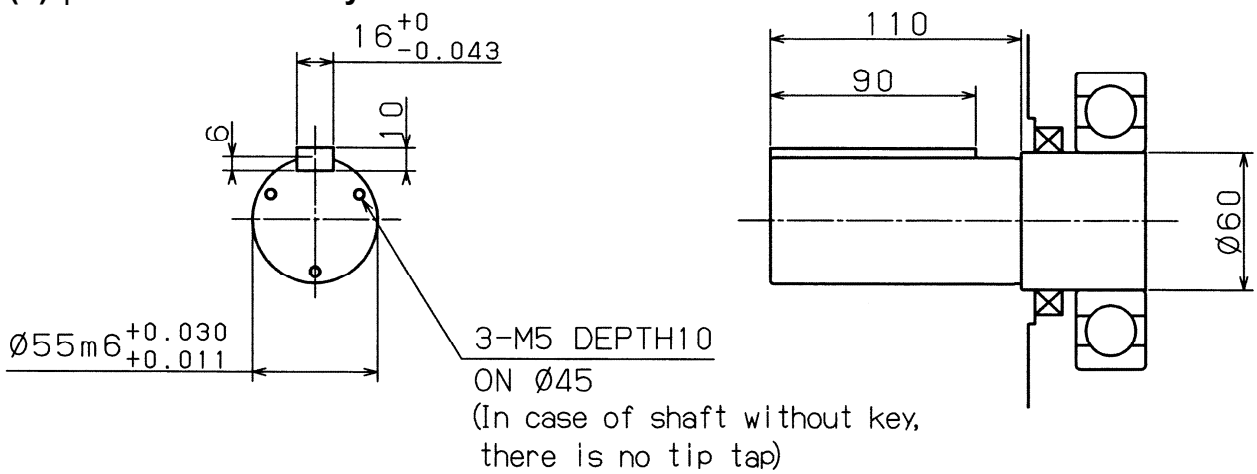
(c) ϕ48 Shaft with a key



(d) ϕ55 Shaft with a key



3.3.3.3 Allowable radial load

Use the motor output shaft below the allowable radial loads shown in the table below.

Model	Allowable radial load	
	At output shaft end	At output shaft center
βiI 15/8000, βiIP 15/8000, βiIP 18/8000	2940N (300kgf)	3410N (348kgf)
βiIP 22/8000, βiIP 30/8000	4410N (450kgf)	4988N (509kgf)

NOTE

1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, abnormal sound may also occur.)

2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.

3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

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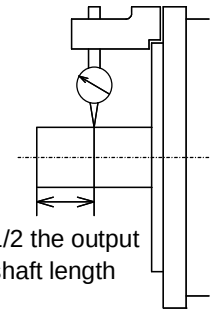
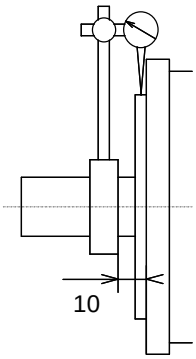
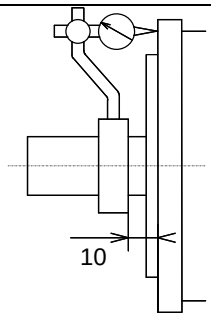
3.3.3.4 Axial run-out accuracy

Axial run-out accuracy assumes the values below.

Item \ Model	βiI 15/8000, βiIP 15/8000 to βiIP 30/8000	Measuring method
Shaft run-out	20μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	

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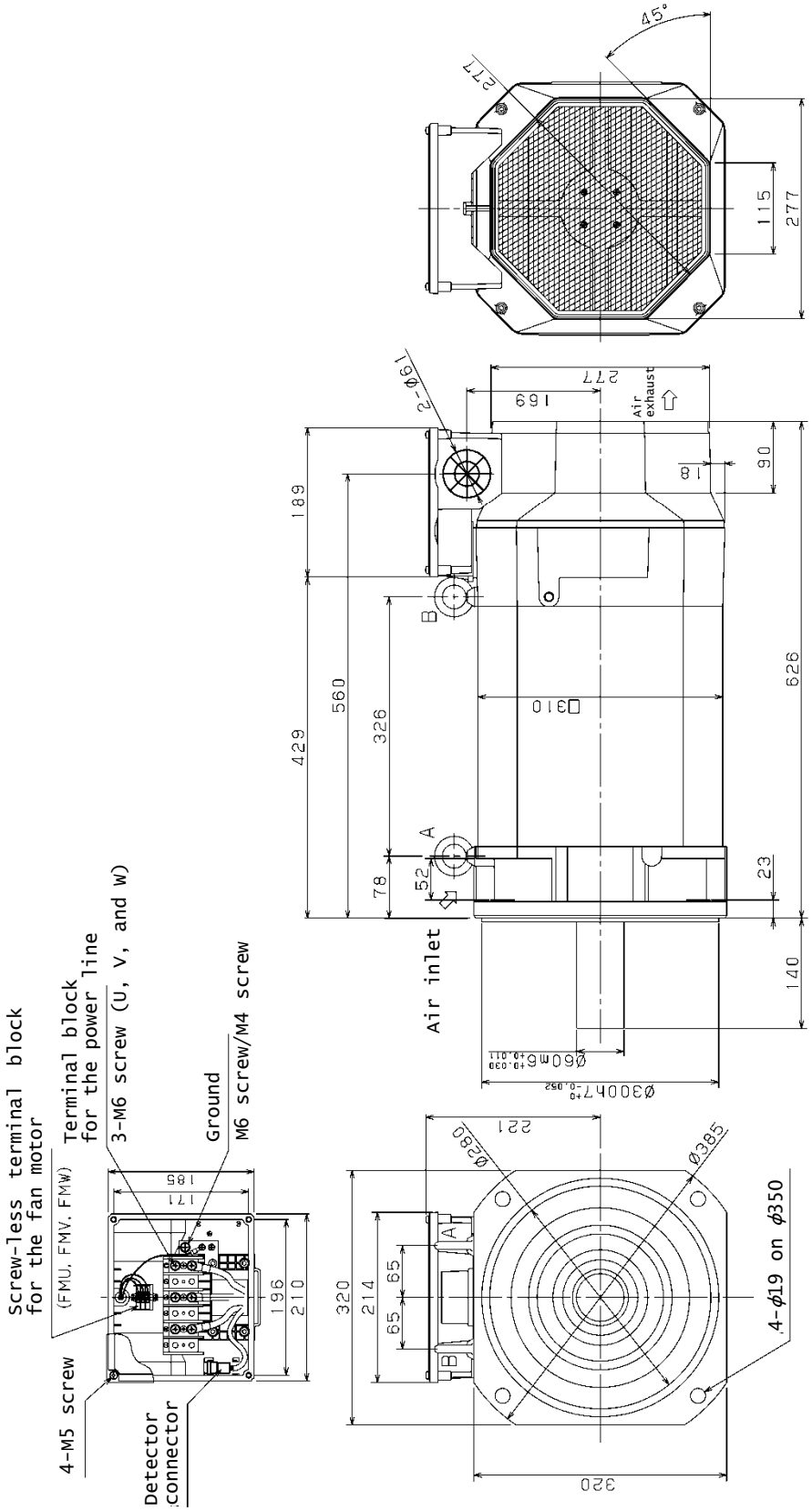
3.3.4 Model βiIP 40/6000

3.3.4.1 External Dimensions

(1) Flange mounting type



(Notes)
1. Use M16 hexagon head bolts not longer than 50 mm for mounting.
2. The reversed air flow direction is also available.

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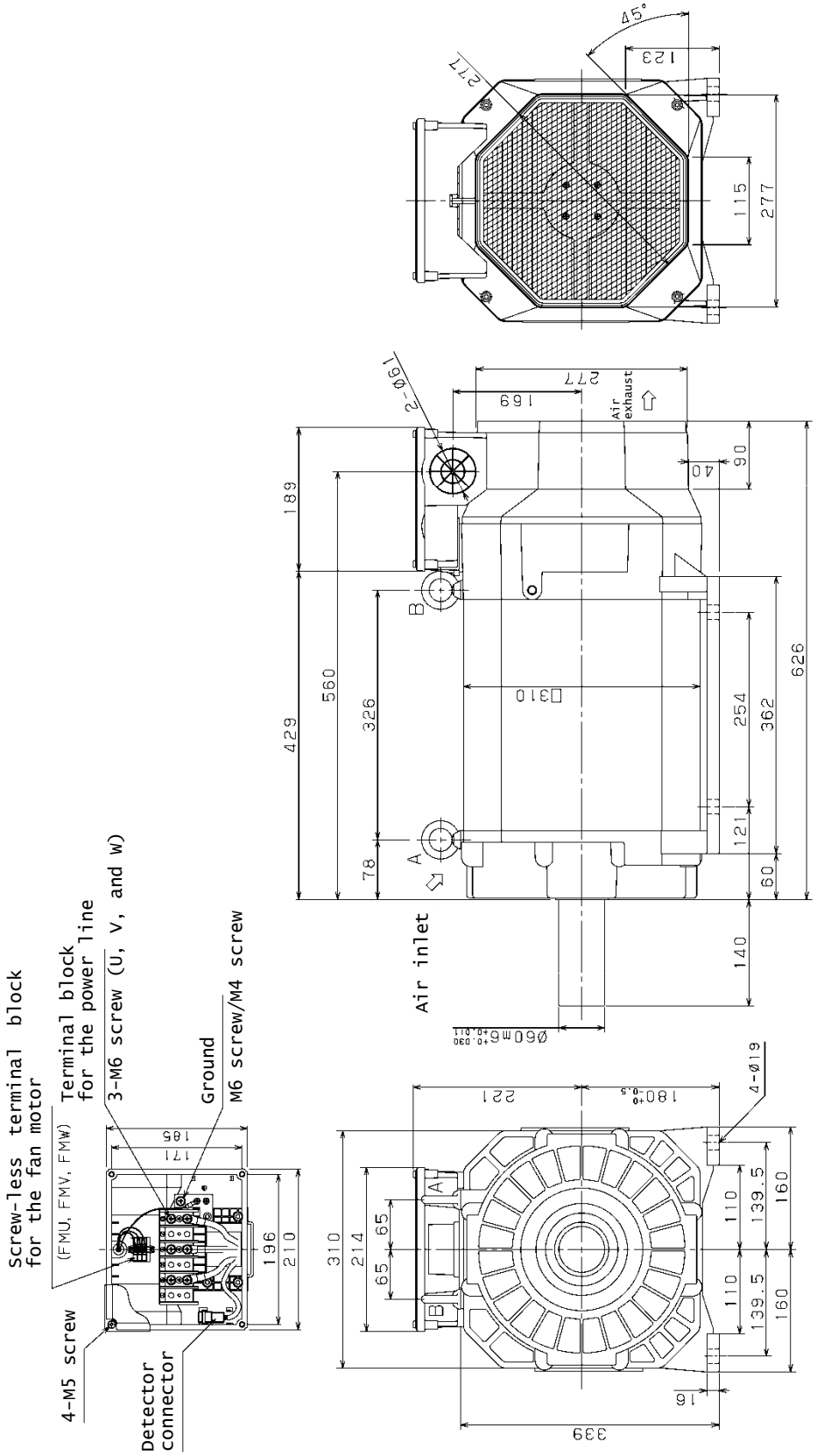
(2) Foot mounting type



(Notes)
1. Use M16 hexagon head bolts not longer than 40 mm for mounting.
2. The reversed air flow direction is also available.

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3.3.4.2 Shaft figure

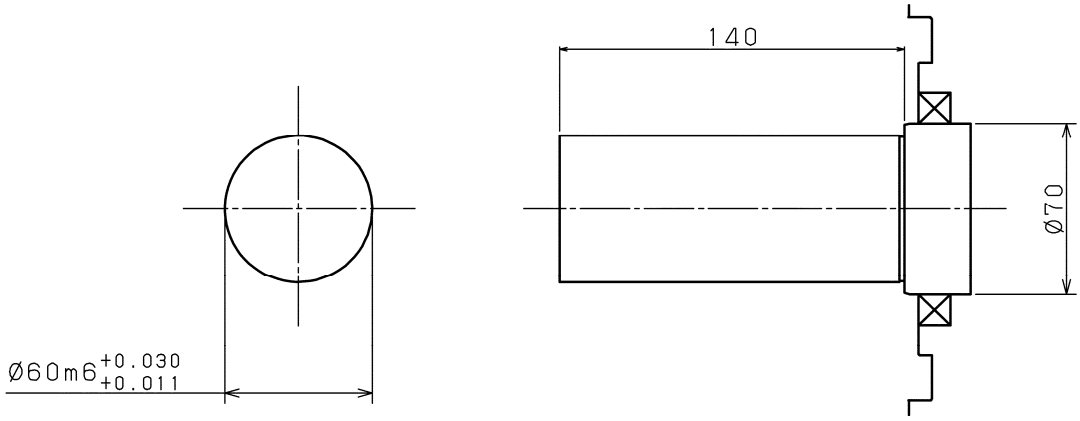
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

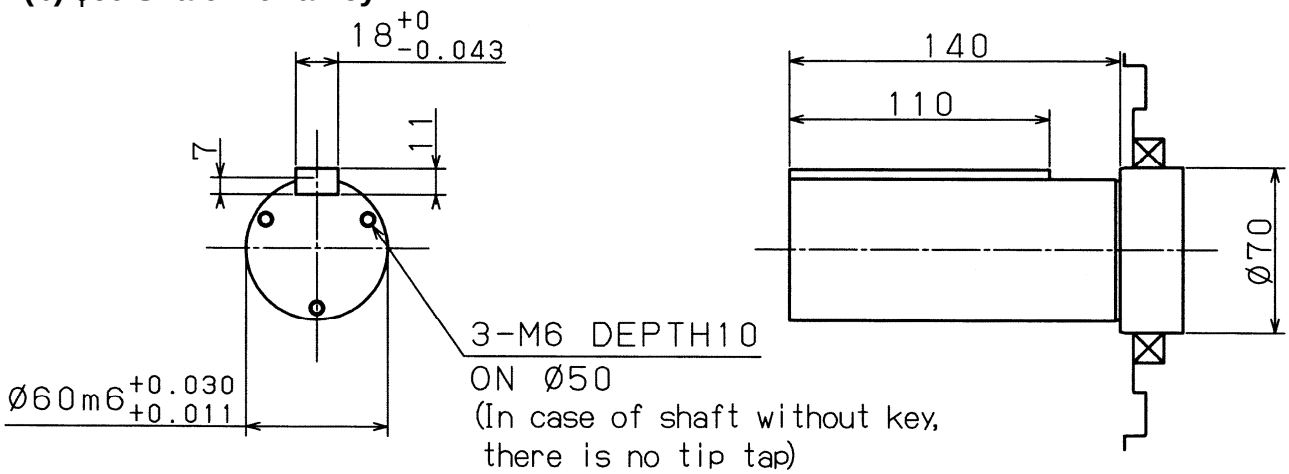
Model	Shaft with no key		Shaft with a key	
	Shaft diameter	Details	Shaft diameter	Details
βiIP 40/6000	ϕ60	(2) (a)	ϕ60	(2) (b)

(2) Shaft details

(a) ϕ60 Shaft with no key



(b) ϕ60 Shaft with a key



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3.3.4.3 Allowable radial load

Use the motor output shaft below the allowable radial loads shown in the table below.

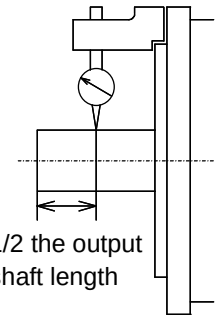
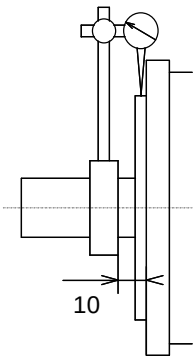
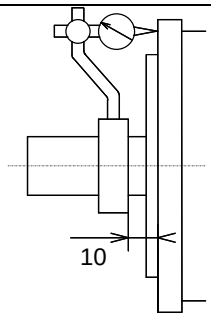
Model	Allowable radial load	
	At output shaft end	At output shaft center
βiIP 40/6000	5390N (550kgf)	6134N (626kgf)

NOTE

1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, abnormal sound may also occur.)
2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.
3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

3.3.4.4 Axial run-out accuracy

Axial run-out accuracy assumes the values below.

Model / Item	βiIP 40/6000	Measuring method
Shaft run-out	20μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	

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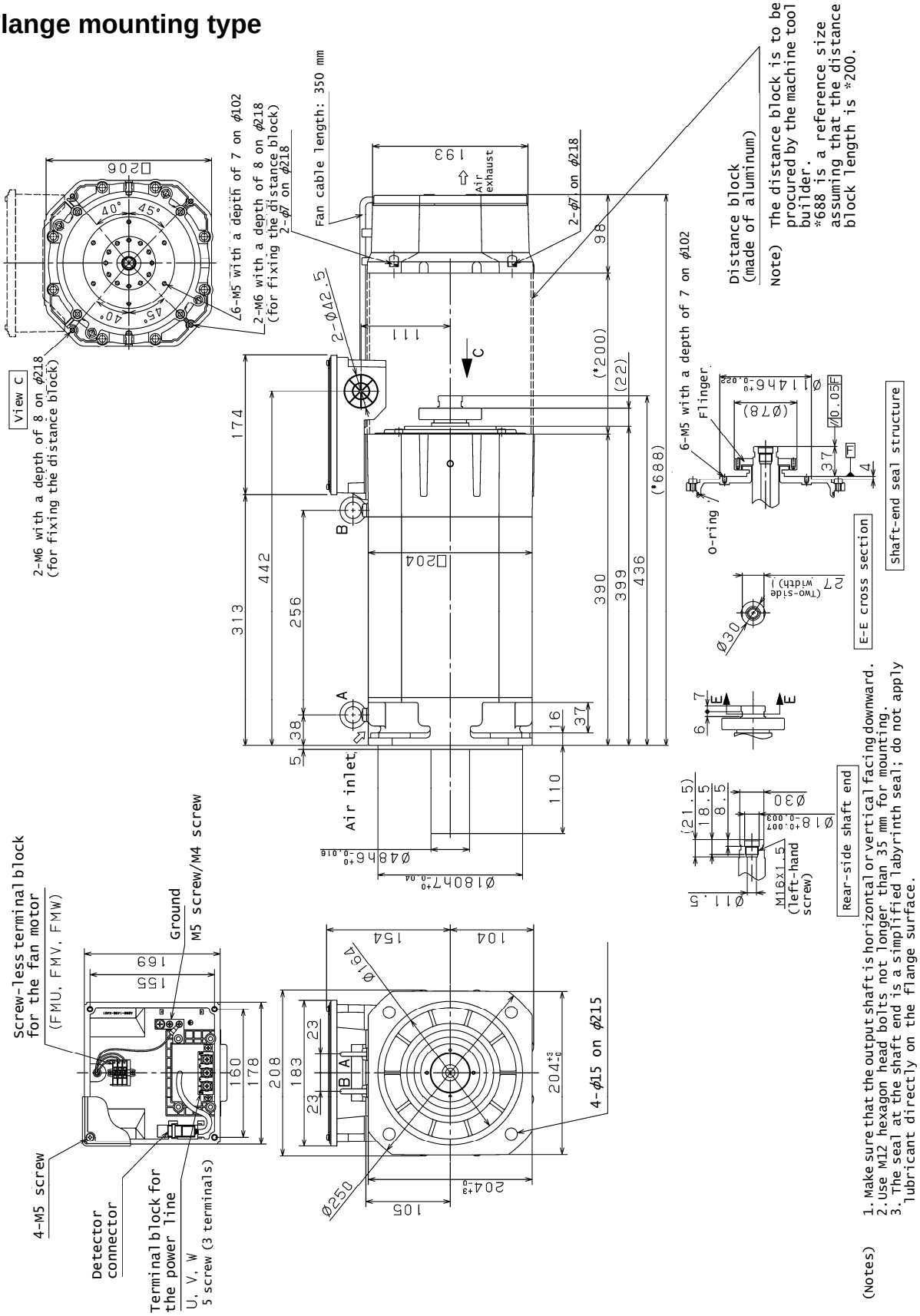
3.3.5 Model βiIT 12/10000

3.3.5.1 External Dimensions

(1) Flange mounting type



(Notes)
1. Make sure that the output shaft is horizontal or vertical facing downward.
2. Use M12 hexagon head bolts not longer than 35 mm for mounting.
3. The seal at the shaft end is a simplified labyrinth seal; do not apply lubricant directly on the flange surface.

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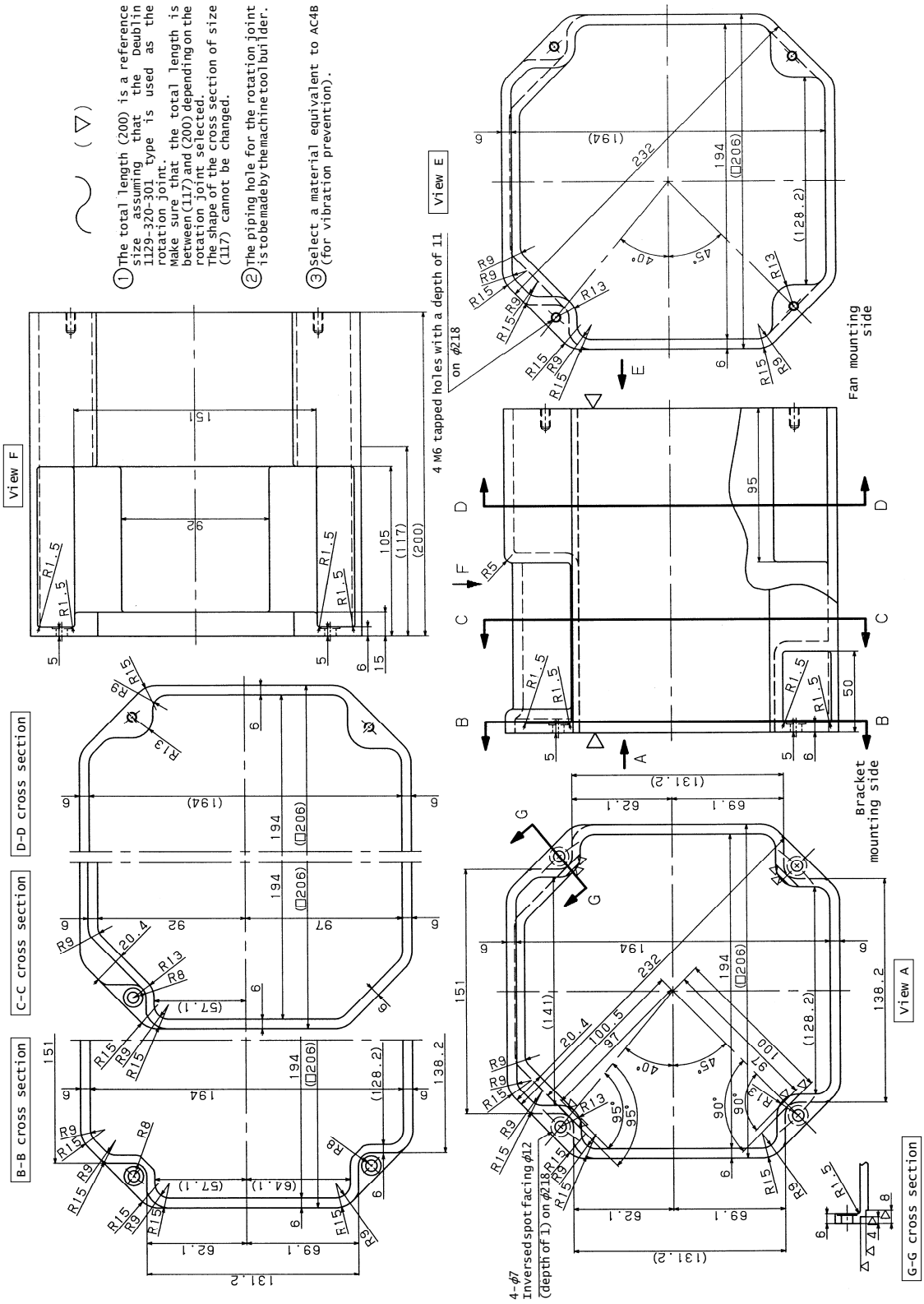
(2) Distance block type (A06B-1466-K560)



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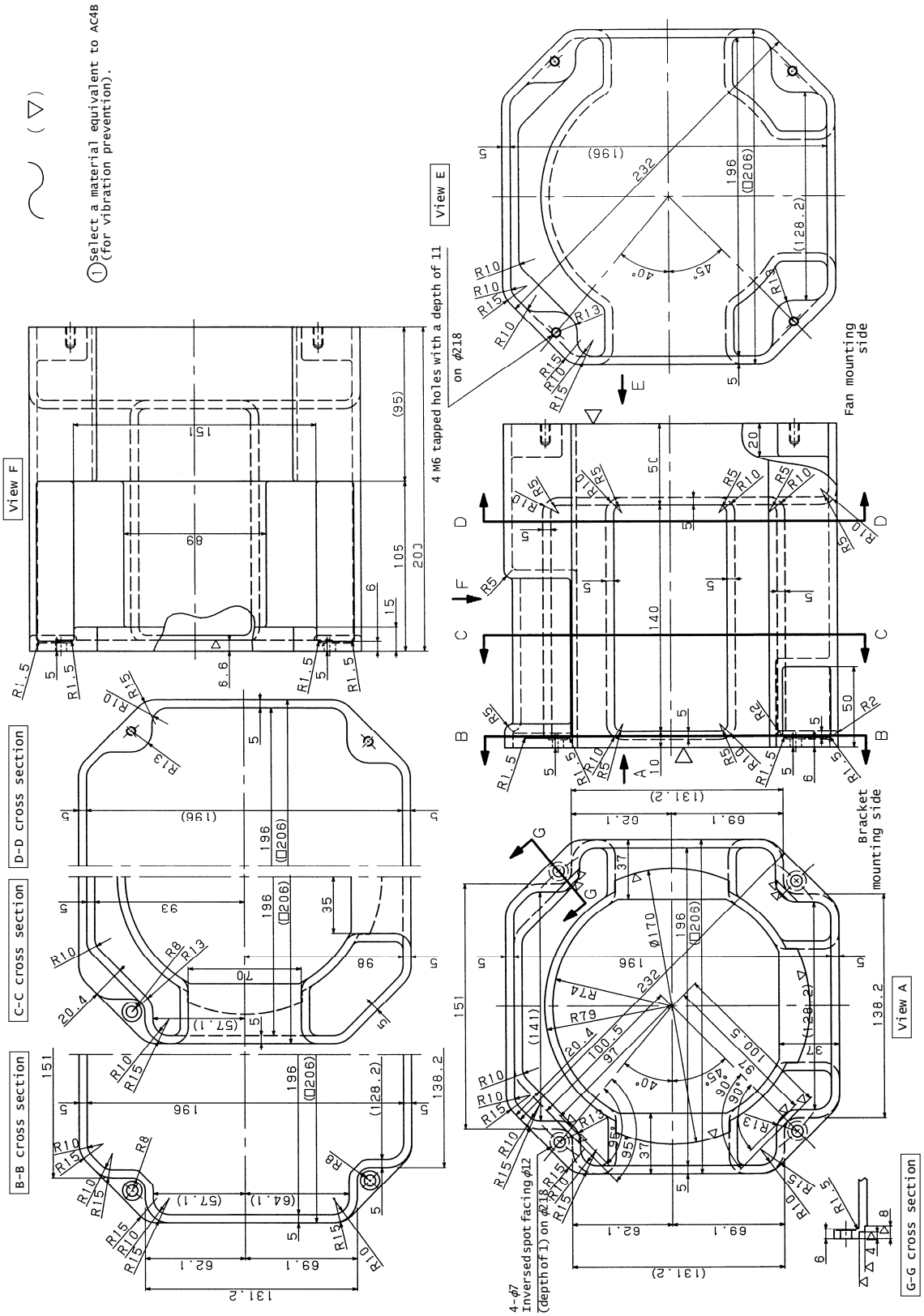
(3) Distance block with windows type (A06B-1466-K580)



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3.3.5.2 Shaft figure

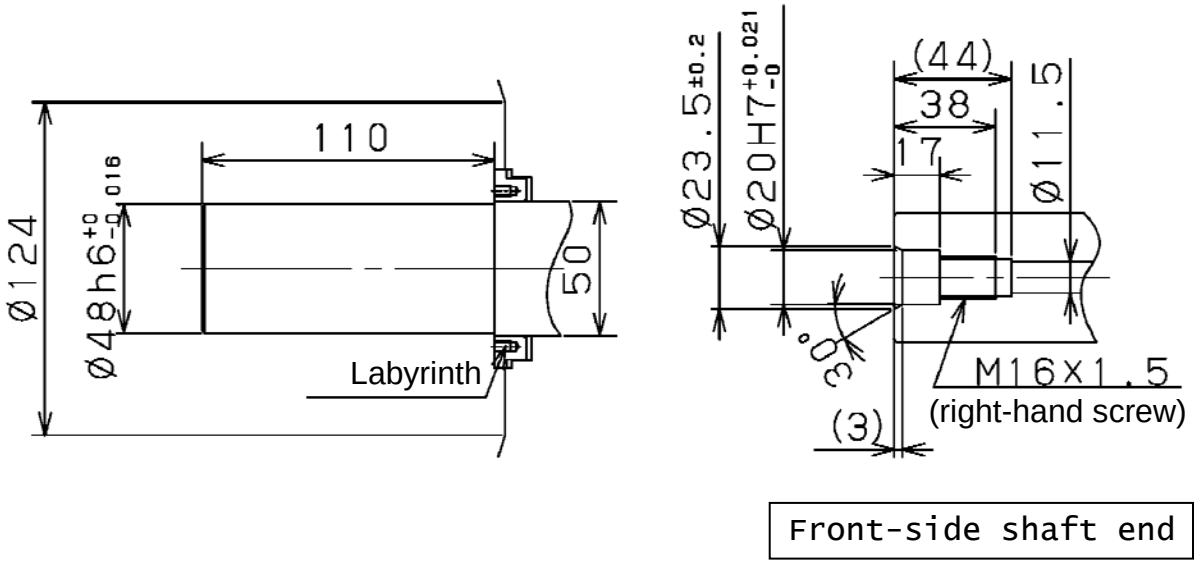
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

Model	Shaft with no key	
	Shaft diameter	Details
βiIT 12/10000	ϕ48	(2) (a)

(2) Shaft details

(a) ϕ48 hollow shaft with no key



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3.3.5.3 Allowable radial load

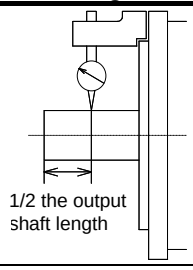
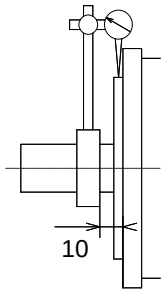
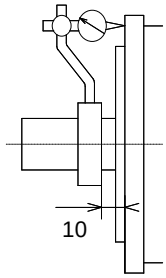
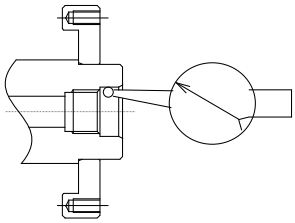
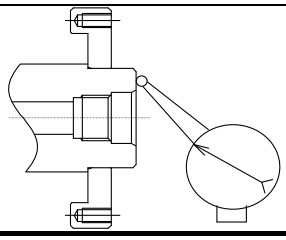
Use the motor so that the thrust load on the output shaft does not exceed the load listed in the table below. (Only in the direction in which the motor shaft is pressed forward)

Model	Allowable thrust load
βiIT 12/10000	127N (13kgf)

NOTE
1 Directly connect a βiIT series spindle motor with the spindle so that no radial load is applied on the output shaft.

3.3.5.4 Assembling accuracy

The following table lists the assembling accuracy values.

Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	
Run-out of the flange mounting surface against the core of the shaft	40μm or less	
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

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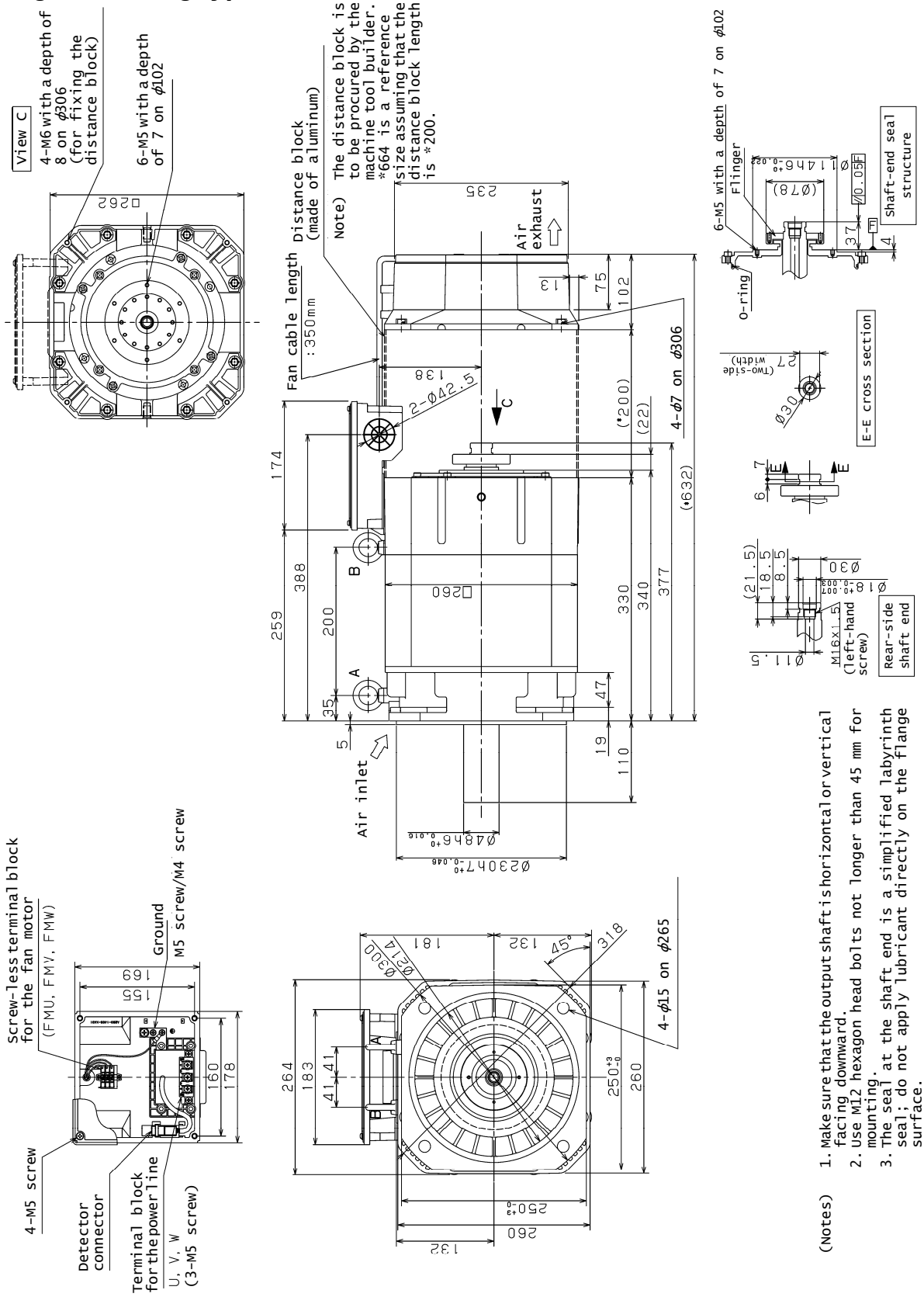
3.3.6 Model βiIT 15/8000

3.3.6.1 External Dimensions

(1) Flange mounting type



(Notes)
1. Make sure that the output shaft is horizontal or vertical facing downward.
2. Use M12 hexagon head bolts not longer than 45 mm for mounting.
3. The seal at the shaft end is a simplified labyrinth seal; do not apply lubricant directly on the flange surface.

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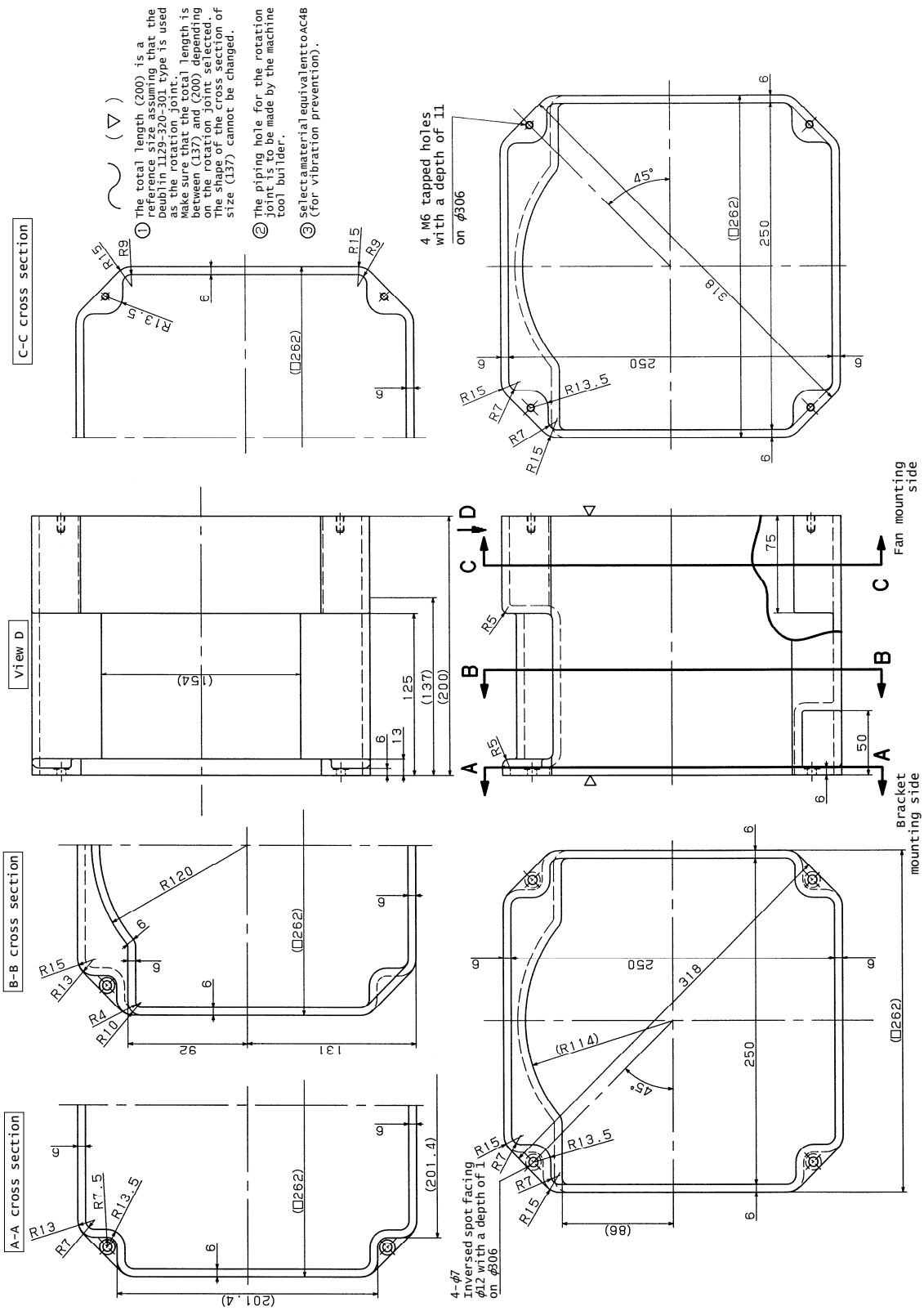
(2) Distance block type (A06B-1469-K560)



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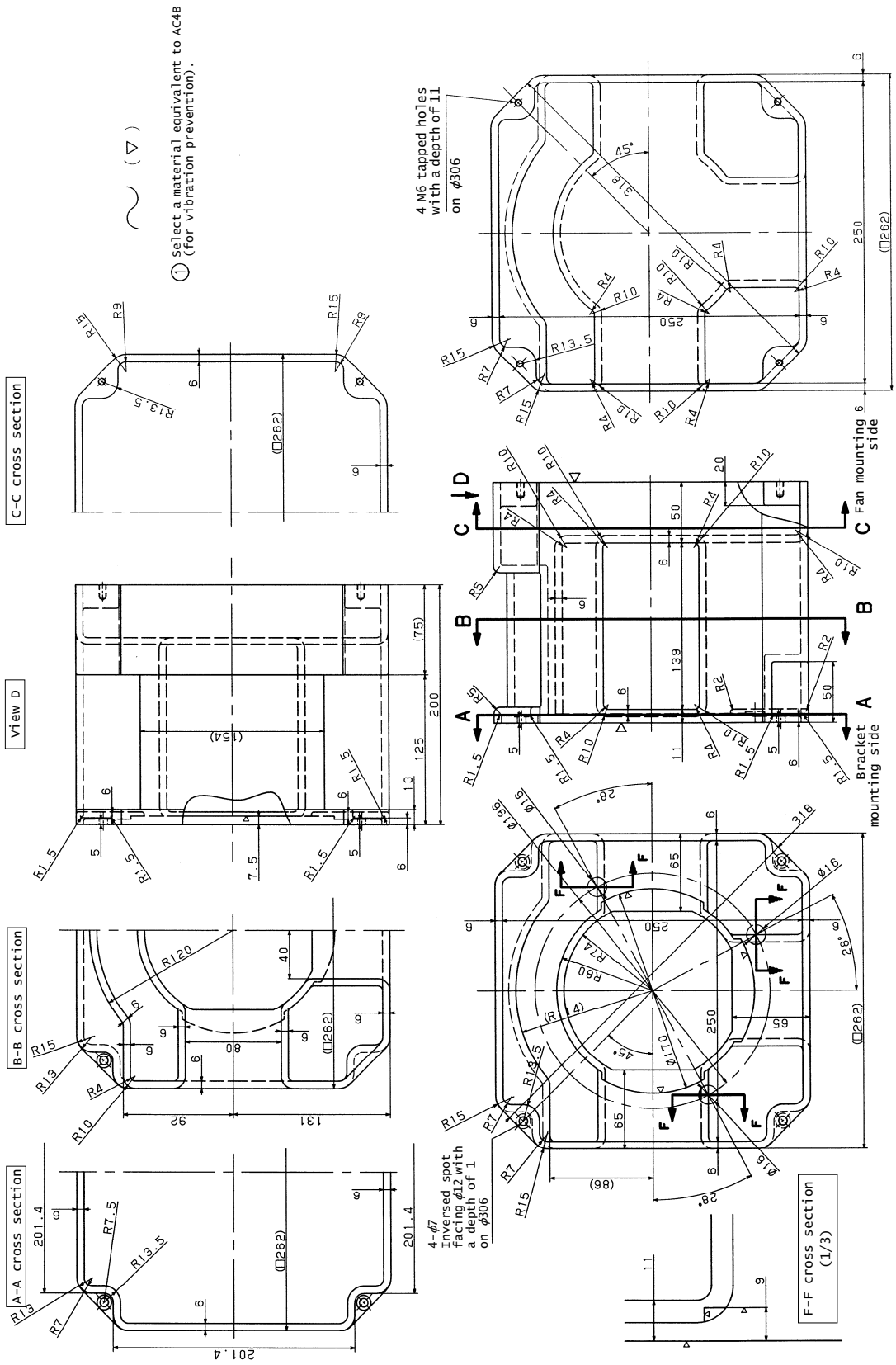
(3) Distance block with windows type (A06B-1469-K580)



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3.3.6.2 Shaft figure

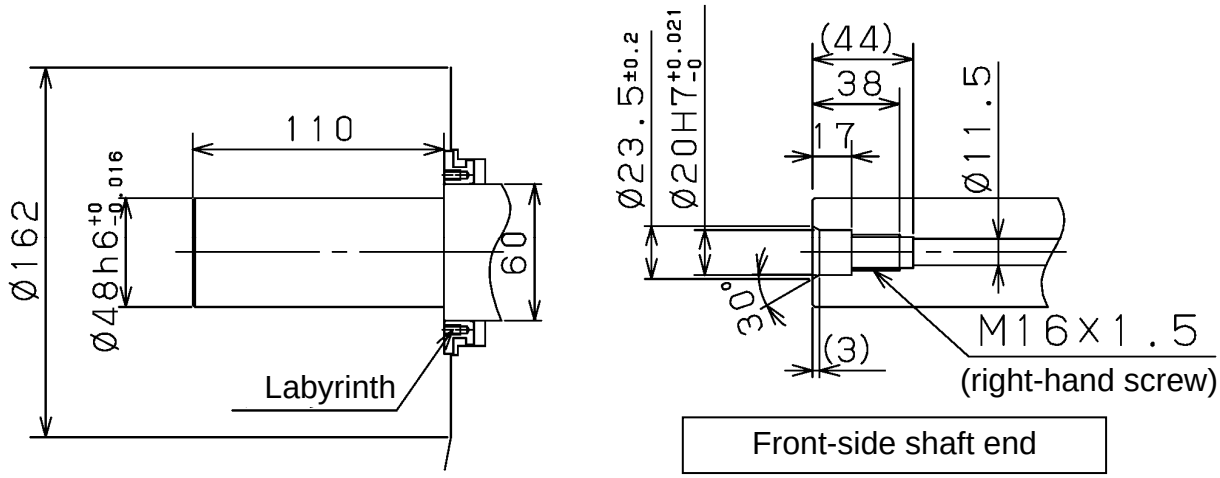
(1) Shaft figure types

The shaft figure with a key for each motor is as given below.

Model	Shaft with no key	
	Shaft diameter	Details
βiIT 15/8000	ϕ48	(2) (a)

(2) Shaft details

(a) ϕ48 hollow shaft with no key



3.3.6.3 Allowable radial load

Use the motor so that the thrust load on the output shaft does not exceed the load listed in the table below. (Only in the direction in which the motor shaft is pressed forward)

Model	Allowable thrust load
βiIT 15/8000	127N (13kgf)

NOTE

1 Directly connect a βiIT series spindle motor with the spindle so that no radial load is applied on the output shaft.

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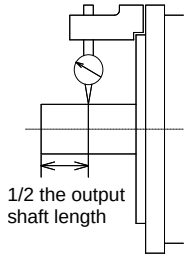
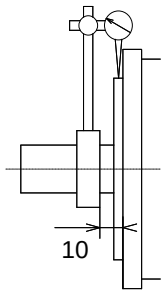
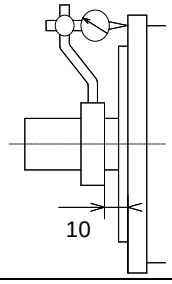
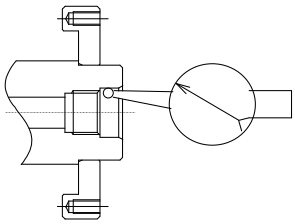
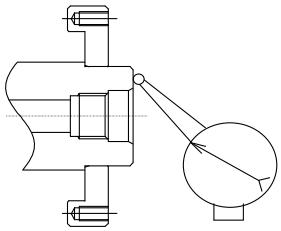
3.3.6.4 Assembling accuracy

The following table lists the assembling accuracy values.

Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	
Run-out of the flange mounting surface against the core of the shaft	40μm or less	
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

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3.4 COOLING FAN

A cooling fan is mounted to the FANUC AC spindle motor βi series. This cooling fan is described in this section.

This section, "COOLING FAN", consists of the following.

3.4.1 Cooling Fan Specifications..... 68
3.4.2 Cooling Fan Connection..... 69

3.4.1 Cooling Fan Specifications

Fan motor current values

βiI, βiIP, βiIC series 200-V type	50Hz				60Hz			
	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]
βiI 3/12000, βiI 6/12000, βiIC 3/6000, βiIC 6/6000	170-240	200	0.10	0.20	170-240	200	0.10	0.20
βiI 8/12000, βiI 12/10000, βiIP 12/6000, βiIT 12/10000, βiIC 8/6000	170-240	200	0.13	0.29	170-240	200	0.14	0.28
βiI 15/8000, βiIP 15/8000, βiIP 18/8000, βiIP 22/8000, βiIP 30/8000, βiIT 15/8000	170-240	200	0.22	0.91	170-240	200	0.32	0.85
βiIP 40/6000	170-253	200	0.38	1.59	170-253	200	0.46	1.57

βiI series 400-V type	50Hz				60Hz			
	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]
βiI 6/12000HV	170-220	200	0.11	0.37	195-253	230	0.13	0.42
βiI 8/12000HV, βiI 12/10000HV	323-440	400	0.07	0.31	391-528	480	0.08	0.35

NOTE
1 The term "surge current" represents a peak-to-peak current that flows when the power is turned on.
2 The values listed above are a rough standard. They are not guaranteed.

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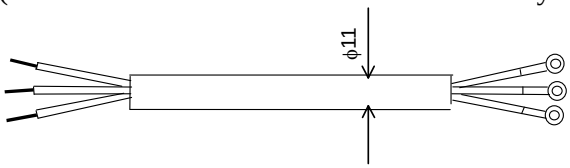
3.4.2 Cooling Fan Connection

Cable for the fan motor

The machine tool builder is to prepare the following cable for the fan motor:

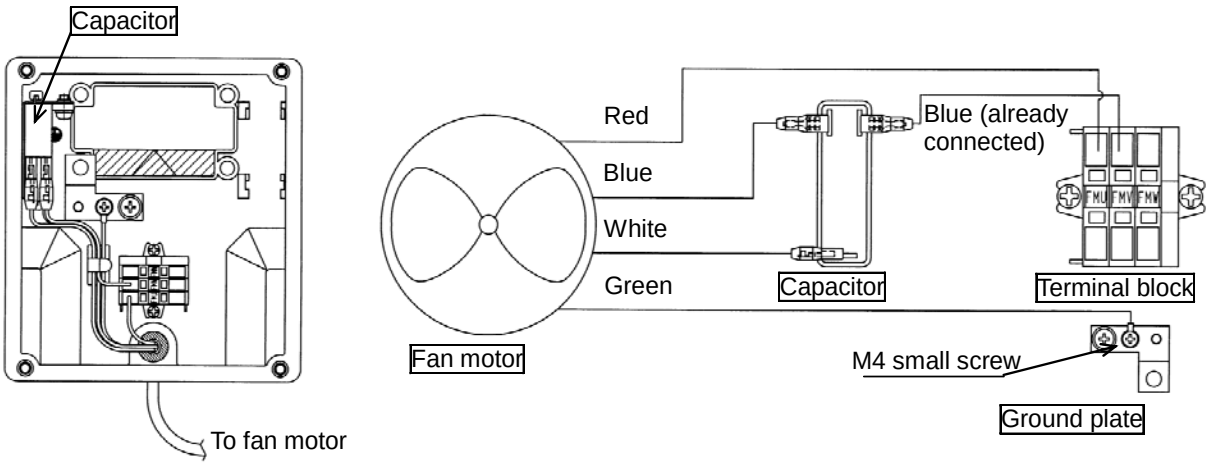
Vinyl heavy-duty power cord JIS C 3312 3-conductor
Conductor: 37/0.26 (2 mm^2)
Sheath: PVCϕ11
Crimp terminal: T2-4S

For a screw-less terminal block (Peel off each wire sheath on the motor side by 8 to 9 mm.)



Connection of a single-phase fan motor

The input power voltage requirements of the fan motor for β*i*I 6/12000HV are 200/230 VAC +10% -15%, single-phase, and 50/60 Hz ±1 Hz.



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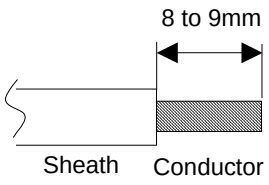
Method of connection to a screw-less terminal for the fan motor



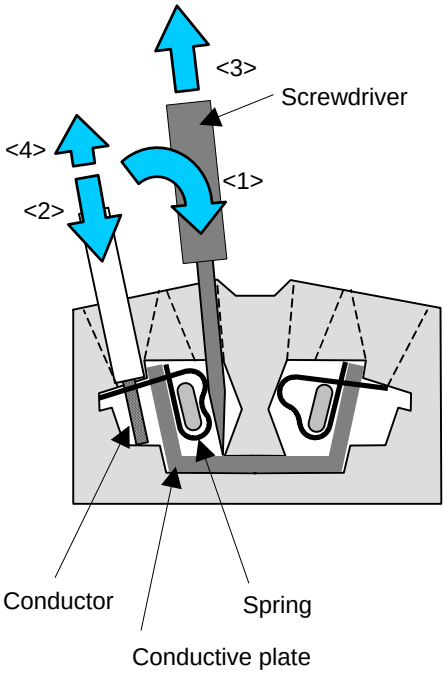
Peel-off length of a wire sheath

By using an appropriate tool, peel off each wire sheath by 8 to 9 mm.

Screwdriver

Use a flat-blade screwdriver with a blade size of 3.5 × 0.5 mm.
(210-120J (standard type), 210-350J (short type) manufactured by WAGO)

Connection procedure



<1> Insert the tip of the screwdriver into the screwdriver insertion slot (small rectangular hole) until the tip touches the spring. Next, while tilting the screwdriver toward the inside of the terminal block, push the screwdriver until it butts the conductive plate. In this state, the spring is opened completely, and the screwdriver is held in the terminal block. Ensure that the screwdriver is secured. Otherwise, the next step (wire insertion) cannot be conducted easily.

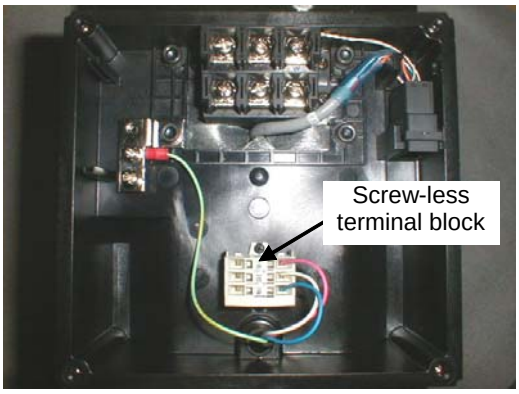
<2> Check the peel-off length (8 to 9 mm), then insert the wire into the wire insertion slot (large rectangular hole) until it stops, by sliding the wire along the outer side of the hole slowly so that the conductor does not become loose. Be careful not to push a thin wire excessively.

<3> While holding down the inserted wire by one hand, extract the screwdriver. The spring is closed to make a connection.

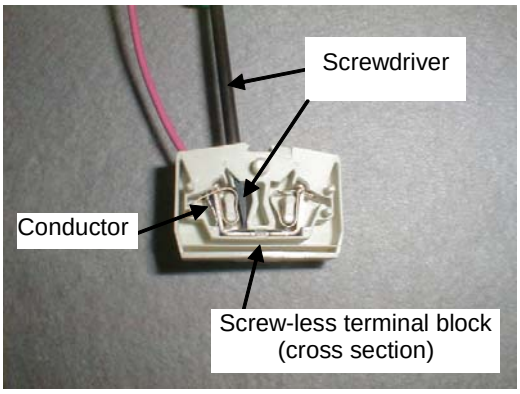
<4> By slightly pulling the wire, check that the wire is connected firmly. The wire need not be pulled intensely.

Cautions

- Only one wire must be connected to one spring.
- A wire, which may be a stranded wire or single conductor, can be directly connected without performing terminal processing if its sheath is peeled off. A wire after ferrule processing can also be connected.



Inside the terminal box



State of cable connection

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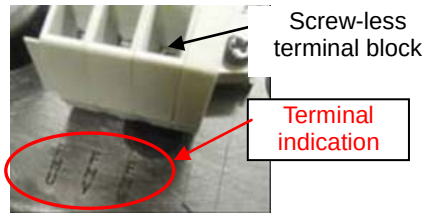

Terminal indication of screw-less
terminal block (plastic terminal box)

* Terminal indication of the fan motor is indicated on the terminal box from the end of June, 2014.

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4 BUILT-IN DETECTOR

The αiM/MZ sensor is a detector built into the standard spindle motor. This chapter describes the built-in detector used in the FANUC AC spindle motor βi series.

This chapter, "BUILT-IN DETECTOR", consists of the following sections:

4.1 TYPE AND SPECIFICATION METHOD..... 72
4.2 OUTLINE 72
4.3 CONNECTION..... 72

4.1 TYPE AND SPECIFICATION METHOD

(Omitted because they depend on which motor is specified.)

(Reference)
The αiM/MZ sensor is available in the types below.

αiM/MZ sensor types

Sensor name	One-rotation signal detection	Number of teeth
αiM sensor	No	128λ, 256λ
αiMZ sensor	Yes	

4.2 OUTLINE

(Omitted because the sensor is built into the motor.)

4.3 CONNECTION

For the αiM sensor → Cable K14
For the αiMZ sensor → Cable K17

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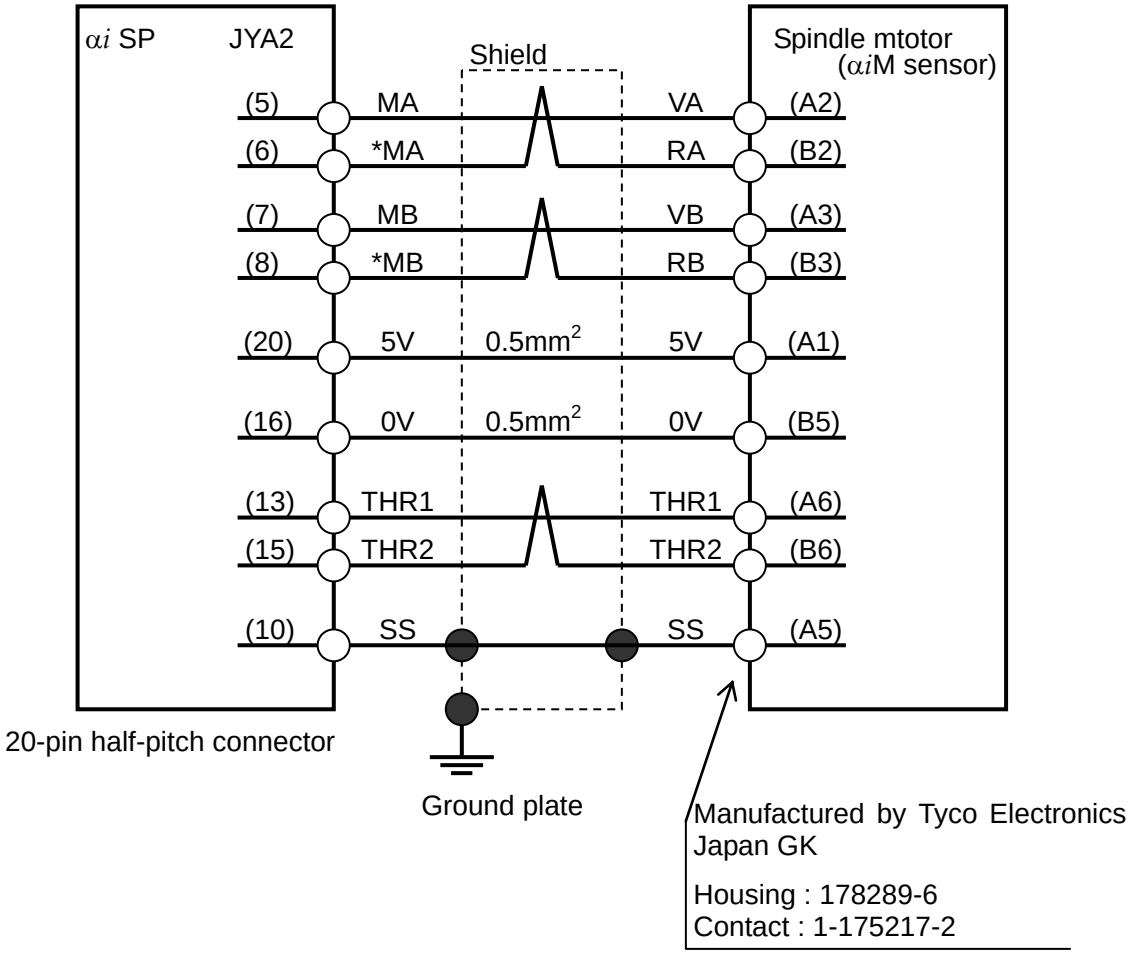
4.3.1 Details of Cable K14

4.3.1.1 For the spindle motor with αiM sensor



Cable specification : 6 common shielded cable (Three 0.18mm^2 twisted pairs + 0.5mm^2 wires)
Recommended cable conductor : A66L-0001-0368

NOTE

1 If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 For the recommended cable conductor, the maximum length is 72 m.
3 If using a cable conductor other than the recommended one, make sure that the sum of the 5V-0V electric wire resistances is 5 Ω or less.
4 For an explanation of the recommended cable and the JYA2-side connector conforming to the recommended cable, refer to the FANUC SERVO AMPLIFIER βi–B series DESCRIPTIONS (B-65422EN).

⚠ **WARNING**

If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

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Connector pin assignment

JYA2

9	5V	10	SS	19	#	20	5V
7	MB	8	*MB	17	#	18	5V
5	MA	6	*MA	15	THR2	16	0V
3	OH1	4	OH2	13	THR1	14	0V
1	MZ	2	*MZ	11	#	12	0V

NOTE

Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

Pin arrangement of the connector (manufactured by Tyco Electronics Japan GK) on the motor side

A1	+5V	B1	
A2	VA	B2	RA
A3	VB	B3	RB
A4		B4	
A5	SS	B5	0V
A6	THR1	B6	THR2

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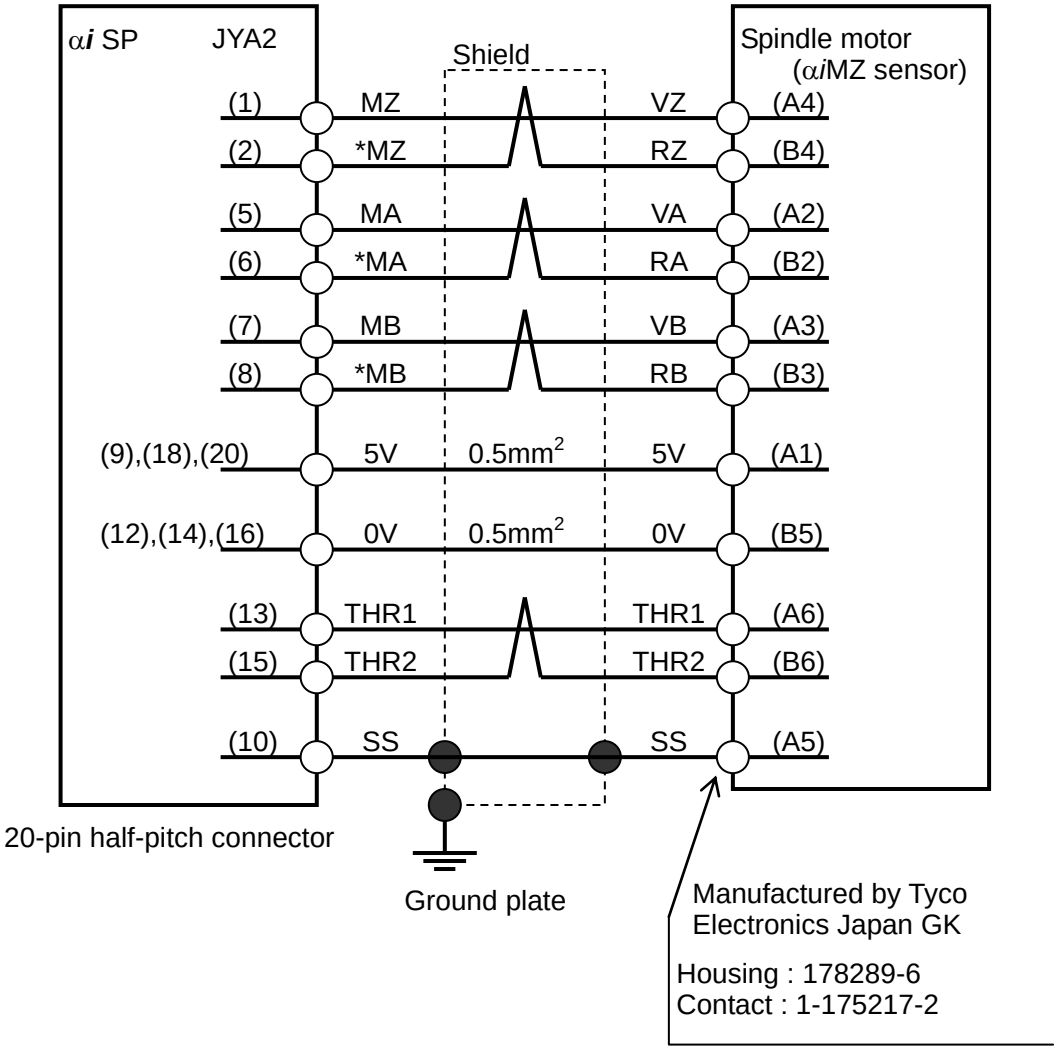
4.3.2 Details of Cable K17

4.3.2.1 For the spindle motor with αiMZ sensor



Cable specification : 6 common shielded cable (Four 0.18mm^2 twisted pairs + 0.5mm^2 wires)
Recommended cable conductor : A66L-0001-0368

NOTE

1 If only one 5 V line and only one 0 V line are used, use pins 20 and 16 for them, so that, if the connector is attached the wrong way, the sensor can be prevented from being damaged.
2 For the recommended cable conductor, the maximum length is 50 m.
3 If using a cable conductor other than the recommended one, make sure that the sum of the 5V-0V electric wire resistances is 4Ω or less.
4 For an explanation of the recommended cable and the JYA2-side connector conforming to the recommended cable, refer to the FANUC SERVO AMPLIFIER βi–B series DESCRIPTIONS (B-65422EN).

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> ⚠ **WARNING**
> If the feedback signal is connected incorrectly, an unpredictable motor operation may occur.

Connector pin assignment

JYA2

See the description of K14.

JYA4

9	5V	10	SS	19	#	20	5V
7	MB	8	*MB	17	#	18	5V
5	MA	6	*MA	15		16	0V
3	#	4	#	13		14	0V
1	MZ	2	*MZ	11	#	12	0V

> **NOTE**
> Do not use any pin that is marked #, because they may already be in use for input/output signals for an optional PCB.

Pin arrangement of the connector (manufactured by Tyco Electronics Japan GK) on the motor side

A1	+5V	B1	
A2	VA	B2	RA
A3	VB	B3	RB
A4	VZ	B4	RZ
A5	SS	B5	0V
A6	THR1	B6	THR2

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II. CONFIGURATION AND SELECTION

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1 CONDITIONS FOR APPROVAL RELATED TO THE IEC60034 STANDARD

This Subsection describes the conditions the following FANUC AC spindle motor β*i* series must clear before they can be approved for the IEC60034 standard. For details on EMC compliance authorization, refer to the separate manual "Compliance with EMC Directives."

This chapter, "CONDITIONS FOR APPROVAL RELATED TO THE IEC60034 STANDARD", consists of the following sections:

1.1 TYPES OF MOTORS TO BE APPROVED.....79
1.2 APPROVED SPECIFICATIONS.....80

1.1 TYPES OF MOTORS TO BE APPROVED

The following FANUC AC Spindle Motor β*i* series can comply with the IEC60034 standard if you follow the descriptions in this chapter.
The TUV mark is printed on the nameplate of a motor approved for the standard.
The following tables list the standard approval status of each motor.

β*i*I series 200-V type

Model name	Motor specification number	Standard approval status
β*i*I 3/12000	A06B-1444-Bxxx#0P0x	Preparing for approval
β*i*I 6/12000	A06B-1445-Bxxx#0P0x	Preparing for approval
β*i*I 8/12000	A06B-1446-Bxxx#0P0x	Preparing for approval
β*i*I 12/10000	A06B-1447-Bxxx#0P0x	Preparing for approval
β*i*I 15/8000	A06B-1498-Bxxx#0P0x	Preparing for approval

β*i*I series 400-V type

Model name	Motor specification number	Standard approval status
β*i*I 6/12000HV	A06B-1545-Bxxx#0P0x	Preparing for approval
β*i*I 8/12000HV	A06B-1546-Bxxx#0P0x	Preparing for approval
β*i*I 12/10000HV	A06B-1547-Bxxx#0P0x	Preparing for approval

β*i*IP series

Model name	Motor specification number	Standard approval status
β*i*IP 12/6000	A06B-1458-Bxxx	Approved
β*i*IP 15/8000	A06B-1442-Bxxx	Preparing for approval
β*i*IP 18/8000	A06B-1443-Bxxx	Preparing for approval
β*i*IP 22/8000	A06B-1459-Bxxx	Preparing for approval
β*i*IP 30/8000	A06B-1499-Bxxx	Preparing for approval
β*i*IP 40/8000	A06B-1480-Bxxx	Preparing for approval

β*i*IT series

Model name	Motor specification number	Standard approval status
β*i*IT 12/10000	A06B-1490-B123#0P21	Preparing for approval
β*i*IT 15/8000	A06B-1491-B123#0P21	Preparing for approval

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βiIc series

Model name	Motor specification number	Standard approval status
βiIc 3/6000	A06B-1415-Bxxx#0009	Approved
βiIc 6/6000	A06B-1416-Bxxx#0009	Approved
βiIc 8/6000	A06B-1417-Bxxx#0009	Approved

1.2 APPROVED SPECIFICATIONS

The following specifications are approved for the IEC60034 standard.

(1) Motor speed (IEC60034-1)

The "allowable maximum speed" are given on the data sheet in Section 3.2, “CURVES AND DATA SHEET” in Part I
The allowable maximum speeds are specified in such a way that the approval conditions of the IEC60034-1 standard, as they relate to rotational speed, are satisfied.

(2) Output (IEC60034-1)

The "rated output" available with a motor is given on the data sheet in Section 3.2, “CURVES AND DATA SHEET” in Part I. This rated output is guaranteed under the insulation class H, as the continuous output (S1), short time use rating (S2), and repeated use rating (S3) in the rated speed range.

(3) Protection type (IEC60034-5)

According to IEC 60034-5, the models equipped with an oil seal comply with the degree of protection IP54, and the other models comply with IP40. Even for the models complying with IP40, their motor main body excluding the output shaft end (with a simple labyrinth for the high-speed models or with no seal for the foot mounting type models) complies with IP54.

IP5□ : Machine protected from dust
- Ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with satisfactory operation of the motor.

IP4□ : Machine protected from introduction of solid foreign matter over 1.0 mm
- Electric cables and wires with a diameter or thickness greater than 1.0 mm can not enter.

IP□4 : Machine protected from water spray
- Water sprayed on the motor from any direction will have no harmful effect.

IP□0 : Machine not protected
- No special protection is provided to prevent ingress of water.

Note that these models satisfy the provisions for short-time water immersion, and do not guarantee their water-proof performance in an atmosphere in which cutting fluid is applied directly to the motor.

(4) Cooling method (IEC60034-6)

The cooling method of the motor is as given below.

IC code	Method
IC416	Air cooling with a fully closed, external independent fan

(5) Mounting method (IEC60034-7)

All motors can be mounted as follows:
IMB5: Flange mounting with the shaft facing sideways (from the rear)
IMV1: Flange mounting with the shaft facing downward (from the rear)

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IMB6: Shaft facing sideways, foot mounting on the left
IMB7: Shaft facing sideways, foot mounting on the right
IMB8: Shaft facing sideways, foot mounting on the top
IMV5: Shaft facing downward, foot mounting

Use a motor with the output axis being between 45° upward and vertical downward.

βiIT 12/10000 and βiIT 15/8000 can be mounted as follows:
IMB5: Flange mounting with the shaft facing sideways (from the rear)
IMV1: Flange mounting with the shaft facing downward (from the rear)
Use a motor with the output shaft being horizontal or vertical downward.

(6) Heat protection (IEC60034-11)

The spindle motor conforms to the heat protection standard (IEC60034-11) by using an overheat protection circuit with temperature detection (overheat alarm).

(7) Grounding (IEC60204-1)

The spindle motor has been confirmed to conform to the safety standard IEC60204-1 by verifying the continuity between the ground terminal plate of the conductive plate for screwing and the housing inside the terminal box in accordance with the standard.
The ground wire to be connected to the motor must have a diameter not smaller than the diameter of each phase wire.

(8) Remarks

For details on EMC compliance authorization, refer to the separate manual "Compliance with EMC Directives"
Mechanical and electrical safety of each motor should be evaluated after the motor is mounted on the machine.

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2 MOTOR SELECTION

This chapter describes the types of the FANUC AC Spindle Motor β*i* series and the selection conditions.

This chapter, "MOTOR SELECTION", consists of the following sections:

2.1 SELECTING MOTOR SPECIFICATIONS ACCORDING TO THE SPINDLE STRUCTURE.....82
2.2 SPINDLE MOTOR SELECTION CONDITIONS.....83
2.3 DETERMINING THE ACCELERATION TIME.....84
2.4 DETERMINING THE RMS OUTPUT.....86

2.1 SELECTING MOTOR SPECIFICATIONS ACCORDING TO THE SPINDLE STRUCTURE

Each model includes the types of motors listed below, and the user can make an optimal choice according to the spindle driving structure.
See Chapter 2, “ORDERING SPECIFICATION NUMBER” in Part I or "Order List" (B-65311EN) for available motors.

Item	Type	Use	Remarks
Mounting types	Flange mounting type	Connected to spindle via a gear Directly connected to a spindle Connected to spindle via a belt	The motor can be positioned accurately.
	Foot mounting type	Connected to spindle via a belt	
Built-in detector	α*i*M sensor	When connected to the spindle via a belt or gear at a deceleration ratio other than 1:1 (When the spindle has a sensor)	For a detailed explanation, refer to the following descriptions: FANUC SERVO AMPLIFIER β*i*-B series DESCRIPTIONS (B-65422EN)
	α*i*MZ sensor	When connected to the spindle via a belt, gear, or coupling on a 1:1 basis (When the spindle has no sensor)	
Shaft shape	With no key	Connected to a pulley	A shaft with no key is used as standard to facilitate pulley and gear balance correction and acceleration/ deceleration operation. When a shaft with a key is needed, contact your FANUC sales representative.
Cooling air exhaust direction	Rearward exhaust (Exhaust fromthe opposite side of the output shaft)	When the machine is positioned at the output shaft side	Direct the exhaust out and away from the machine.
	Forward exhaust (Exhaust from the output shaft side)	When the machine is positioned at the side opposite the output shaft	

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Output shaft seal	Oil seal	Gear connection, direct connection, and belt driving	Used in flange mounting type standard-speed models.
	No seal	Belt driving (Only when no lubricant splashes onto the flange surface of the motor)	Foot-mounting type models have no output shaft seal, but can be changed to a model with an oil seal or labyrinth. For the models that can be changed, refer to "Order List" (B-65311EN).

2.2 SPINDLE MOTOR SELECTION CONDITIONS

Selecting a spindle motor is based on the acceleration output and cutting output required of the spindle motor and so on. In selecting a motor, calculate these outputs according to this chapter and check that the values meet the selection conditions contained in this chapter.
The spindle motor selection conditions are as described below.

[Selection condition 1] Motor speed

- **The motor speed must not exceed the maximum motor speed.**
  Calculate the motor speed and check that the speed does not exceed the maximum motor speed.

[Selection condition 2] Acceleration time

- **Acceleration can be made with a desired time constant.**
  Since the load torque generally helps deceleration, if acceleration can be executed with a desired time constant, deceleration can be made with the same time constant, though both acceleration and deceleration should be considered in principle. Calculate the acceleration time and check that it does not exceed the desired acceleration time constant.

[Selection condition 3] RMS output

- **The RMS output in a single cycle has a value more than enough for the S1 continuous rated output.**
  The motor generates heat in proportion to the square of the output. For a spindle motor, for which load conditions constantly fluctuate, therefore, it is necessary to calculate the RMS output in a single cycle and check that the value is more than enough for the S1 continuous rated output.
  Caution is required, particularly if the cutting output, acceleration/deceleration conditions, and so on vary greatly in a single cycle.
  If the frequency of acceleration/deceleration increases, the ratio that the acceleration/deceleration output accounts for in the total operating time increases, making the RMS torque larger. In this case, increasing the acceleration/deceleration time constant is effective in reducing the RMS output.

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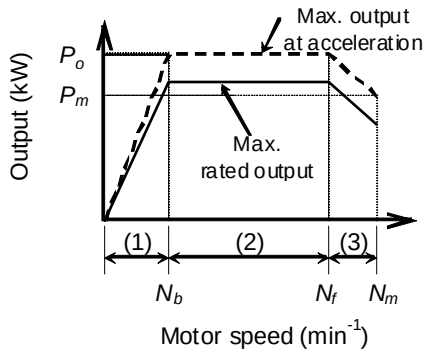
2.3 DETERMINING THE ACCELERATION TIME

The maximum output at acceleration is shown with broken line in a speed-output characteristic chart, such as that in Section 3.2 in Part I.
(The output at acceleration/deceleration for each model is not a guaranteed value but a guideline.)
For output characteristics such as those shown in the figure below, the acceleration time can be calculated as a reference value from the formula below. The load torque of the machine is not included in this calculation, so the actual acceleration time may be slightly longer than the time calculated here.



J_L	: Load inertia converted for the motor shaft [kgm^2]
J_m	: Moment of inertia of the rotor [kgm^2]
P_o , P_m	: Output [kW]
N_b , N_f , N_m	: Motor speed [min^{-1}]

(1) Acceleration time (t_1) in the constant-torque range (0 to N_b)

$$t_1 = 0.01097 \cdot \frac{(J_L + J_m) \cdot N_b^{\,2}}{P_o \cdot 1000} \quad \text{[sec]}$$

(2) Acceleration time (t_2) in the constant-output range (N_b to N_f)

$$t_2 = 0.01097 \cdot \frac{(J_L + J_m) \cdot (N_f^{\,2} - N_b^{\,2})}{2 \cdot P_o \cdot 1000} \quad \text{[sec]}$$

(3) Acceleration time (t_3) in the decreasing-output range (N_f to N_m)

$$t_3 = 0.01097 \cdot \frac{(J_L + J_m) \cdot (N_m - N_f) \cdot \left\{ (N_m - N_f) - \frac{P_o \cdot N_m - P_m \cdot N_f}{P_m - P_o} \cdot \ln \frac{P_m}{P_o} \right\}}{(P_m - P_o) \cdot 1000} \quad \text{[sec]}$$

The total time (t) required for acceleration in the range from 0 to N_m is t_1+t_2+t_3 [sec]

NOTE
This is not a guaranteed value but a guideline.

Deceleration can be controlled so that the time required for deceleration is nearly equal to that for acceleration. When the power voltage is high, or the impedance of the power is high, the time required for deceleration may not be made equal to that for acceleration.

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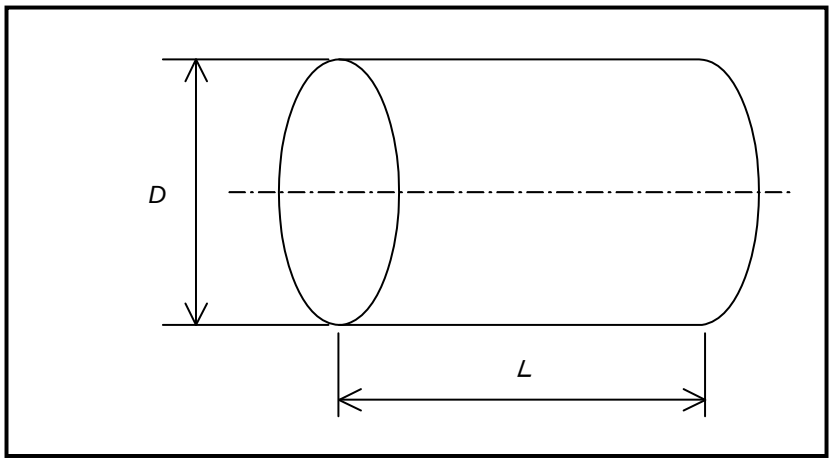
Reference 1

The moment of inertia of a cylindrical object rotating about its central axis is calculated as follows:



-SI unit----------

$$J = \frac{\pi\gamma}{32} D^4 L \quad [\mathrm{kg \cdot m^2}]$$

J : Moment of inertia [kg·m^2]
γ : Weight of the object per unit volume [kg/m^3]
D : Diameter of the object [m]
L : Length of the object [m]

-Gravitational system of units----------

$$J = \frac{\pi\gamma}{32 \times 980} D^4 L \quad [\mathrm{kgf \cdot cm \cdot s^2}]$$

J : Moment of inertia [kgf·cm·s^2]
γ : Weight of the object per unit volume [kg/cm^3]
D : Diameter of the object [cm]
L : Length of the object [cm]

Reference 2

The moment of inertia applied to the motor shaft for J_O is calculated as follows:

$$J = \left(\frac{Z_1}{Z_2}\right)^2 \times J_0 \quad or \quad \left(\frac{1}{Z}\right)^2 \times J_0$$

J_0 : Moment of inertia before deceleration
Z_1 : Number of teeth of the gear on the motor side (for gear connection)
Z_2 : Number of teeth of the gear on the spindle side (for gear connection)
1/Z : Deceleration ratio

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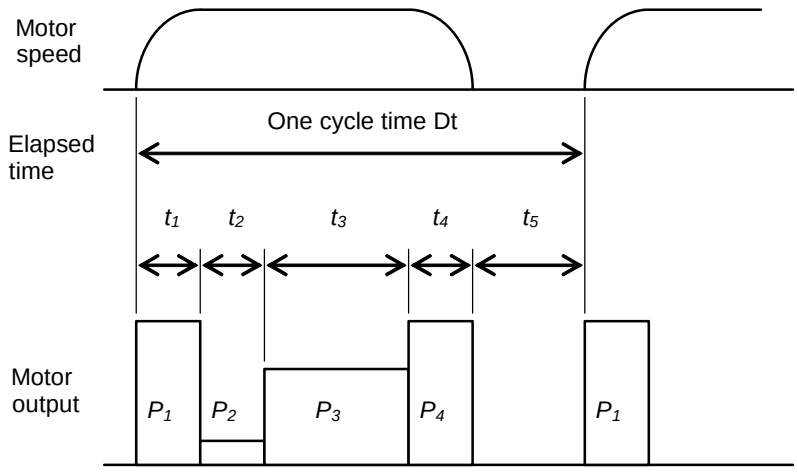
2.4 DETERMINING THE RMS OUTPUT

When machining is to be performed with the frequent acceleration/deceleration of the spindle, it is necessary to make sure that the RMS output in a single cycle does not exceed the S1 rated output.
(Comparing the RMS output with the S1 rated output provides a guideline as to whether continuous use is possible or not, but does not guarantee continuous use.)
The following describes how to determine the RMS output for a representative model of an AC spindle motor.
For a cycle such as that shown in the figure below, the RMS output can be calculated as a reference value from the formula below. The load torque of the machine is not included in this calculation, so the actual RMS output may be slightly larger than the RMS output calculated here.



P_1, P_4	: Acceleration/deceleration output [kW]
P_2	: Output with no load [kW]
P_3	: Cutting output [kW]

RMS output $Pav=\sqrt{\dfrac{P_1^2t_1+P_2^2t_2+P_3^2t_3+P_4^2t_4}{Dt}}$ [kW]

NOTE This is not a guaranteed value but a guideline.

NOTE

1 Cutting output P_3 at motor speed N which is lower than base speed Nb shall be calculated by the following equation.
$P_3=P_C \times Nb/N$ [kW] (P_C: Actual cutting output)

2 In case that P_3 is calculated by the load meter output voltage, use the following equation.
$P_3=P_1 \times L_3/10$ [kW] (L_3: Load meter output voltage in cutting [V])

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III. HANDLING, INSTALLATION, AND USE ENVIRONMENT OF THE MOTOR

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1 MOTOR HANDLING

This chapter contains notes on handling the FANUC AC spindle motor β*i* series.

This chapter, "MOTOR HANDLING", consists of the following sections:

1.1 CHECKING A DELIVERED SPINDLE MOTOR AND STORING A SPINDLE MOTOR 89
1.2 SEPARATING AND DISPOSING OF A SPINDLE MOTOR.....90

1.1 CHECKING A DELIVERED SPINDLE MOTOR AND STORING A SPINDLE MOTOR

When the spindle motor is delivered, check the following items.

- The motor meets the specifications. (Specifications of the model/shaft/sensor)
- Damage caused by the transportation.
- The shaft is normal when rotated by hand.
- Looseness or allowance in screws.

FANUC spindle motors are completely checked before shipment, and the inspection at acceptance is normally unnecessary. When an inspection is required, check the specifications (wiring, current, voltage, etc.) of the motor and sensor. Store the motor indoors. The storage temperature is -20°C to +60°C. Avoid storing in the following places.

- Place with high humidity so condensation will form.
- Place with extreme temperature changes.
- Place always exposed to vibration.
  (The bearing may be damaged.)
- Place with much dust.

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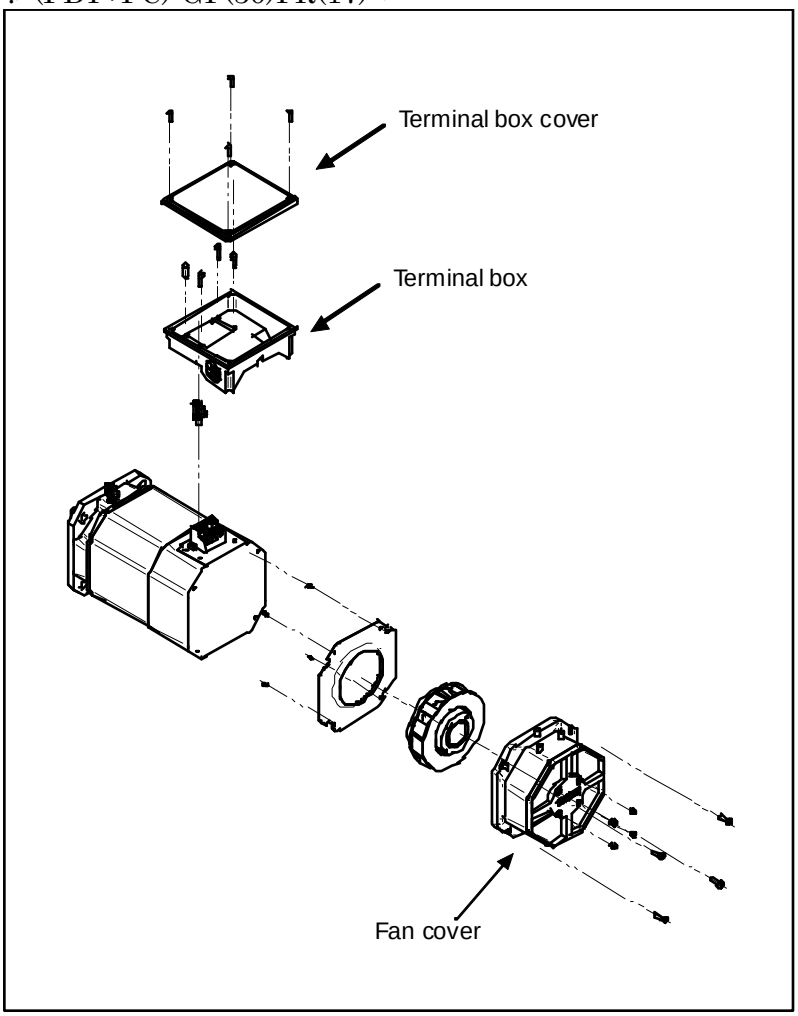
1.2 SEPARATING AND DISPOSING OF A SPINDLE MOTOR

Separating and disposing of plastic and metal parts of a motor

Separate plastic parts (terminal box, terminal box cover, and fan cover) and dispose of them by disassembling the motor as shown in the figure below. The following plastic material is used:

Plastic material :>(PBT+PC)-GF(30)FR(17)<



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2 NOTES ON INSTALLATION

This chapter contains notes on installing the FANUC AC spindle motor β*i* series.

This chapter, "NOTES ON INSTALLATION", consists of the following sections:

2.1 COMMON 91
2.2 AMBIENT TEMPERATURE, HUMIDITY, INSTALLATION HEIGHT, AND VIBRATION 97
2.3 USAGE CONSIDERING ENVIRONMENTAL RESISTANCE 98

2.1 COMMON

Be sure to observe the following, regardless of the connection method of the motor:

⚠ WARNING

When connecting a metallic conduit to a plastic terminal box, connect the conduit to ground on the power magnetics cabinet side.

⚠ CAUTION

1 Mount the motor so that the output shaft points in a direction ranging within 45 degrees above the horizontal to vertically downwards.

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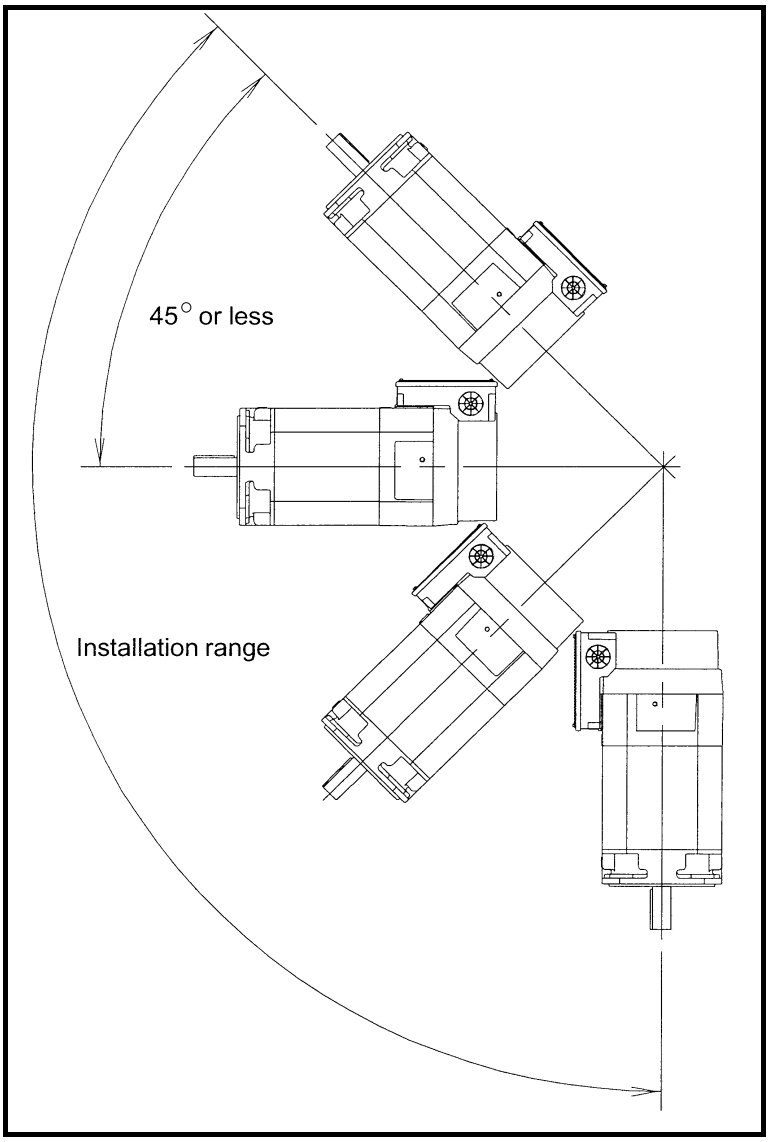
2 When the motor needs to be pointed to more than 45 degrees above the horizontal, consult your FANUC representative.



3 Use the eyebolt of the motor to lift only a single motor, (gear and pulley may be attached).

4 Place a cover over an air-cooled motor to prevent the motor from being exposed to coolant or lubricant.

5 Limit the vibration acceleration at the rear bracket of the motor to 4.9 m/s^2 (0.5G) to ensure the long-term reliability of each part of the motor.
In particular, to limit the acceleration in the case of direct connection to 4.9 m/s^2 (0.5G), carefully perform centering with the mating spindle and make the motor shaft parallel with the spindle.

- Details of the measuring method
  Measuring instrument:
  Equivalent to the VM-3024S or VM-3024H manufactured by IMV CORPORATION. (For details, see Section 3.3, "WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A COUPLING" in this part.)
  Condition: At the time of highest-speed rotation with no load
  Measurement frequency range with no load at the highest speed: 10 to 1000 Hz
  Criteria: 4.9 m/s^2 (0.5G) or less at the rear bracket

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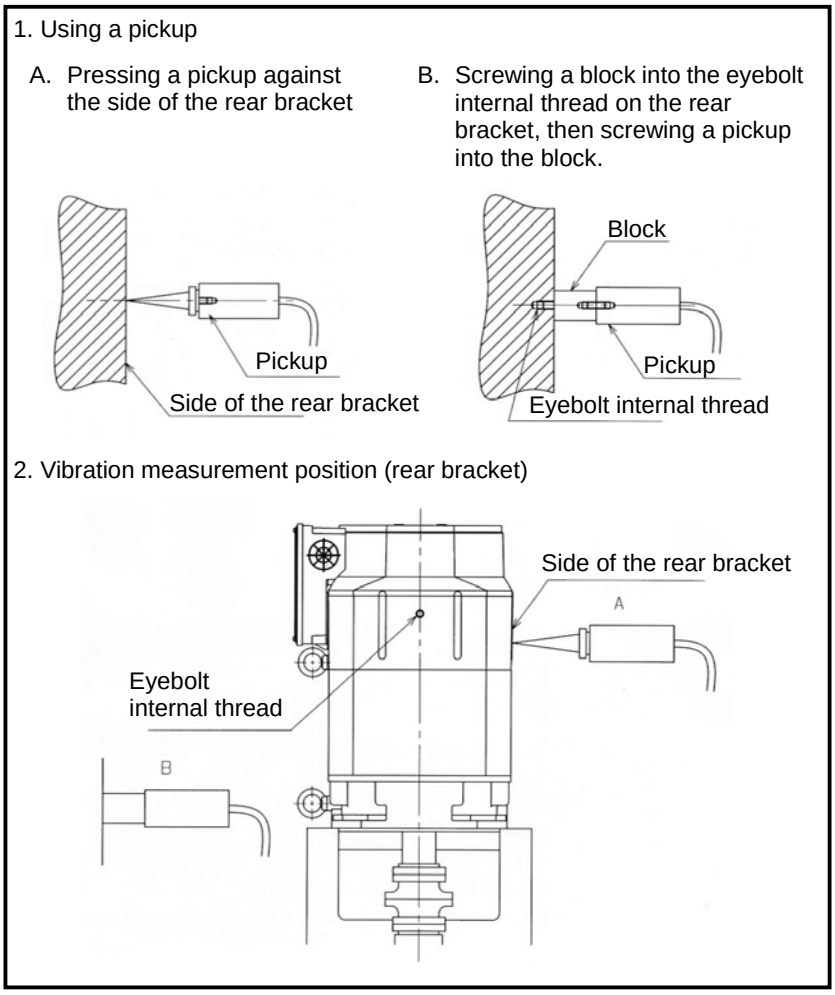

6 Dynamic balance

During high-speed operation, a small imbalance may cause a large vibration, resulting in an unusual sound, premature bearing damage, or some other abnormality.

Therefore, reduce the amount of the imbalance with the dynamic balance of the other rotation shafts, as well as the gear and pulley mounted on the output shaft of the motor, as much as possible.

- Balance correction

  With the β*i* series, a shaft with no key is used as standard to facilitate the balance correction of a pulley, gear, and coupling attached to the shaft. Use a completely symmetric pulley, gear, or coupling, and use a backlash-less tightening part such as a SPANN ELEMENTE to secure a pulley, gear, or coupling to the shaft. When attaching a pulley to a shaft, for example, adjust the periphery vibration to within 20 μm. This basically eliminates the need for balance correction. To further reduce the vibration level, make a field balance correction, for example, by tightening a screw into the tapped hole for balance correction provided on a component such as a pulley.

7 Vibrations applied to the motor must be 49 m/s^2 (5G) or less in a state where the motor is attached to the machine.

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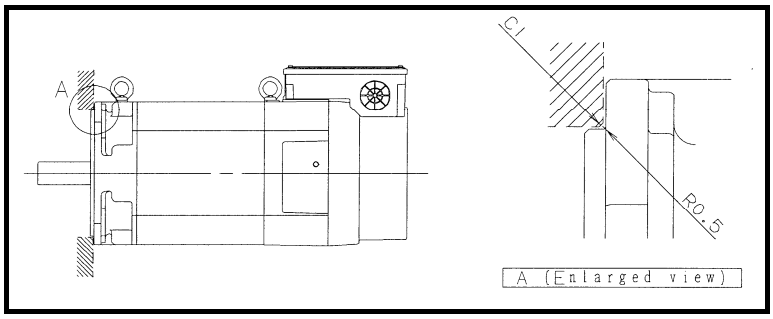
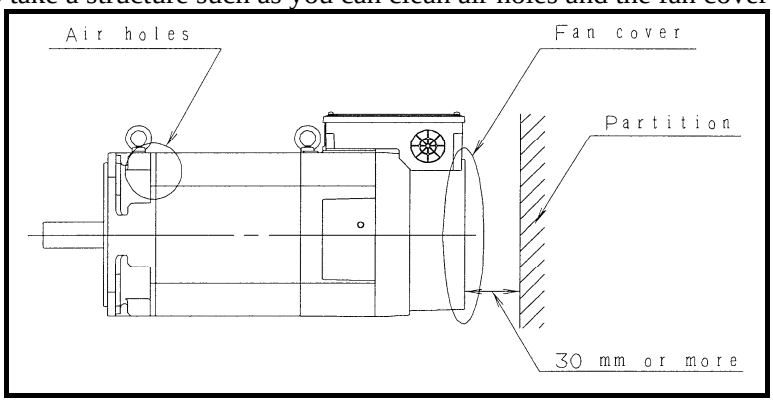
8 The edge of the faucet joint to mount the flange mounting type motor should be chamfered about C1.

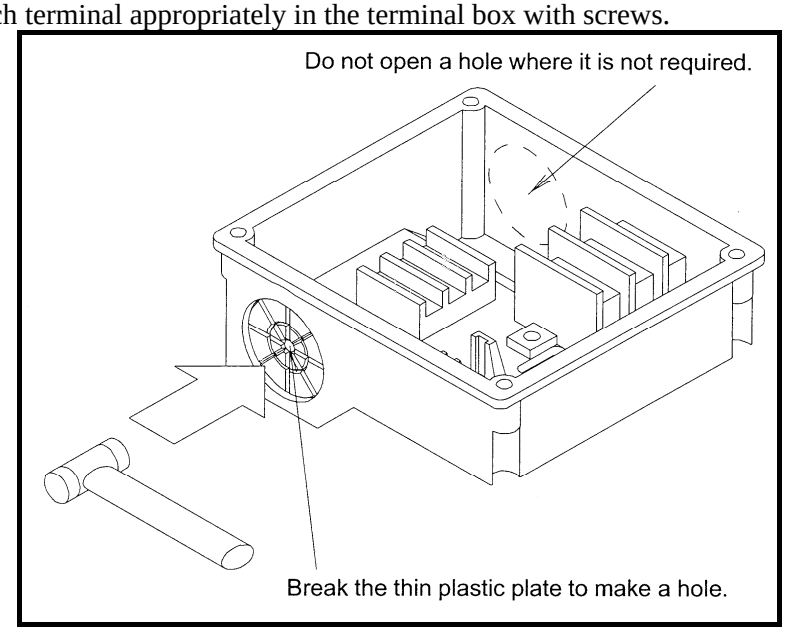


9 Please space 30 mm or more between the fan cover and the partition to keep the cooling ability well. We recommend to take a structure such as you can clean air holes and the fan cover easily.



NOTE

1 Cable wiring
Follow the procedure below to install the cable.
(1) Use a hammer to strike the portion for the cable hole on the terminal box and open the hole. This time, pay attention not to break the other place except the hole.
(2) Thread the cable through a conduit. Connect the conduit with the connector.
(3) Tighten the connector at the cable hole of the terminal box using a nut. (*1, *2)
(4) Connect each terminal appropriately in the terminal box with screws.



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When a hole once made is not used, purchase the following rubber bushing and mount it at the hole.

Model	Ordering number
βiI 3/12000 to βiI 15/8000 βiI 6/12000HV to βiI 12/10000HV βiIP 12/6000 to βiIP 30/8000 βiIT 12/10000, βiIT 15/8000 βiIC 3/6000 to βiIC 8/6000	A06B-0754-K001
βiIP 40/6000	A06B-0731-K001

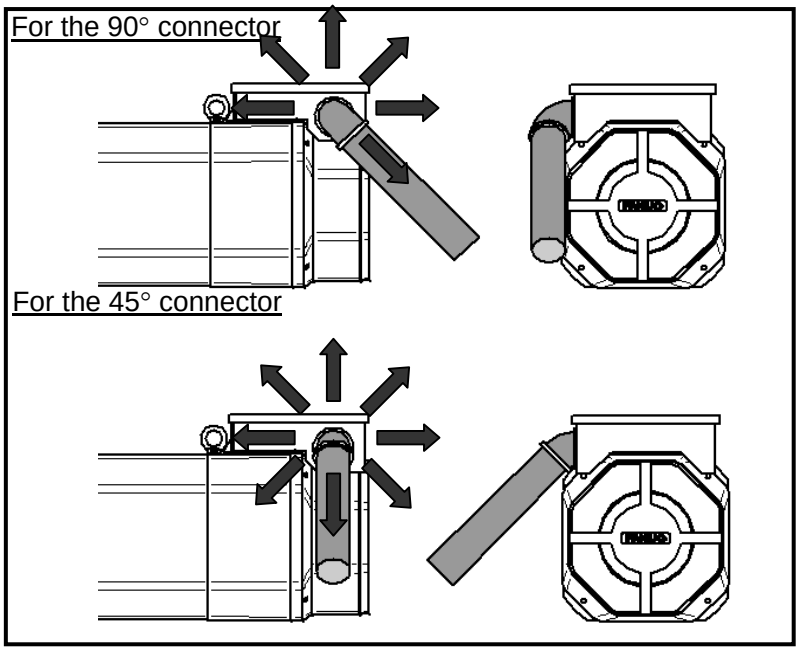
NOTE 1

When the 90 degrees connector is used in the following models, the mounting direction of the conduit is restricted to prevent interference between the conduit and the motor. To allow the conduit to be mounted in any direction, use the 45 degrees connector.

(In a model other than the following, the conduit can be mounted in any direction even when the 90 degrees connector is used.)

Applicable models:

βiI 15/8000, βiIP 15/8000, βiIP 18/8000, βiIP 22/8000, βiIP 30/8000, βiIP 40/6000, βiIT 15/8000



NOTE 2

The nut used to fasten the connector to the terminal box must be smaller than the size listed below. (Any larger nut interferes with the terminal box.) For the diameter of the cable hole in each model, refer to the outside dimension drawing of the respective models.

Model	Cable hole diameter	Outside diameter e	Width t
βiI 3/12000 to βiI 15/8000 βiI 6/12000HV to βiI 12/10000HV βiIP 12/6000 to βiIP 30/8000 βiIT 12/10000, βiIT 15/8000 βiIC 3/6000 to βiIC 8/6000	ϕ42.5 mm	53 mm (maximum)	9 mm (maximum)
βiIP 40/6000	ϕ61 mm	80 mm (maximum)	15 mm (maximum)

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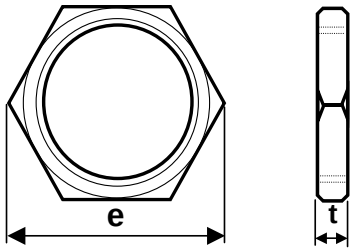
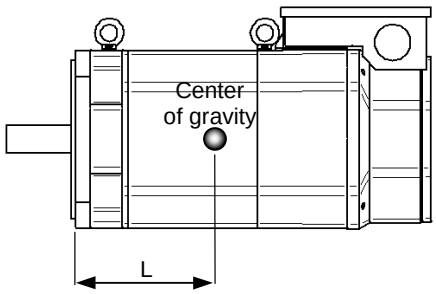
Outside dimensions of the conduit-connector retaining nut



2 Center of gravity

The distance L from the flange end face to the center of gravity in each model is listed below.



βiI series 200-V type	βiI series 400-V type	βiIP series	βiIc series	Center of gravity [mm]
βiI 3/12000			βiIc 3/6000	125±5
βiI 6/12000	βiI 6/12000HV		βiIc 6/6000	170±5
βiI 8/12000	βiI 8/12000HV		βiIc 8/6000	150±5
βiI 12/10000	βiI 12/10000HV	βiIP 12/6000		185±5
βiI 15/8000		βiIP 15/8000		160±5
		βiIP 18/8000		170±5
		βiIP 22/8000		190±5
		βiIP 30/8000		205±5
		βiIP 40/6000		240±5

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2.2 AMBIENT TEMPERATURE, HUMIDITY, INSTALLATION HEIGHT, AND VIBRATION

Ambient temperature

The ambient temperature should be 0°C to 40°C. If the ambient temperature exceeds this range, the operating conditions must be eased to prevent the motor and detector from overheating. (The specification values and external dimensions in the data sheet assume an ambient temperature of 20°C.)

Ambient humidity

The ambient humidity should be 80%RH or less and no condensation should not be caused.

Installation height

Up to 1,000 meters above the sea level requires, no particular provision for attitude. When operating the machine at a higher level, special care is unnecessary if the ambient temperature is lowered 1°C at every 100m higher than 1,000m. For example, when the machine is installed at a place of 1,500 meters above sea level, there is no problem if the ambient temperature is 35°C or less.

Vibration

When installed in a machine, the vibration applied to the motor must not exceed 5G (49 m/s^2).

If any one of the four environmental conditions (ambient temperature, ambient humidity, installation height, and vibration) specified above is not satisfied, the output must be restricted.

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2.3 USAGE CONSIDERING ENVIRONMENTAL RESISTANCE

⚠ CAUTION

The motor is an electric part, and if the lubricant or cutting fluid falls on the motor, it will enter the inside of the motor, possibly adversely affecting the motor. In particular, if the cutting fluid adheres to the motor, it will deteriorate the resin or rubber sealing members, causing a large amount of cutting fluid to enter the inside of the motor and possibly damaging the motor. When using the motor, note the points described below.

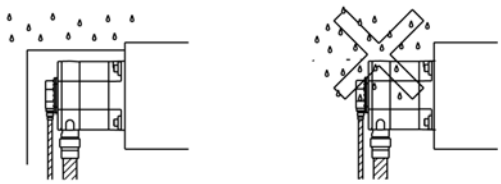
1. Level of motor protection

According to IEC 60034-5, the models equipped with an oil seal comply with the degree of protection IP54, and the other models comply with IP40. Even for the models complying with IP40, their motor main body excluding the output shaft end (with a simple labyrinth or with no seal) complies with IP54.
Note that these models satisfy the provisions for short-time water immersion, and do not guarantee their water-proof performance in an atmosphere in which cutting fluid is applied directly to the motor. Before actual use, note the points described below.

2. Motor periphery

If the cutting fluid or lubricant falls on the motor, it will adversely affect the sealing properties of the motor surface, entering the inside of the motor and possibly damaging the motor.

- Make sure that the motor surface is never wet with the cutting fluid or lubricant, and also make sure that no fluid builds up around the motor. If there is a possibility of the surface being wet, a cover is required.



- If the cutting fluid is misted, the cutting fluid may be condensed on the inside of the cover and fall on the motor. Make sure that no condensed droplets fall on the motor.

- If the inside of the machine is full of misted cutting fluid, the cutting fluid adhered to the motor can enter the inside of the motor and damage the motor. Install a mist collector with an appropriate capacity to prevent the inside of the machine from becoming full of mist.

- Completely separate the machining area from the motor area, using a telescopic cover, accordion curtain, and so on. Note that partitions such as accordion curtains are consumable and require periodic inspection for damage.

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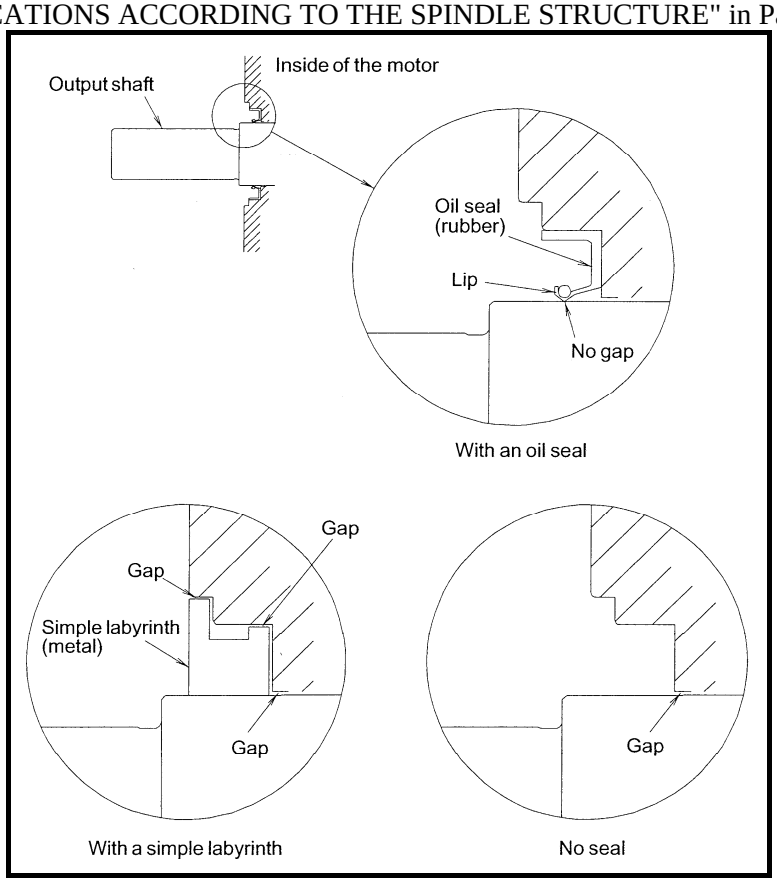
3. Output shaft seal

To prevent cutting lubricant or dust from penetrating inside the motor, one of the following output shaft seals is provided on the output shaft. (For the use and applicable motors, see Section 2.1, "SELECTING MOTOR SPECIFICATIONS ACCORDING TO THE SPINDLE STRUCTURE" in Part II.)



For those models with an oil seal, ensure that the surface of the lubricant is below the lip of the oil seal.

If a simple labyrinth is used as the output shaft seal or if no seal is provided (foot mounting type), ensure that lubricant does not splash onto the flange surface. If such a motor is directly mounted on a gear box, the lubricant may gradually penetrate inside the motor even when no lubricant splashes on flange surface, thus resulting in motor failure. Therefore, do not mount such a motor on a gear box directly.

When the motor is used in an environment in which lubricant does not splash onto the motor, the simple labyrinth type instead of the oil seal type may be selected. Generally in a dry environment, the motor temperature of the simple labyrinth type will increase more moderately than that of the oil seal type.

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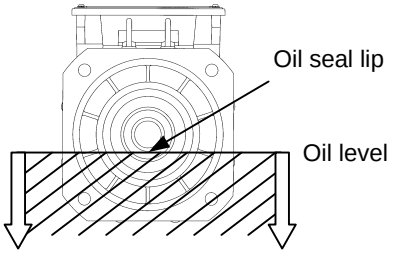
3.1 Oil seal

The shaft of the motor is provided with an oil seal to prevent entry of lubricant and other fluids into the motor. (The foot mounting type is excluded.) It does not, however, completely prevent the entry of lubricant and other fluids depending on the working conditions.

- When the motor is rotating, the oil seal has an effect of discharging any oil that enters, but if it is pressurized for a long time when the motor is stopped, it may allow oil to enter through the lip. When lubrication with an oil bath is conducted for gear engagement, for example, the oil level must be below the lip of the oil seal of the shaft, and the oil level must be adjusted so that the oil does nothing but splash on the lip.



Diameters of the oil seal lips of motor shafts

Motor model	Oil seal diameter [mm]
βiI 3/12000, βiI 6/12000, βiI 6/12000HV, βiI 8/12000, βiI 8/12000HV	ϕ40
βiI 12/10000, βiI 12/10000HV, βiIP 12/6000	ϕ50
βiI 15/8000, βiIP 15/8000, βiIP 18/8000 βiIP 22/8000, βiIP 30/8000	ϕ60
βiIP 40/6000	ϕ70

- If foreign matter such as cutting chips is caught by the oil seal lip, it will be easily worn, losing its sealing properties. When the motor is used within a splash guard, and so cutting chips may fall on the motor, for example, take measures to prevent cutting chips from entering near the lip.

- In an environment in which dry and wet states alternate, if cutting fluid splashes onto the lip after it has worn in a dry state, the cutting fluid may easily enter the inside of the motor. In this case, provide a cover to prevent cutting fluid from splashing onto the oil seal of the motor.

- Ensure that no pressure is applied to the lip of the oil seal.

- The oil seal shows its sealing effect when a part such as the gear coupling is lubricated by oil bath. Cutting fluid does not provide lubrication for the oil seal lip, so the cutting fluid may easily penetrate the seal. Therefore, provide a cover to prevent cutting fluid from splashing onto the oil seal.

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3.2 When the oil seal is not used

When a simple labyrinth is used as the output shaft seal or when no seal is provided (foot mounting type, βiIc series), ensure that lubricant does not splash onto the flange surface directly. If such a motor is directly mounted on a gear box, lubricant may gradually enter the inside of the motor even when the flange surface is protected against lubricant splash, therefore resulting in motor failure. So, do not mount such a motor on a gear box directly.

NOTE

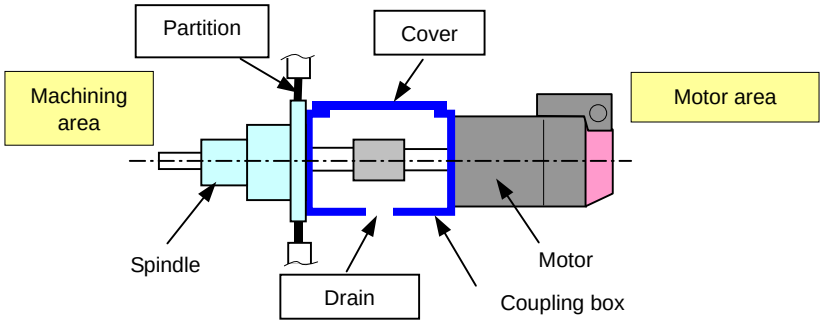
1 The foot mounting type motors are not equipped with an oil seal. When an oil seal is necessary, add #0102 to a motor specification number when ordering the motor. For details, refer to the order list (B-65311EN).
Example)
Model βiIP 15/8000 (foot mounting type, with no key, rear exhaust)
To add an oil seal to A06B-1442-B600, order A06B-1442-B600#0102.

2 When lubricant does not splash onto the oil seal, remove the coil spring of the oil seal to reduce friction between the lip and shaft.
This does not affect sealing from dry dust.
When the area in which the shaft touches the oil seal is dry, turning the shaft at a high speed may generate contact sound (abnormal sound) from that area or may damage the lip.

4. Motor coupling

When a coupling box is used to connect the motor to the machine, take measures as follows not to allow leaked cutting fluid to build up in the coupling box.

- Provide a cover for the top and sides of the coupling box.
- Provide a drain hole at the bottom of the coupling box. The hole must be large enough to avoid clogging.



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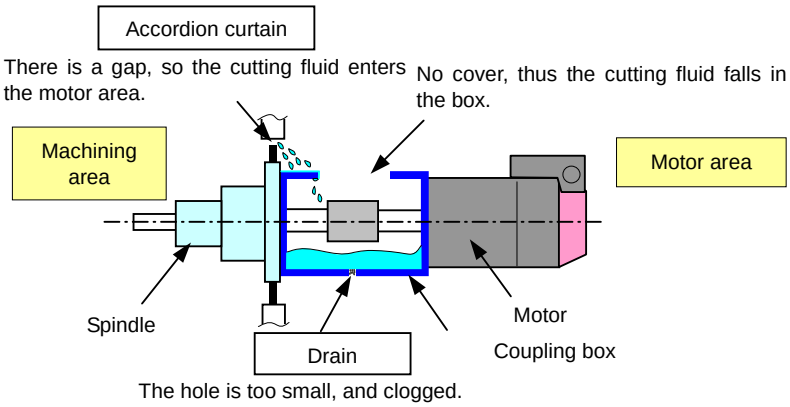
<Fault example>

The cutting fluid leaks from a gap in the accordion curtain to the motor area, and builds up in the coupling box. While the spindle is moving, the cutting fluid ripples, splashing onto the oil seal of the motor. The cutting fluid enters the inside of the motor there in large quantities, deteriorating the insulation of the motor.

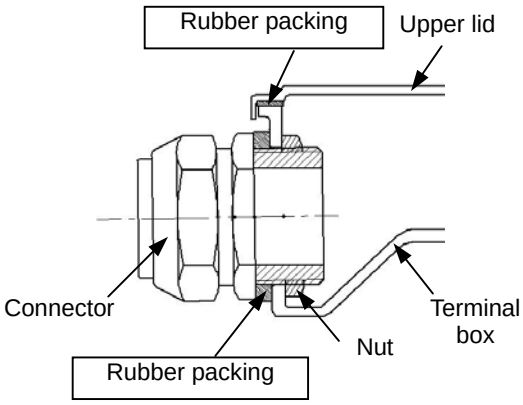


5. Terminal box and their surroundings

βiI series, βiIP series, βiIT series, and βiIC series use a terminal box to connect the power and signal cables.

- When a conduit is attached to the terminal box, use a water-proof connector with rubber packings to prevent lubricant and cutting fluid from entering the inside of the terminal box through its cable holes.

- On the inner side of the upper lid of the terminal box, a rubber water-proof packing is installed. Ensure that the packings are not damaged, then install the lid so that no foreign matter is caught.



- If the connector you want to use is smaller than the cable hole on the terminal box, prepare the bushing, nut, and O-ring shown below.

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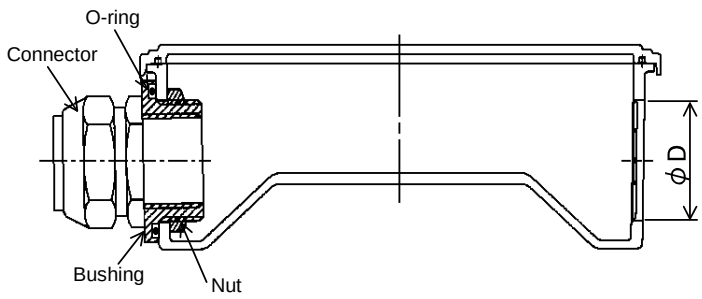


Model	Cable hole diameter ϕD	O-ring code	
		JIS B 2401	ISO 3601-1
βiI 3/12000 to βiI 15/8000 βiI 6/12000HV to βiI 12/10000HV βiIP 12/6000 v βiIP 30/8000 βiIT 12/10000, βiIT 15/8000 βiIC 3/6000 to βiIC 8/6000	ϕ42.5 mm	P46	C0462G
βiIP 40/6000	ϕ61 mm	P65	C0650G

NOTE

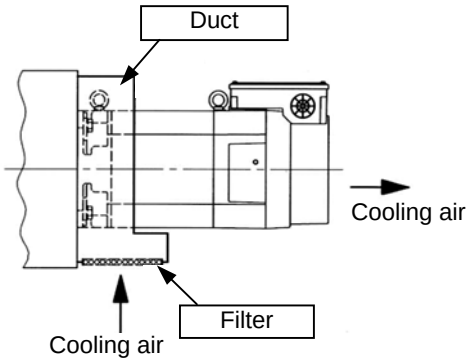
For the diameter of the cable hole in each model, refer to the outside dimension drawing of the respective models.

6. Fan motor and its surroundings

If lubricant or cutting fluid mist, particles, or cutting chips are drawn into the fan motor, the air holes in the motor and the blades of the fan motor will clog, causing the cooling capacity to reduce. Employ a machine structure that allows clean, cooling air to be fed into the motor.

Example)

When a duct with a filter is installed on a flange mounting type motor with a rear exhaust (The filter requires periodic cleaning.)



7. Motor with a through hole

The βiIT series motor with a through hole complies with the degree of protection IP40. The motor main body excluding the simplified labyrinth at the end of the output shaft and the flinger at the rear end of the shaft complies with IP54. When center through coolant machining is performed, employ such a structure that cutting fluid leaked from the coolant joint or rotation joint does not enter the inside of the motor.

7.1 Front side of the motor

A simplified labyrinth is mounted on the shaft on the front side of the motor. Therefore, a splash of cutting fluid or cutting fluid leaked from the coolant joint can enter the inside of the motor.

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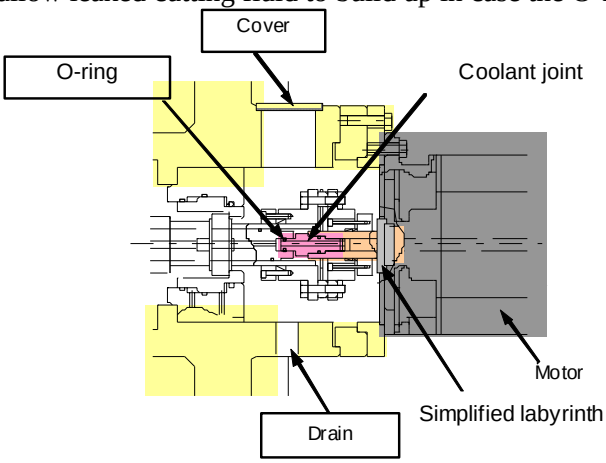
- Employ such a structure that the O-ring of the coolant joint is not damaged by sliding.

- Provide a drain not to allow leaked cutting fluid to build up in case the O-ring is damaged.



7.2 Rear side of the motor

When a separate external support type rotation joint is installed at the rear end of the shaft, cutting fluid leaks from the seal (where the stationary side and the rotation side come in contact); therefore, employ such a structure that the leaked cutting fluid does not enter the inside of the motor.

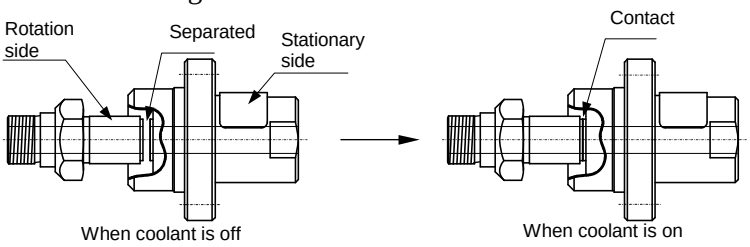


Fig. Example of a separate external support type rotation joint

- Provide the rotation joint mounting housing with notches and drains not to allow leaked cutting fluid to build up in the housing.

- The rotation joint is a consumable part. It requires periodic inspection and replacement.

- If the rotation joint is damaged, a large amount of cutting fluid can leak out. So, provide the mounting housing with many notches.

- When the motor is oriented downward vertically, enhance drainage by means such as air purging.

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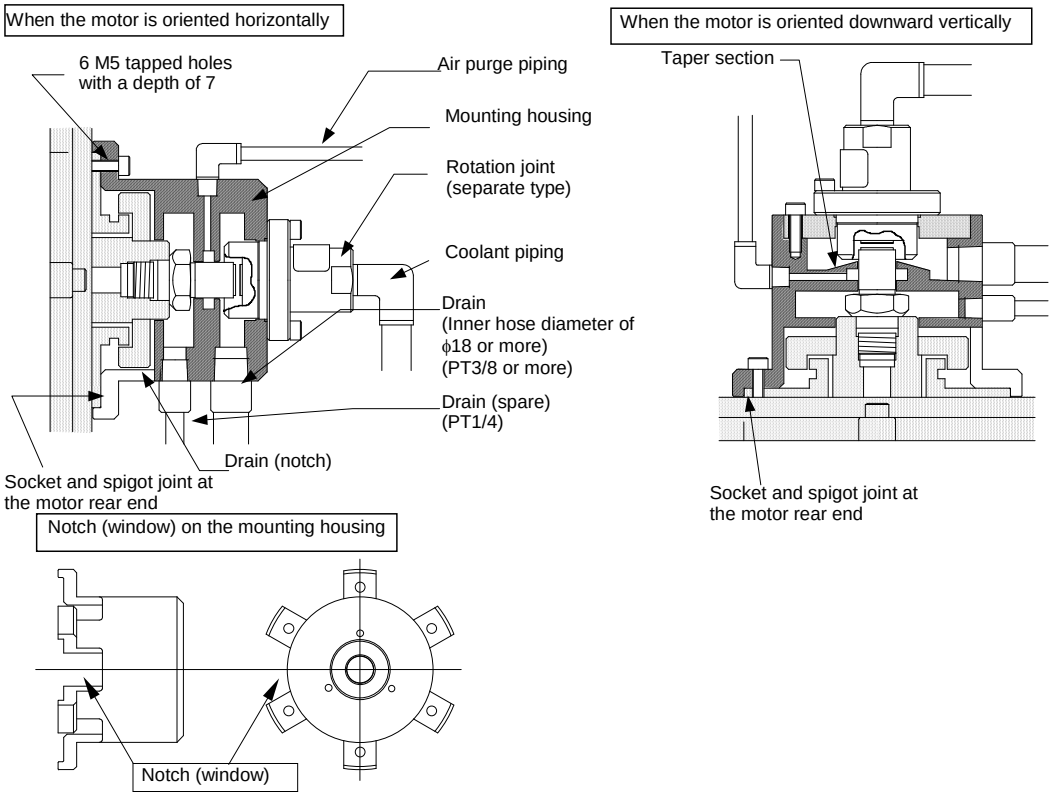

8 Notes on cutting fluid

Cutting fluid containing highly active sulfur or chlorine, oil-free cutting fluid called synthetic cutting fluid, and highly alkaline, water-soluble cutting fluid in particular significantly affect the CNC, motor, or amplifier. Even when these components are protected from direct spraying of cutting fluid, problems as described below may arise. So special care should be taken.

- Cutting fluid containing highly active sulfur or chlorine
  Some cutting fluids containing sulfur or chlorine show extremely high activity. Attachment of such cutting fluid to the CNC, motor, or amplifier can cause chemical reaction with plastic and so on, therefore resulting in corrosion or deterioration of them. And ingress of such cutting fluid into the CNC, motor, or amplifier can cause corrosion of copper, silver, and so on used as parts' materials, therefore resulting in parts' failures.

- Synthetic cutting fluid with high permeability
  Some synthetic type cutting fluids that use polyalkylene glycol (PAG) as a lubricant have extremely high permeability. Such cutting fluid can easily penetrate into the motor even if the motor is sealed well. Ingress of such cutting fluid into the CNC, motor, or amplifier can degrade insulation or lead to parts' failures.

- Highly alkaline, water-soluble cutting fluid
  Some cutting fluids that strengthen pH by alkanolamine show strong alkalinity of pH10 or higher when diluted to the standard level. Ingress of such cutting fluid into the CNC, motor, or amplifier can cause chemical reaction with plastic and so on and deteriorate them.

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3 MOTOR INSTALLATION

This chapter describes how to install the FANUC AC spindle motor β*i* series.

This chapter, "MOTOR INSTALLATION", consists of the following sections:

3.1 WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A BELT 106
3.2 WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A GEAR..... 108
3.3 WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A COUPLING..... 109

3.1 WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A BELT

⚠ CAUTION

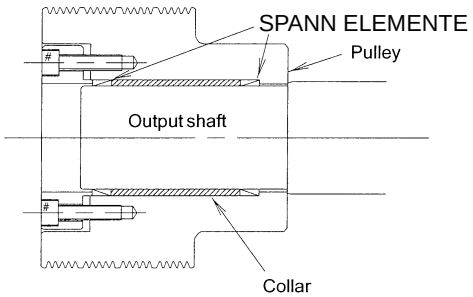
1 Mounting the pulley

- The gap between the inner surface of the motor pulley and output shaft should be 10μm to 15μm.
- If the gap is large during the high-speed rotation (4500 min^{-1}), fretting produced at the gap causes a large vibration, resulting in damage to the motor bearing.
- As the vibration is intensified, fretting occurs in the gap mentioned above, and the pulley and shaft can stick to each other.
- To secure a pulley, use a friction-tightening part such as a SPANN ELEMENTE or clamping sleeve.

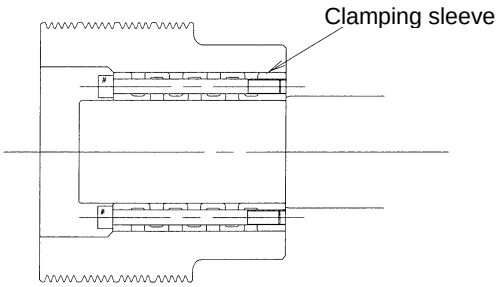
NOTE

The SPANN ELEMENTE RfN8006 is manufactured by RINGFEDER.
The clamping sleeve DSM is manufactured by SPIETH.

Example 1 Two sets of SPANN ELEMENTE RfN8006 are used.
The collar is pinched at two points by the two sets.



Example 2 Clamping sleeve DSM is used.



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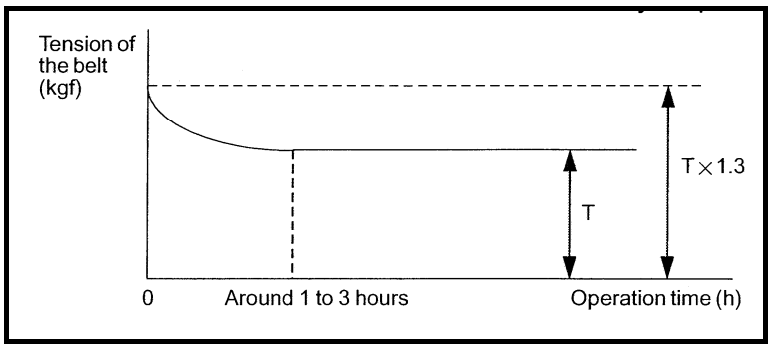
2 After attaching a pulley to the motor, adjust the runout of the belt groove to within 20 μm (T.I.R).

3 Before the belt is looped, FANUC recommends that the dynamic balance (field balance) be corrected.

4 Limit the radial load applied to the motor output shaft by the tension of the belt to the allowable value described in the manual for each series. If the allowable value is exceeded, the bearing or shaft may fail prematurely.

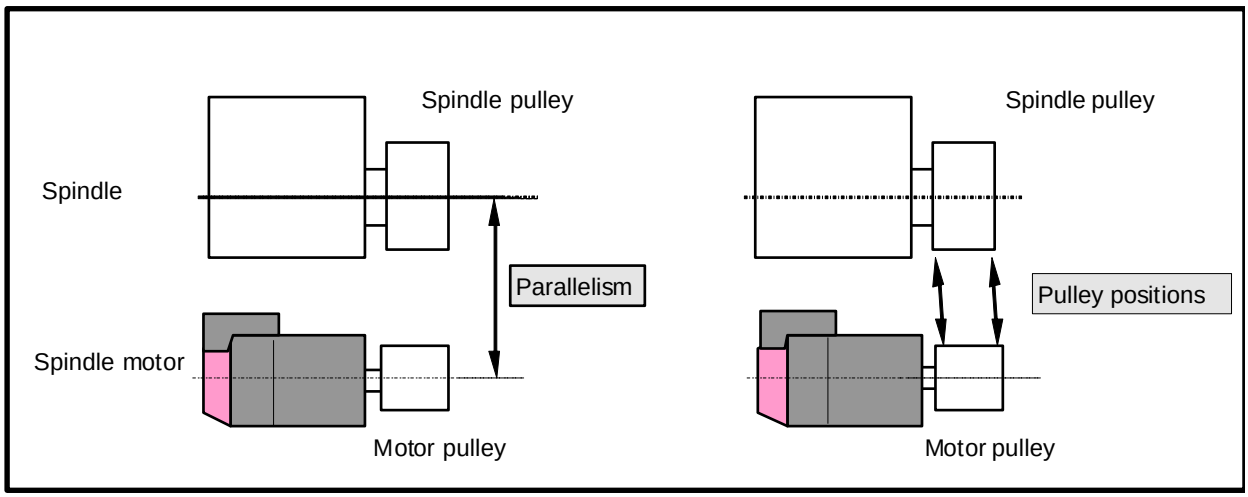
5 The tension of the belt is reduced as a result of abrasion during the initial several hours of operation. To transfer torque normally after this reduction in tension, the initial tension before operation should be set to a value 1.3 times the actually required tension T.



Recommended belts:
Ribace manufactured by BANDO.
Ribstar manufactured by MITSUBOSHI.

6 Use an appropriate tension gage to tension the belt.
Examples
Sonic type:
U-305 series manufactured by UNITTA.
CLAVIS belt tension meter by IDS (UK)

7 Reduce the deviation between the positions of the motor and machine pulleys in the shaft direction as much as possible and ensure that the center lines of the shafts are as parallel as possible.



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Example of belt design

Design must be made so that the static axial load by a belt that was subject to initial wear does not exceed the allowable radial load for each model. (A new belt is subject to initial wear after several hours of operation and the static axial load becomes equal to that for the restretched belt in the following table.)

NOTE

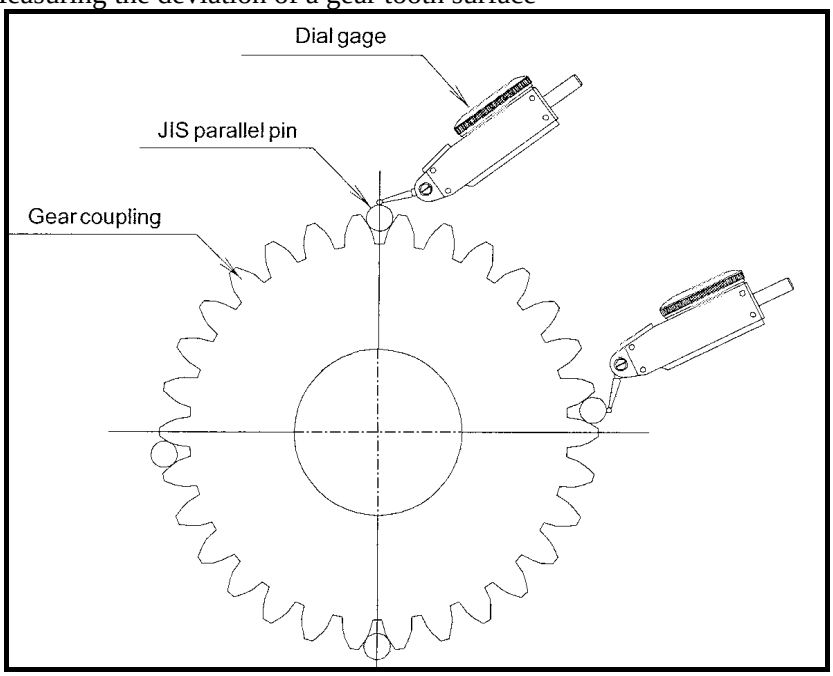
1 Prevent oil or dust from entering between the belt and the pulley. Otherwise, the belt may slip.
2 If the allowable radial load is exceeded, reduce the load by using support bearings on the machine side or directly connecting to the machine in order to secure reliability for an extended period of time.

3.2 WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A GEAR

⚠ CAUTION

1 Do not use a helical gear which applies a load in the motor axial direction.

2 To prevent unusual gear sounds, apply the following precautions:
(1) The deviation of the gear tooth surface should indicate the proper value.
(Tip) Measuring the deviation of a gear tooth surface



(2) The correct backlash should be provided.
(3) The perpendicularity of the motor flange mounting surface to the machine shaft should indicate the proper value.

3 Mount the motor on the machine so that the vibration acceleration is 49 m/s^2 (5G) or less when it is measured using the method described in CAUTION 5 of Section 3.1, “COMMON”.

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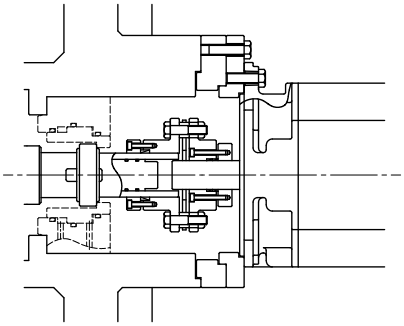
3.3 WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A COUPLING

⚠ CAUTION

1 When connecting the spindle and motor shaft, be sure to use a flexible coupling.
(Flexible coupling examples)
- Diaphragm coupling (EAGLE INDUSTRY CO., LTD.)
- Oldham's coupling
- Gear coupling (MIKI PULLEY)



Example of disk coupling

Flexible coupling has three tolerances of degree of freedom: radial, angular, and axial displacement. This enables coupling with less vibration and less noise to achieve high-speed rotation.
- Tolerances of radial and angular displacement: Slight radial and angular displacement that could not be absorbed by centering are absorbed.
- Tolerance of axial displacement: Extension of the spindle and motor shaft due to temperature increase is absorbed.

(Caution)
- These tolerances are criteria for preventing the coupling from being damaged, not criteria for preventing load from being applied to the spindle and motor bearings. Therefore, to perform rotation with low vibration and low noise before high-speed rotation is achieved, the spindle and motor shaft must be centered.
- FANUC has confirmed that with a coupling (disk coupling) that permits only the degrees of freedom of angular and axial displacement, rotation can take place properly if centering has been performed with a concentricity of 5 μm.

2 It is important to perform centering and obtain parallelism to avoid having to recourse to the flexibility of the coupling.
At high speeds, any radial displacement may cause the bearing to fail prematurely.

3 Check all machines before shipping to confirm that the vibration acceleration is 4. m/s^2 (0.5G) or less when measured using the method described in CAUTION 5 of Section 2.1, “COMMON”.

4 Set the torsional rigidity of the coupling to an appropriate high value. If the torsional rigidity is low, vibration may be produced during orientation.

5 When attaching the coupling to the motor shaft, never use a hammer or the like; otherwise, impact load is applied to the bearing.

6. When the motor shaft and the spindle are to be connected via a coupling, the motor shaft may remain pressed inside the motor when the motor shaft is inserted into the spindle. (Caution is required particularly for Oldham's coupling which requires large thrust force to be engaged.)

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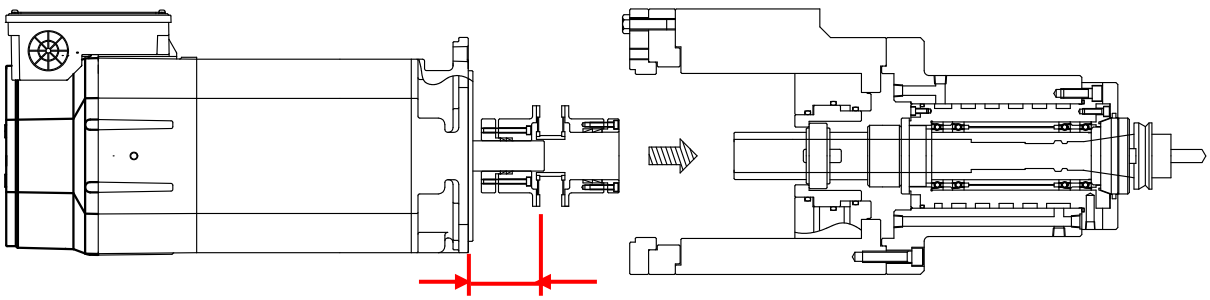
With the motor shaft remaining pressed inside the motor, the precompression load of the built-in bearing of the motor may be lost or become excessive, possibly causing the bearing to be defective. After connection via a coupling, check that the motor shaft does not remain pressed inside the motor.

NOTE

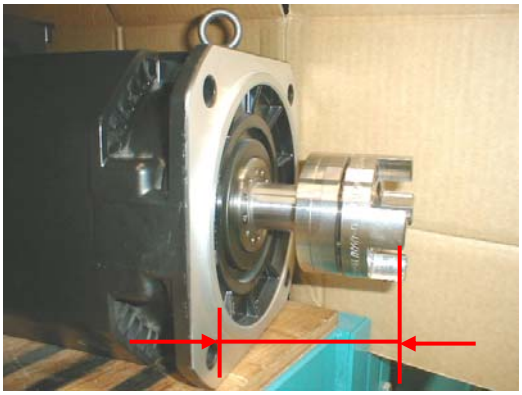
1 **Examples of how to check that the motor shaft does not remain pressed inside the motor**
- After connection via a coupling, check that the axis direction dimension (total length) of the coupling itself is correct.
  * In some cases, if the motor shaft is not inserted correctly, the total length may be longer than the normal dimension.
- Before inserting the coupling, measure the distance between the coupling and a datum plane of the motor (such as the inside low end), and check that the distance does not change after insertion.
  Alternatively, prepare a datum plane on the machine side to facilitate measurement inside the coupling box, check the positional relation between the datum plane of the motor and the datum plane on the machine side first, and then check the position of the coupling from the datum plane on the machine side.

2 **If the motor shaft remains pressed inside the motor**
- Mount a coupling or the like to the motor shaft and pull the coupling to bring the motor shaft back to the original position.

(Reference)



(Example) For a solid shaft motor



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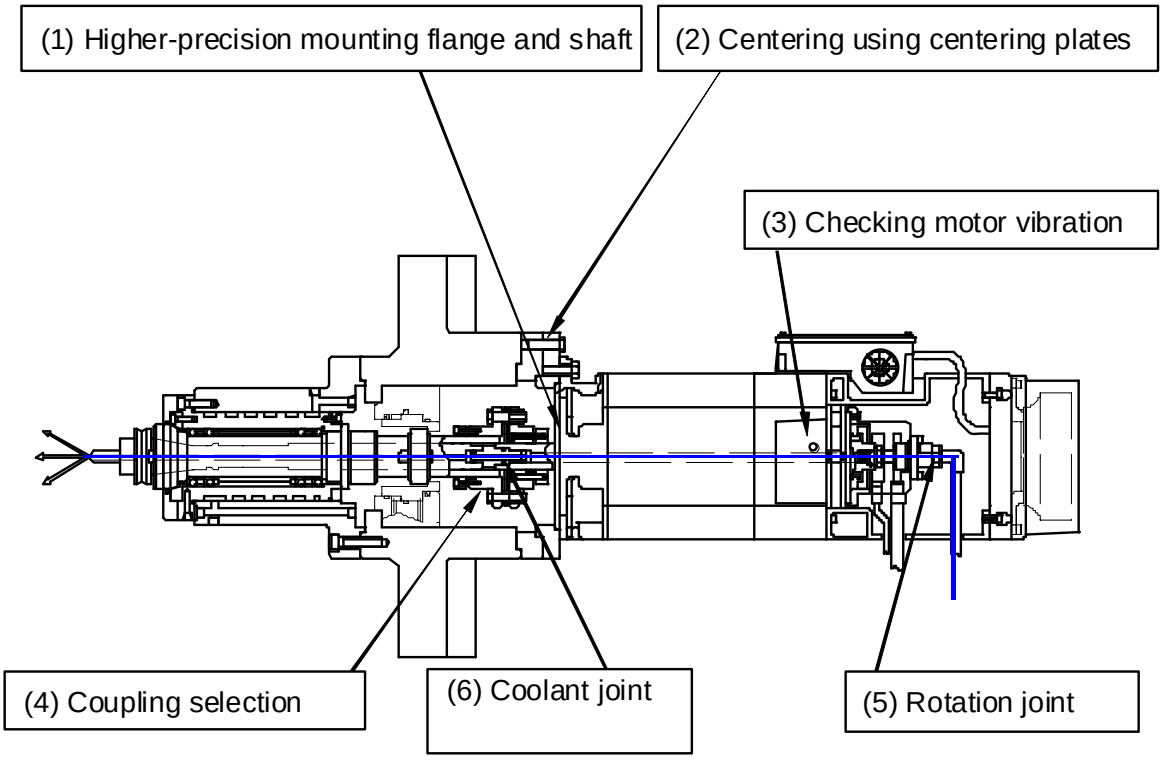
3.3.1 Points about the Direct Connection Structure of Spindle Motors with a Through Hole

If the motor shaft and spindle are not centered precisely when the spindle motor with a through hole (βiIT series, etc.) is directly connected to the spindle, fretting can occur with the motor shaft in a short-time operation, or the bearing of the motor can be damaged because of vibration occurring at the joint. Six important points for high-speed rotation with low vibration in a direct motor connection structure are described below.



Higher-precision mounting flange and shaft

With high-precision and low-vibration specification motors, and βiIT series motors, a mounting flange and shaft are assembled with higher precision for direct connection with the spindle.
For details, see the assembling accuracy list corresponding to each motor.

Centering using centering plates

When connecting the spindle with the motor shaft, make centering with a target concentricity of 5μm.
If centering accuracy measurement is difficult, the use of mounting plates for centering (called centering plates below) between the spindle head and motor is recommended. The MTB is requested to prepare centering plates.
When making centering plates, produce a socket and spigot joint on both sides with a target concentricity of 5 μm or less for the spigot joint and inner surface and with a target parallelism of 20 μm or less for both sides.
For centering, it is advisable to prepare a stand and orient the spindle upward.

1. When one centering plate is used

First, attach the centering plate to the spindle head and center the spindle with the inner surface of the centering plate.
Then, position the centering plate by putting a taper pin (with a diameter of about 8 to 10) on the spindle head.

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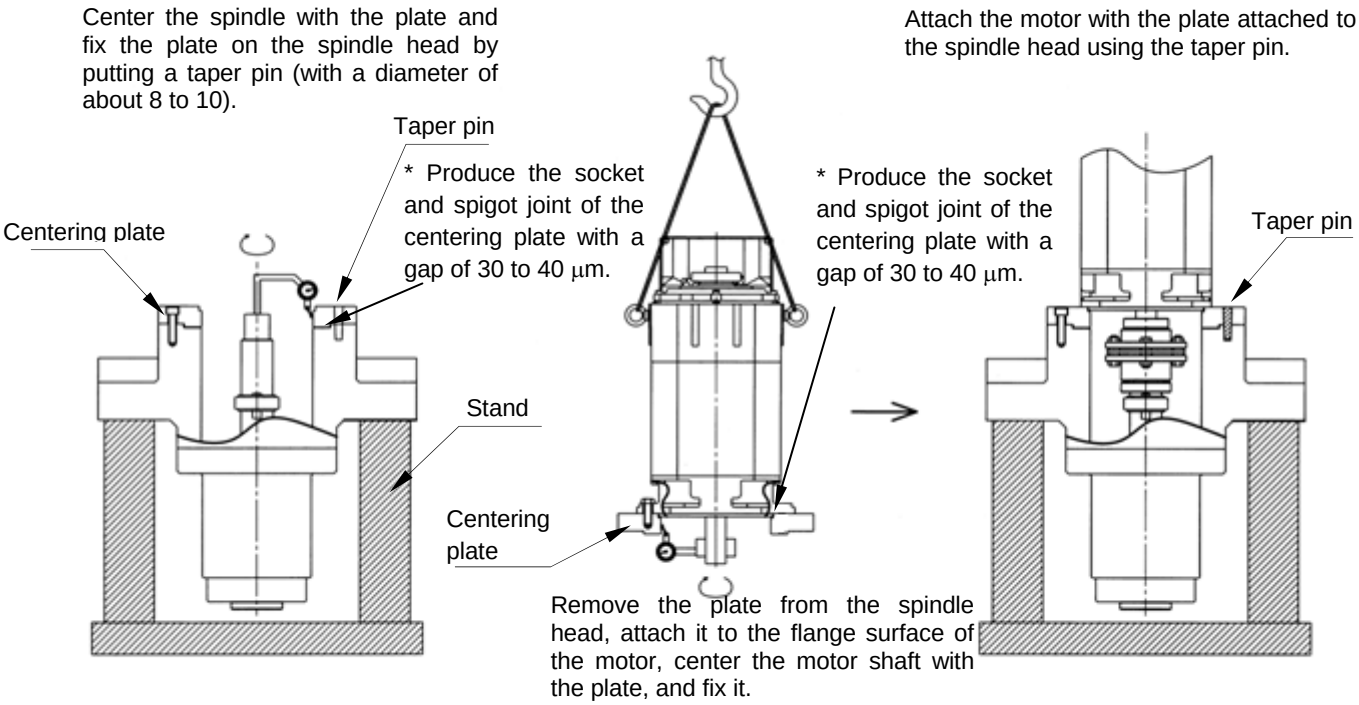
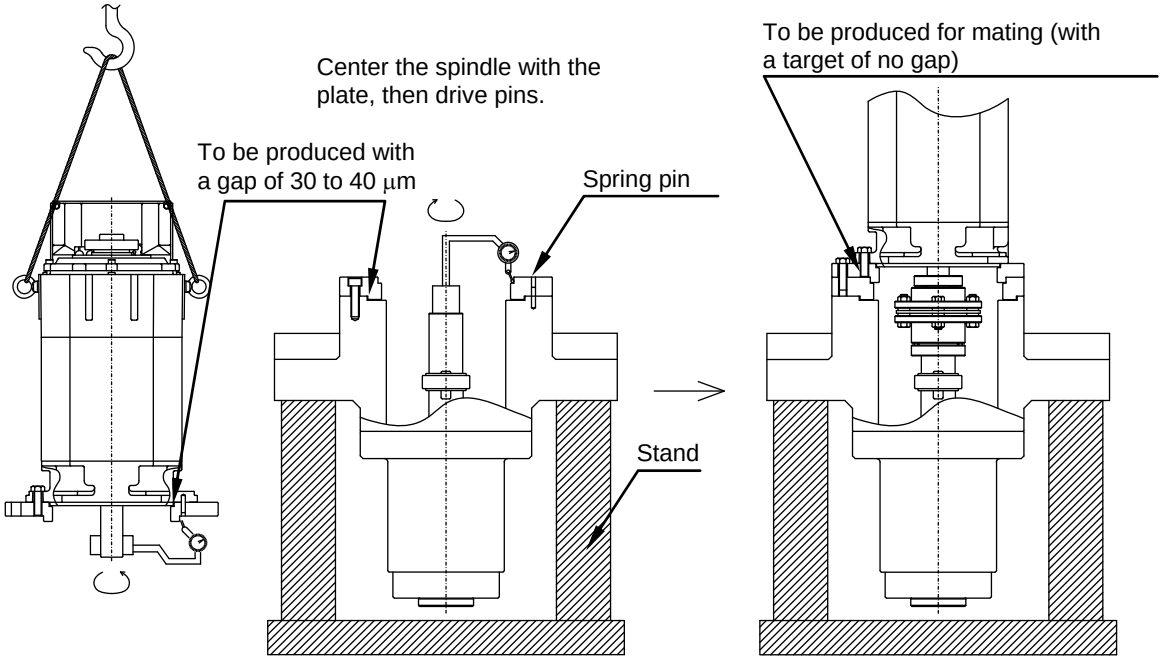
Then, remove the centering plate from the spindle head, attach it to the flange surface of the motor, center the motor shaft with the inner surface of the centering plate, and fix it.
Finally, attach the motor with the centering plate attached to the spindle head using the taper pin.



2. When two centering plates are used

Prepare two centering plates: one for the motor and the other for the spindle head. Mate the socket and spigot joints of the plates (with a target of no gap). After centering of the plate for the motor with the motor shaft, center the plate for the spindle head with the spindle. Then, attach the motor with the plate to the plate for the spindle head.



* This centering structure allows high-precision installation even in the case of motor replacement in the field.

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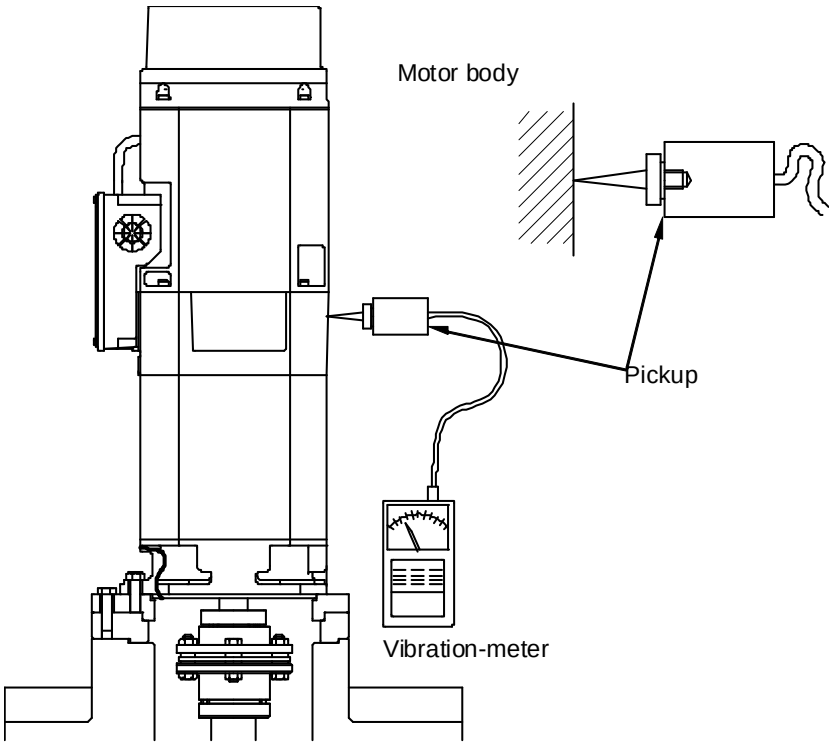
Checking motor vibration (to see whether centering is successful)

To check whether the spindle is centered with the motor successfully, measure the vibration acceleration of the motor.
Center the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 4.9 m/s^2 (0.5G) at maximum speed.
(Frequency range: 10 to 1000 Hz)
Before shipping machines, check that the vibration acceleration is 4.9 m/s^2 (0.5G) or less for all motors.

Method of motor vibration measurement



Recommended vibration-meter

The following vibration-meter is recommended:

Name : SmartVibro
Model : VM-3024S
Manufacturer : IMVCORPORATION
Setting : The frequency range is fixed to 10 to 1000 Hz, so that this vibration-meter is suitable for the measurement of motor rotation components.
Select EQP (equivalent peak value) for Calculation setting.

An equivalent of the above vibration-meter, for example, the following vibration-meter is also available:

Name : Vibration Analyzer
Model : VA-12
Manufacturer : RION Co., Ltd.
Setting : Set 10 Hz for the high-pass filter and 1 kHz for the low-pass filter to make the vibration-meter suit for the measurement of motor rotation components.
This vibration-meter can display only m/s^2 (RMS) as the acceleration unit, so it is necessary to convert the value to m/s^2 (EQP). (To convert the RMS value to the EQP value, multiply the measurement value by $\sqrt{2}$.)

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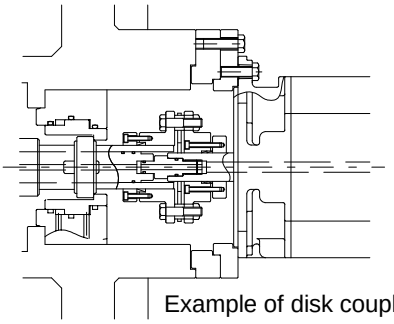
Coupling selection

1. If a thrust load is applied on a motor shaft, the shaft moves in the direction of the thrust. So, it is necessary to select a coupling which does not apply a thrust load on motor shaft (at the time of connecting, with increasing temperature and so on). For that reason, be sure to use a flexible coupling for connecting the spindle and motor shaft.
   (Flexible coupling examples)
   - Diaphragm coupling (EAGLE INDUSTRY CO., LTD.)
   - Oldham's coupling
   - Gear coupling (MIKI PULLEY)



Example of disk coupling

   Flexible coupling has three tolerances of degree of freedom: eccentricity, declination, and axial displacement. This enables coupling with less vibration and less noise to achieve high-speed rotation.
   - Tolerances of eccentricity and declination: Slight eccentricity and declination that could not be absorbed by centering are absorbed.
   - Tolerance of axial displacement: Extension of the spindle and motor shaft due to temperature increase is absorbed.

   (Caution)
   - These tolerances are criteria for preventing the coupling from being damaged, not criteria for preventing load from being applied to the spindle and motor bearings. Therefore, to perform rotation with low vibration and low noise before high-speed rotation is achieved, the spindle and motor shaft must be centered.
   - FANUC has confirmed that with a coupling (disk coupling) that permits only the degrees of freedom of declination and axial displacement, rotation can take place properly if centering has been performed with a concentricity of 5 μm.

2 It is important to perform centering and obtain parallelism to avoid having to recourse to the flexibility of the coupling.
   At high speeds, any eccentricity may cause the bearing to fail prematurely.

3 Use a coupling in which thrust load is not applied to the motor shaft by, for example, an increased temperature, cutting operation, or coolant pressure.

4 Set the torsional rigidity of the coupling to an appropriate high value. If the torsional rigidity is low, vibration may be produced during orientation.

5 When attaching the coupling to the motor shaft, never use a hammer or the like; otherwise, impact load is applied to the bearing.

6 After a motor shaft is inserted into spindle for connecting spindle and a motor shaft with a coupling, a motor shaft may remain pushed inside the motor. (Caution is required particularly for Oldham's coupling which requires large thrust force to be engaged.)
   If motor is driven with motor shaft pushed inside the motor, pressure of motor bearings may be too much or too low, and the bearing may be broken.
   Please check whether or not motor shaft is pushed inside the motor after connecting the spindle and a motor shaft with a coupling.

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NOTE

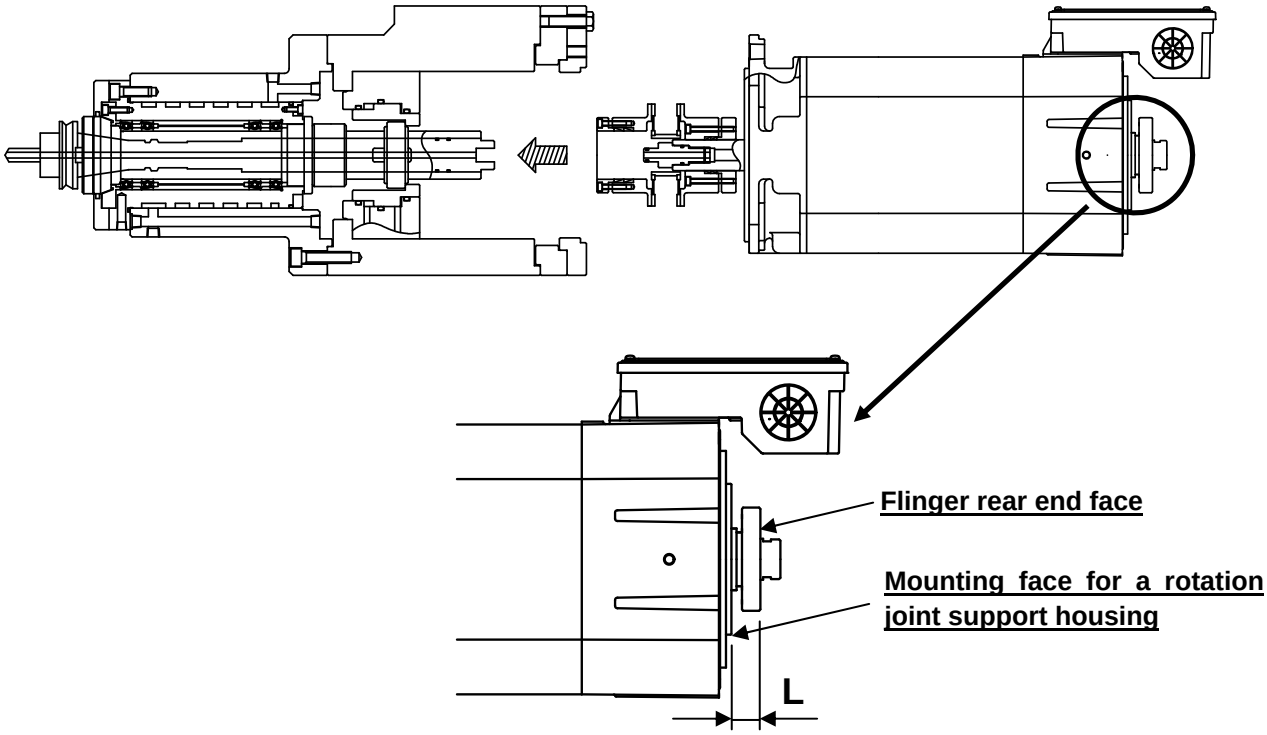
1 **How to check whether or not motor shaft is pushed inside the motor**

- When the motor shaft is inserted into the spindle to connect the motor shaft and spindle using a coupling, the motor shaft may remain pushed inside the motor. So, measure the distance (L in the figure below) between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.
- Check whether or not the axial length of the coupling (full length) is correct after connecting the spindle and a motor shaft with coupling.
  * The axial length of the coupling may be longer than normal length if connection of a coupling is not correct.

2 **If the motor shaft remains pressed inside the motor**

- The motor shaft of a spindle motor with a through hole protrudes from the rear side of the motor. Push the motor shaft back to the original position.

(Reference)



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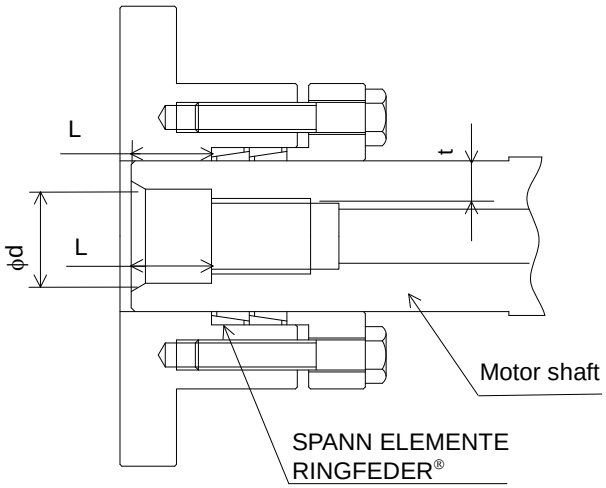
NOTE

Select SPANN ELEMENTE that can withstand a torque 3.3 times greater than the S3 rated torque to protect against slippage in intermittent cutting.
As shown below, provide a space of L mm or more between the SPANN ELEMENTE and the tip of the motor shaft.

See the example of SPANN ELEMENTE selection shown below. For the method of calculation and the location of fastening to the motor shaft, contact the following company:
TAKEDA TRADE CO., LTD. (RINGFEDER®)



Model	βiIT 12/10000 βiIT 15/8000
ϕ d	$\phi 20^{+0.021}_{-0}$
L	17

An example of SPANN ELEMENTE selection for the model βiIT 12/10000 is given below.

[Example of selection]

Condition 1: Two sets of SPANN ELEMENTE RfN8006 48 × 55 (inner diameter × outer diameter) are used.
Condition 2: Four M8 bolts (strength class: 12.9) are tightened by a tightening torque of 40 [N·m].

↓

Surface pressure P (120.4 [N/mm^2]) is produced on the motor shaft, and torque T (449.7 [N·m]) becomes transferable.

↓

Checking transferable torque T
[Check]: Transferable torque T ≥ 3.3 times maximum torque at motor acceleration time
The maximum rated torque of the model βiIT 12/10000 is 118 [N·m]. Accordingly, the following transferable torque is obtained:
449.7 ≥ 3.3 × 118

↓

From the produced surface pressure P and the transferable torque T, check stress σ applied onto the motor shaft.
[Check]: Stress σ applied onto the motor shaft ≤ Motor shaft yield point (350 [N/mm^2])
From the produced surface pressure P (120.4 [N/mm^2]) and the transferable torque (449.7 [N·m]), stress σ applied onto the motor shaft is calculated as σ = 326 [N/mm^2]. Accordingly, the following is obtained:
326 ≤ 350

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Rotation joint

When coolant is flown through the through hole of the motor shaft, a coolant pressure acts on the end face of the coolant joint attached to the shaft front end, thus producing a thrust load that pushes the motor shaft backward.
If a rotation joint of separate external support type is attached to the motor shaft rear end, a coolant pressure acts also on the rotation joint to push the motor shaft forward, and therefore the thrust load can be canceled.
(To use a rotation joint of other than the separate external support type, consult with FANUC.)

The αiIT series is designed assuming that a rotation joint indicated in the table below is attached to the shaft rear end:
Rotation joints of separate external support type manufactured by Deublin or Rix.

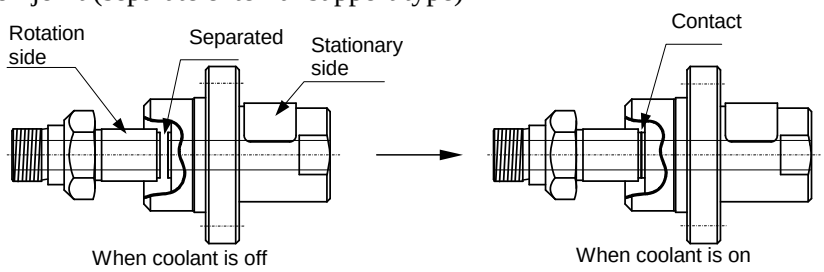
Motor model	βiIT 12/10000, βiIT 15/8000	
Mounting screw size	M16 × 1.5 (left-hand screw)	
Piping direction	Straight type	Elbow type
Specification of Deublin (Caution)	1129-036-301	1129-033-301
Specification of Rix (Caution)	ESX20M-S016	ESX20M-E016
Function	Spindle-through coolant during rotation or stopping Air-through during stopping (Air-through disabled during rotation)	

⚠ CAUTION
For selecting a rotation joint, if the coolant through frequency is high during the tact time when the rotation joint is used on a dedicated machine or line machine, be sure to consult with the rotation joint manufacturer.
Deublin provides rotation joints for a dedicated machine and line machine.
Contact Deublin.

NOTE
Inquire the following of the rotation joint manufacturer:
- Details of features of the rotation joint and its installation
- Type for enabling air-through during rotation

For rotation joints and support housings, contact:
Deublin Japan Ltd.
Rotation Joint Div., RIX CORPORATION Co., LTD.

Example of rotation joint (separate external support type)



* Before attaching a rotation joint to the motor shaft, apply screw locking adhesive.

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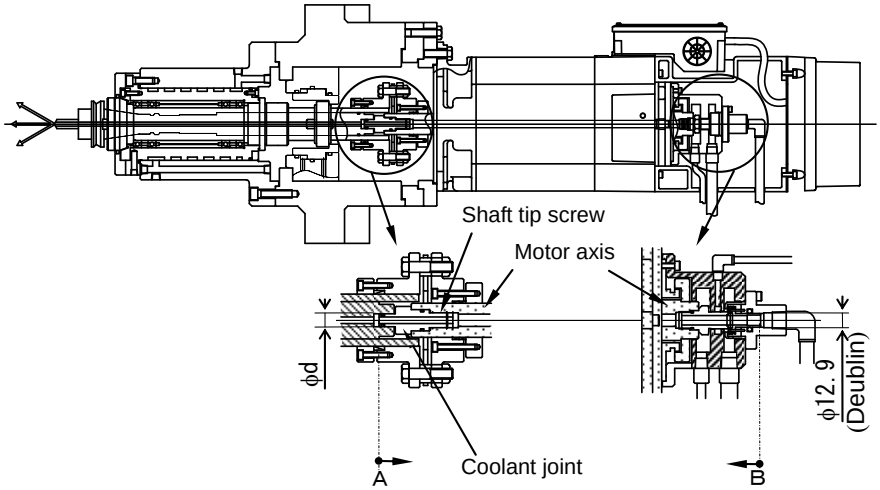
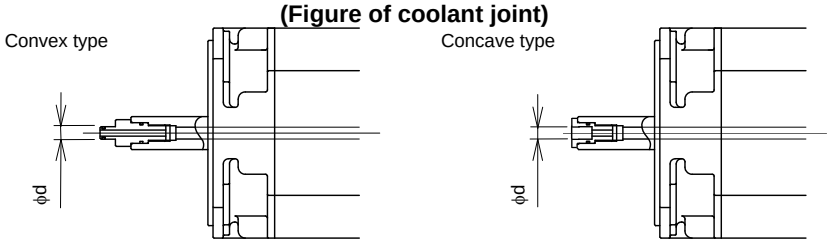
COOLANT JOINT

The machine tool builder is to prepare the following coolant joint:



(Figure of coolant joint)



* • When installing the coolant joint, apply thread-locking adhesive to the joint, and be sure to use the screw used at the end of the motor axis.
• Press the coolant joint against the axis end face.

(1) When center-through coolant is used, thrust load due to coolant is applied between the spindle and motor and between the motor and rotation joint. The motor can be made stable without affecting impacts such as pulsation of the coolant pump by setting a slightly larger thrust load in direction B in the above figure than a thrust load in direction A.

(2) When a recommended rotation joint is used, the pressure reception diameter on the rotation joint side is 12.9 (Deublin) or 12.6 (Rix). So, ensure that the pressure reception diameter (ϕd) on the side of a coolant joint attached to the motor shaft tip follows the table below.
* When the coolant pressure is 70 kgf/cm^2 or less (For a coolant pressure of more than 70 kgf/cm^2, consult with FANUC.)

Motor model	Manufacturer	Rotation joint specification	Pressure reception diameter ϕd on coolant joint side	Shaft tip screw size
βiIT 12/10000, βiIT 15/8000	Deublin	1129-036-301 1129-033-301	ϕ12.0	M16
	Rix	ESX20M-S016 ESX20M-E016	ϕ11.7	

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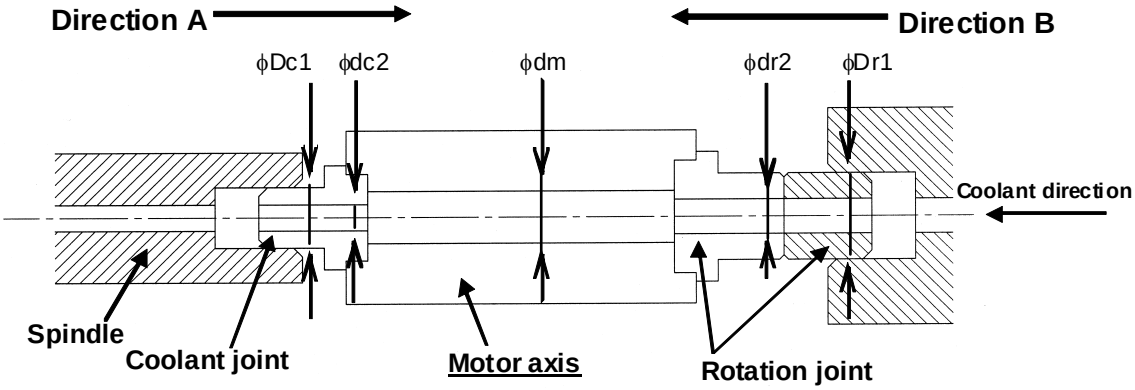
(3) Concept of thrust load applied to the motor



<1> In the above figure, calculate the thrust load applied to the motor.
Coolant pressure: P
Outside diameter of coolant joint: ϕDc1, outside area: Sc1
Inside diameter of coolant joint: ϕdc2, inside area: Sc2
Inside diameter of motor axis: ϕdm, inside area: Sm
Outside diameter of rotation joint: ϕDr1, outside area: Sr1
Inside diameter of rotation joint: ϕdr2, inside area: Sr2

- Thrust load applied to the motor in direction A: F_A=P(Sc1-Sc2)+P(Sm-Sr2)
- Thrust load applied to the motor in direction B: F_B=P(Sr1-Sr2)+P(Sm-Sc2)
- Total thrust load applied to the motor:
  $F=F_B-F_A$= P(Sr1-Sr2)+P(Sm-Sc2)-(P(Sc1-Sc2)+P(Sm-Sr2))
  =P(Sr1-Sc1)=P(π(ϕDr1)^2/4-π (ϕDc1)^2/4)

Therefore, only the coolant pressure, the outside diameter of the rotation joint (ϕDr1), and the outside diameter of the coolant joint (ϕDc1) are related to the calculation of the thrust load applied to the motor.

<2> Example for calculating the thrust load
Assume that the coolant pressure is 70 kgf/cm^2, the pressure reception diameter is ϕDc1=ϕ12.
Also assume that the rotation joint is manufactured by Deublin (ϕDr1=ϕ12.9).
The thrust load applied to the motor is then calculated as follows:
F=70kgf/cm^2×(1.31cm^2 (ϕ12.9)- 1.13cm^2(ϕ12))= 12.6 kgf
A thrust load of 12.6 kgf is applied in such a direction that it presses the motor shaft forward.

(4) Allowable thrust load on the motor (in the direction in which the motor shaft is pressed forward)

Motor model	Allowable thrust load
β*i*IT 12/10000, β*i*IT 15/8000	127N (13kgf)

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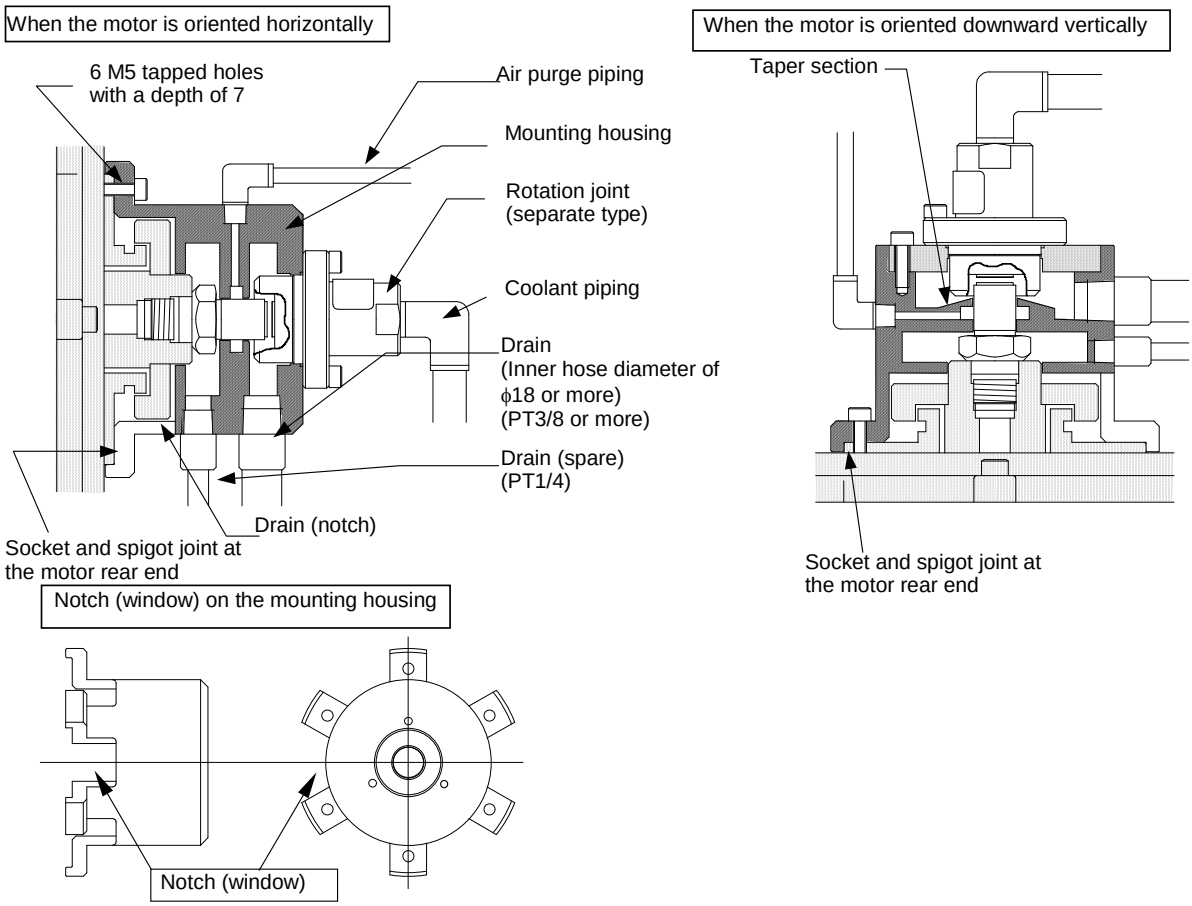
Rotation joint support housing

The machine tool builder is to prepare a rotation joint support housing. To secure a housing, use a socket and spigot joint and six M5 tapped holes at the motor rear end. Prepare six M5 bolts to secure a housing.
When a rotation joint of separate external support type is used, cutting fluid leaks from the sealing section (contact section between the stationary side and rotation side). So, be sure to provide a drain on the housing for the rotation joint. A drain of PT3/8 or more is required, and a hose with an inner diameter of ϕ12 mm or more is required.
(To determine the final figure of a drain, be sure to contact the manufacturer of a rotation joint.)
A housing of labyrinth structure for preventing cutting fluid from penetrating into the inside of the motor is required. Particularly when the motor is oriented downward vertically, enhance drainage by means such as air purging.
When the rotation joint is damaged, a large amount of cutting fluid can leak. So, provide many notches on the housing. Moreover, attach a flow rate sensor to the drain to perform periodic flow rate management. For details, refer to the specifications of each rotation joint.

(Example of rotation joint support housing)



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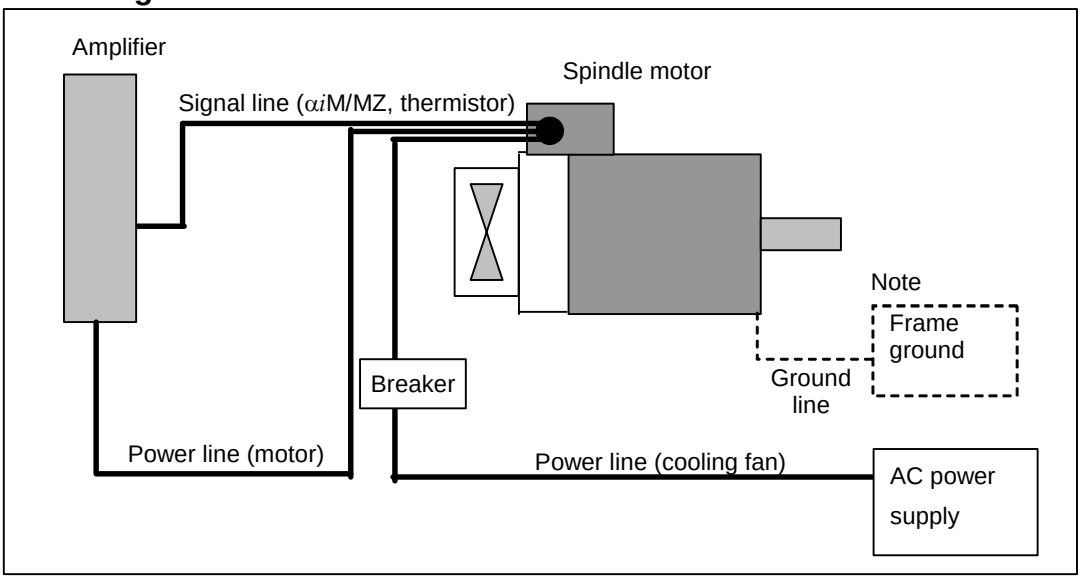
4 CONNECTING A SPINDLE MOTOR

4.1 CONNECTING A SPINDLE MOTOR

The FANUC AC spindle motor β*i* series requires that the power line of the motor and the signal line of the detector be connected to the amplifier. The cooling fan must also be connected to the prescribed power supply.

Connection diagram



* For the βiIc series, only the thermistor signal line is to be connected.

> ⚠ **CAUTION**
> If a motor is not connected to ground through the machine (cabinet) in which the motor is installed, connect the motor grounding point and the amplifier grounding point to absorb noise. In this case, use a wire with a thickness of at least 1.25 mm^2, other than the GND conductor in the power line. Keep the wire as far from the power line as possible.

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4.1.1 Connection of Power Line

Cables for power line and fan motor are connected to the terminal block.

Size of screws used in the terminal block / Model	Power line	Fan motor
	U,V,W,G	FMU,FMV,FMW
βiI 3/12000 to βiI 15/8000 βiI 6/12000HV to βiI 12/10000HV βiIP 12/6000 to βiIP 30/8000 βiIT 12/10000, βiIT 15/8000 βiIC 3/6000 to βiIC 8/6000	M5	Screw-less terminal block
βiIP 40/6000	M6	Screw-less terminal block

For an explanation of the arrangement of the power terminals on the spindle motor side, see Section 3.3, "EXTERNAL DIMENSIONS", in Part I.

(1) Cable for the power lead

For the power lead cable specification, refer to "FANUC SERVO AMPLIFIER αi-B series DESCRIPTIONS (B-65412EN)" or "FANUC SERVO AMPLIFIER βi-B series DESCRIPTIONS (B-65422EN)".
FANUC recommends the following cables with a small cable diameter:

LMFC power lead: Fire-retardant Polyflex power cable (Heat resistance: 105°C)
Flonlex power lead: Manufactured by HITACHI CABLE, Ltd. (Heat resistance: 200°C)
FLUBON WIRE: Manufactured by KURABE (Heat resistance: 200°C)

(2) Cable for the fan motor

For the current values and cable specifications of the fan motor, see Subsection 3.4.2, "Cooling Fan Connection" in Part I in this manual. For the breaker, refer to "FANUC SERVO AMPLIFIER αi-B series DESCRIPTIONS (B-65412EN)" or "FANUC SERVO AMPLIFIER βi-B series DESCRIPTIONS (B-65422EN)".

(3) Connection of power leads to the terminal block

⚠ WARNING

To attach the power leads to the terminal, follow the procedure described in this section to make connections with specified torque. Driving a motor with terminals loosened could result in the terminal board overheating and causing a fire. In addition, it may remove terminal to cause a ground fault, short circuit, or electric shock.

⚠ CAUTION

When attaching the power leads to the terminal block of a motor, tighten the screws with torque specified in the table.

Terminal size	Tightening torque [N·m]
M5	2.0 to 2.5
M6	3.5 to 4.5

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4.1.2 Connection of Signal Lead

The αiM sensor or αiMZ sensor signal or thermistor signal use a connector manufactured by Tyco Electronics AMP. The connector housing and the connector are attached in the terminal box.

(1) Connector attachment for a motor with a built-in αiM/αiMZ sensor

For the signal connectors, see Section 4.3 "CONNECTION" in Part I.

(2) Thermistor specifications

The signal names THR1 and THR2 are those of the two terminals of the thermistor.
The resistance value at room temperature (20°C to 30°C) is about 30 to 90 kΩ.

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5 NOTES ON OPERATION

⚠ WARNING

1 When supplying voltage to the spindle motor or the fan motor, ensure that the earth cable is connected to the earth terminal and secure that the spindle motor is put to earth certainly. In addition, be sure to check that the power cable is secured to the terminal block.

⚠ CAUTION

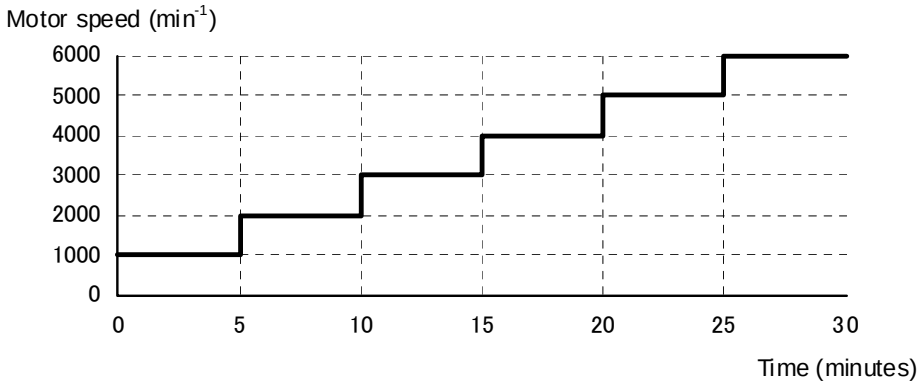
1 Sound and vibration
Check that there is no abnormal sound or vibration.

2 Cooling
Clean off dust from the cooling air inlet and outlet of the stator every year, and check the flow of air carefully. The table given below indicates the direction of the rotation of the cooling fan when viewed from the rear side of the motor. Check that the actual rotating direction is correct.

Model names	Rear exhaust (Exhaust on side opposite to load axis)	Front exhaust (Exhaust on load axis side)
All models	Counterclockwise (CCW)	Clockwise (CW)

NOTE

1 When a motor is driven for the first time, after a motor has been stored for a long time, or after the machine is moved or transported, be sure to break in the motor. As break-in, increase the speed of the motor from 1000 min^{-1} to its maximum speed in 1000 min^{-1} increments, and operate the motor at each speed for about 5 minutes.
Grease is filled in motor bearings for lubrication. In a motor in the initial status or motor after stored for a long time, the grease is not filled uniformly in bearings. The use of the motor without break-in may cause unusual sound, vibration, or premature bearing damage.



Break-in driving pattern

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APPENDIX

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A PARAMETER TABLE FOR EACH MOTOR MODEL

For FANUC spindle motors, each model has specific drive parameters predetermined for it.
Use caution because if a motor is driven with other than the prescribed parameters, this will cause the motor to be defective.

A.1 SPINDLE MOTOR βiI series 128
A.2 SPINDLE MOTOR βiIP series 129
A.3 SPINDLE MOTOR βiIC series 131

For an explanation of any matters that are not contained in this document, refer to the descriptions below.

FANUC AC SPINDLE MOTOR αi series,
FANUC AC SPINDLE MOTOR βi series,
FANUC BUILT-IN SPINDLE MOTOR Bi series
PARAMETER MANUAL (B-65280EN)

NOTE

1 The parameter tables contain two CNC models, FS30*i* and FS0*i*-F, as representatives.
For an explanation of the parameter numbers for those models that are not contained here, refer to the Parameter Manual (B-65280EN).
2 For those models for which no parameter tables are provided, such as models under development, contact a FANUC service representative.

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A.1 SPINDLE MOTOR βiI series

Motor model	βiI 8/12000	βiI 8/12000	βiI 8/12000HV	βiI 12/10000HV
Specification	1446	1446	1546	1547
Applicable amplifier	βiSVSP*-15-B αiSP 15-B	βiSVSP*-18-B αiSP 22-B	βiSVSP*-15HV-B αiSP 15HV-B	βiSVSP*-18HV-B αiSP 22HV-B
Model code	–	–	–	–
S1 continuous rated output	7.5kW 2000/12000min^{-1}	7.5kW 2000/12000min^{-1}	7.5kW 2000/12000min^{-1}	11kW 2000/10000min^{-1}
S2 15 min rated output	11kW 1500/12000min^{-1}	11kW 1500/12000min^{-1}	11kW 1500/12000min^{-1}	15kW 1500/10000min^{-1}
4007	00000000	←	00000000	00000000
4008	00000000	←	00010000	00010000
4009	00000000	←	00000000	00000000
4010	00000000	←	00000001	00000001
4011	00011010	←	00001010	00001010
4012	10000010	←	10000010	10000010
4013	00001100	←	00001100	00001100
4019	00000100	←	00000100	00000100
4020	12000	←	12000	10000
4023		←		
4039	0	←	0	0
4040	3(*1)	←	3(*1)	3(*1)
4041		←		
4048	12(*1)	←	12(*1)	15(*1)
4049		←		
4080	16730	←	14163	13156
4083	30	←	30	30
4093		←		
4100	1680	←	1650	1578
4101	95	←	82	80
4102	2602	←	1999	1712
4103	0	←	0	0
4104	4300	←	7000	7000
4105	0	←	107	129
4106	10000	←	13500	14500
4107	0	←	0	0
4108	0	←	0	0
4109	25	←	25	25
4110	1331	1775	1371	1371
4111	532	←	443	453
4112	200	←	200	200
4113	714	←	870	741
4114	0	←	0	20480
4115	100	←	100	100
4116	8000	←	5700	6500
4117	23130	←	90	90
4118	100	←	100	100
4119	13	←	11	13
4120	0	←	0	0
4124	0	←	0	0
4127	220	←	220	185
4128	110	←	103	105
4129	0	←	0	0
4130	25700	←	25700	25700
4134	110	←	130	130
4136	0	←	0	0
4138	0	←	0	0
4139	0	←	0	0
4140	0	←	0	0
4141	0	←	0	0
4142	0	←	0	0
4143	0	←	0	0
4144	0	←	0	0
4145	0	←	0	0
4146	0	←	0	0
4147	0	←	0	0
4148	0	←	0	0
4149	0	←	0	0
4150	0	←	0	0
4151	0	←	0	0
4152	0	←	0	0
4153	0	←	0	0
4154	0	←	0	0
4155	0	←	0	0
4156	0	←	0	0
4158	0	←	0	0
4159	0	←	0	0
4161	0	←	0	0
4165	0	←	0	0
4166	0	←	0	0
4169	0	←	0	0
4362	-24326	←	-24401	-24476
4363	-28322	←	-28222	-32593
4364	12788	←	25176	-28372
Maximum output during acceleration (for PS selection)	16.5kW	16.5kW	12.1kW	20.4kW

(*1) Set this value as the initial value of the velocity loop gain.

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A.2 SPINDLE MOTOR βiIP series

Motor model	βi IP 12/6000	βi IP 12/6000	βi IP 12/6000	βi IP 12/6000	βi IP 15/8000	βi IP 15/8000	βi IP 15/8000
Specification	1458	1458	1458	1458	1442	1442	1442
Applicable amplifier	βiSVSP*-7.5-B	βiSVSP*-11-B αi SP 11-B	βiSVSP*-15-B	βiSVSP*-18-B	βiSVSP*-11-B αi SP 11-B	βiSVSP*-15-B	βiSVSP*-18-B
Model code	–	–	–	–	–	–	–
S1 continuous rated output	5.5kW 1200/6000min^{-1}	5.5kW 1200/6000min^{-1}	5.5kW 1200/6000min^{-1}	5.5kW 1200/6000min^{-1}	7.5kW 1200/8000min^{-1}	7.5kW 1200/8000min^{-1}	7.5kW 1200/8000min^{-1}
S2 15 min rated output	7.5kW 750/6000min^{-1}	7.5kW 750/6000min^{-1}	7.5kW 750/6000min^{-1}	7.5kW 750/6000min^{-1}	9kW 750/8000min^{-1}	9kW 750/8000min^{-1}	9kW 750/8000min^{-1}
4007	00000000	←	←	←	00000000	←	←
4008	00010000	←	←	←	00010000	←	←
4009	00000000	←	←	←	00000000	←	←
4010	00010000	←	←	←	00010000	←	←
4011	00001010	←	←	←	00001010	←	←
4012	10000000	←	←	←	10000000	←	←
4013	00001100	←	←	←	00001100	←	←
4019	00000100	←	←	←	00000100	←	←
4020	8000	←	←	←	8000	←	←
4023		←	←	←		←	←
4039	0	←	←	←	0	←	←
4040	4(*1)	←	←	←	8(*1)	←	←
4041		←	←	←		←	←
4048	18(*1)	←	←	←	39(*1)	←	←
4049		←	←	←		←	←
4080	18000	←	←	←	20575	←	←
4083	30	←	←	←	30	←	←
4093		←	←	←		←	←
4100	800	←	←	←	750	←	←
4101	78	←	←	←	79	←	←
4102	1059	←	←	←	1566	←	←
4103	0	←	←	←	0	←	←
4104	5000	←	←	←	2000	←	←
4105	0	←	←	←	0	←	←
4106	11000	←	←	←	7000	←	←
4107	0	←	←	←	0	←	←
4108	0	←	←	←	0	←	←
4109	25	←	←	←	25	←	←
4110	927	1159	1738	2318	943	1415	1886
4111	403	←	←	←	503	←	←
4112	200	←	←	←	200	←	←
4113	780	←	←	←	228	←	←
4114	20480	←	←	←	0	←	←
4115	100	←	←	←	100	←	←
4116	6000	←	←	←	5307	←	←
4117	90	←	←	←	90	←	←
4118	100	←	←	←	100	←	←
4119	12	←	←	←	42	←	←
4120	0	←	←	←	0	←	←
4124	0	←	←	←	0	←	←
4127	150	←	←	←	132	←	←
4128	0	←	←	←	90	←	←
4129	0	←	←	←	0	←	←
4130	25700	←	←	←	25700	←	←
4134	110	←	←	←	130	←	←
4136	0	←	←	←	0	←	←
4138	0	←	←	←	0	←	←
4139	0	←	←	←	0	←	←
4140	0	←	←	←	0	←	←
4141	0	←	←	←	0	←	←
4142	0	←	←	←	0	←	←
4143	0	←	←	←	0	←	←
4144	0	←	←	←	0	←	←
4145	0	←	←	←	0	←	←
4146	0	←	←	←	0	←	←
4147	0	←	←	←	0	←	←
4148	0	←	←	←	0	←	←
4149	0	←	←	←	0	←	←
4150	0	←	←	←	0	←	←
4151	0	←	←	←	0	←	←
4152	0	←	←	←	0	←	←
4153	0	←	←	←	0	←	←
4154	0	←	←	←	0	←	←
4155	0	←	←	←	0	←	←
4156	0	←	←	←	0	←	←
4158	0	←	←	←	0	←	←
4159	0	←	←	←	0	←	←
4161	0	←	←	←	0	←	←
4165	0	←	←	←	0	←	←
4166	0	←	←	←	0	←	←
4169	0	←	←	←	0	←	←
4362	0	←	←	←	0	←	←
4363	0	←	←	←	0	←	←
4364	0	←	←	←	0	←	←
Maximum output during acceleration (for PS selection)	8.3kW	8.3kW	8.3kW	8.3kW	9.9kW	9.9kW	9.9kW

(*1) Set this value as the initial value of the velocity loop gain.

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Motor model	βi IP 18/8000	βi IP 18/8000	βi IP 18/8000	βi IP 22/8000	βi IP 22/8000	βi IP 30/8000	βi IP 40/6000
Specification	1443	1443	1443	1459	1459	1499	1480
Applicable amplifier	βiSVSP*-11-B αi SP 11-B	βiSVSP*-15-B	βiSVSP*-18-B	βiSVSP*-15-B αi SP 15-B	βiSVSP*-18-B	βiSVSP*-18-B αi SP 22-B	βiSVSP*-18-B αi SP 22-B
Model code	–	–	–				–
Applicable software series and edition	9DAA/A	9DAA/A	9DAA/A	9DAA/A	9DAA/A	9DAA/A	9DAA/A
S1 continuous rated output	9kW 1000/8000min^{-1}	9kW 1000/8000min^{-1}	9kW 1000/8000min^{-1}	11kW 1000/8000min^{-1}	11kW 1000/8000min^{-1}	15kW 1000/8000min^{-1}	15kW 650/6000min^{-1}
S2 15 min rated output	11kW 750/8000min^{-1}	11kW 750/8000min^{-1}	11kW 750/8000min^{-1}	15kW 750/8000min^{-1}	15kW 750/8000min^{-1}	18.5kW 750/8000min^{-1}	18.5kW 650/6000min^{-1}
4007	00000000	←	←	00000000	←	00000000	00000000
4008	00010000	←	←	00010000	←	00010000	00010000
4009	00000000	←	←	00000000	←	00000000	00000000
4010	00010000	←	←	00010000	←	00010000	00010000
4011	00001010	←	←	00001010	←	00001010	00001010
4012	10000000	←	←	10000000	←	10000000	10000000
4013	00001100	←	←	00001100	←	00001100	00001100
4019	00000100	←	←	00000100	←	00000100	00000100
4020	8000	←	←	8000	←	8000	6000
4023		←	←		←		
4039	0	←	←	0	←	0	0
4040	9(*1)	←	←	8(*1)	←	7(*1)	15(*1)
4041		←	←		←		
4048	41(*1)	←	←	35(*1)	←	35(*1)	69(*1)
4049		←	←		←		
4080	21845	←	←	19275	←	16730	16228
4083	30	←	←	30	←	30	30
4093		←	←	0	←	0	0
4100	750	←	←	770	←	750	670
4101	79	←	←	100	←	100	72
4102	1191	←	←	953	←	1007	775
4103	0	←	←	0	←	0	0
4104	3000	←	←	4000	←	3500	6500
4105	0	←	←	0	←	0	0
4106	7000	←	←	9000	←	8000	7500
4107	0	←	←	0	←	0	0
4108	0	←	←	0	←	0	0
4109	25	←	←	25	←	25	25
4110	793	1190	1586	1077	1436	1143	849
4111	410	←	←	333	←	334	299
4112	200	←	←	200	←	200	200
4113	268	←	←	300	←	300	193
4114	0	←	←	20480	←	0	0
4115	100	←	←	100	←	100	100
4116	4194	←	←	4408	←	4298	4983
4117	90	←	←	90	←	90	90
4118	100	←	←	100	←	100	100
4119	36	←	←	32	←	32	49
4120	0	←	←	0	←	0	0
4124	0	←	←	0	←	0	0
4127	134	←	←	150	←	136	136
4128	105	←	←	103	←	0	108
4129	0	←	←	0	←	0	0
4130	25700	←	←	25700	←	25700	25700
4134	130	←	←	130	←	130	130
4136	0	←	←	0	←	0	0
4138	0	←	←	0	←	0	0
4139	0	←	←	0	←	0	0
4140	0	←	←	0	←	0	0
4141	0	←	←	0	←	0	0
4142	0	←	←	0	←	0	0
4143	0	←	←	0	←	0	0
4144	0	←	←	0	←	0	0
4145	0	←	←	0	←	0	0
4146	0	←	←	0	←	0	0
4147	0	←	←	0	←	0	0
4148	0	←	←	0	←	0	0
4149	0	←	←	0	←	0	0
4150	0	←	←	0	←	0	0
4151	0	←	←	0	←	0	0
4152	0	←	←	0	←	0	0
4153	0	←	←	0	←	0	0
4154	0	←	←	0	←	0	0
4155	0	←	←	0	←	0	0
4156	0	←	←	0	←	0	0
4158	0	←	←	0	←	0	0
4159	0	←	←	0	←	0	0
4161	0	←	←	0	←	0	0
4165	0	←	←	0	←	0	0
4166	0	←	←	0	←	0	0
4169	0	←	←	0	←	0	0
4362	0	←	←	0	←	0	-24526
4363	0	←	←	0	←	0	-28572
4364	0	←	←	0	←	0	-30420
Maximum output during acceleration (for PS selection)	12.1kW	12.1kW	12.1kW	16.5kW	16.5kW	20.4kW	20.4kW

(*1) Set this value as the initial value of the velocity loop gain.

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A.3 SPINDLE MOTOR βiIc series

Motor model	βi Ic 3/6000	βi Ic 6/6000	βi Ic 3/6000
Specification	1415	1416	1417
Applicable amplifier	βiSVSP*-7.5-B	βiSVSP*-7.5-B	βiSVSP*-11-B
Model code	271	272	273
S1 continuous rated output	3.7kW 2000/6000min^{-1}	5.5kW 2000/6000min^{-1}	15kW 2000/6000min^{-1}
S2 15 min rated output	5.5kW 1500/6000min^{-1}	7.5kW 1500/6000min^{-1}	18.5kW 1500/6000min^{-1}
4000	00000000	00000000	00000000
4001	00000001	00000001	00000001
4002	00000010(*2)	00000010(*2)	00000010(*2)
4003	00000000	00000000	00000000
4005	00000001	00000001	00000001
4006	00000000	00000000	00000000
4007	00000000	00000000	00000000
4008	00001000	00001000	00001000
4011	00001000	00001000	00001000
4012	00000000	00000000	00000000
4013	00001100	00001100	00001100
4019	00000000	00000000	00000000
4020	6000	6000	6000
4040 to 4045	24(*3)	34(*3)	28(*3)
4048 to 4053	607(*3)	844(*3)	696(*3)
4080	75	75	80
4083	60	60	60
4084	60	60	60
4085	60	60	60
4100	1600	1607	1450
4101	90	65	90
4102	1800	1607	1799
4103	53	53	36
4104	400	300	400
4105	25	25	25
4106	100	100	100
4107	0	0	0
4108	200	200	200
4109	25	25	25
4110	929	623	580
4111	250	276	250
4112	200	200	200
4113	1000	897	680
4114	0	0	0
4115	100	100	100
4116	8500	7393	8001
4117	29530	120	32090
4118	120	120	100
4119	10	21	12
4120	15	15	15
4124	0	0	0
4127	164	150	161
4128	0	90	90
4129	0	0	0
4130	100	100	100
4131	12900	12900	12900
4134	110	110	110
4138	1500	1700	4350
4139	150	150	450
4140	5600	6000	5800
4141	680	650	600
4142	0	0	0
4143	0	0	0
4362	-28572	-32693	-32693
4363	-30495	-26424	-26424
4364	-28972	26924	26924
Maximum output during acceleration (for PS selection)	6.1kW	8.3kW	12.1kW

(*2) This setting is applied to when the position coder is attached to the spindle.
When using the αiBZ sensor, set bits 3, 2, 1, 0 of parameter No. 4002 to 0, 0, 1, 1, respectively, and set bits 7, 6, 5, 4 of parameter No. 4003 or parameter No. 4361 depending on the number of sensor teeth.

(*3) Since these values are the standard values for the motor alone, they need to be changed as shown below depending on the load state of an actual machine.

Setting = (machine load inertia/motor inertia + 1) * standard value of motor alone

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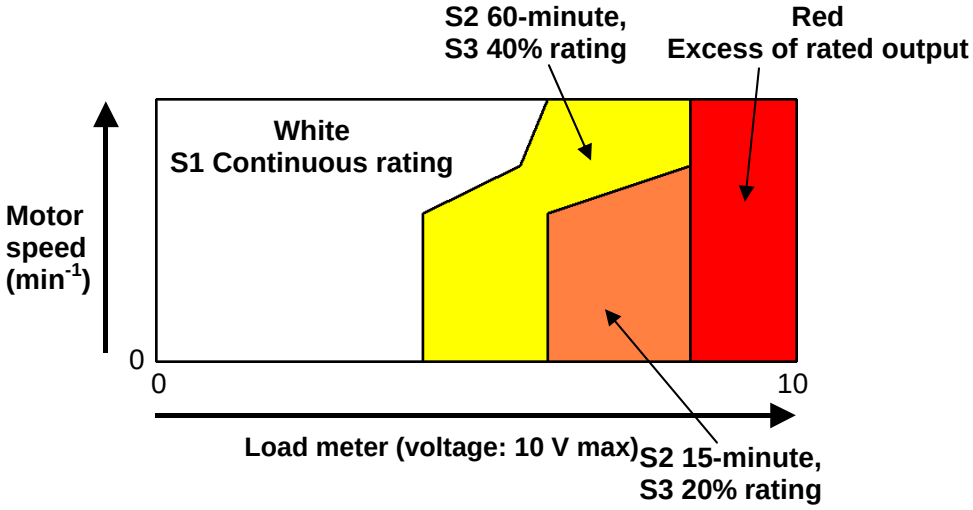
B LOAD METER (DYNAMOMETER)

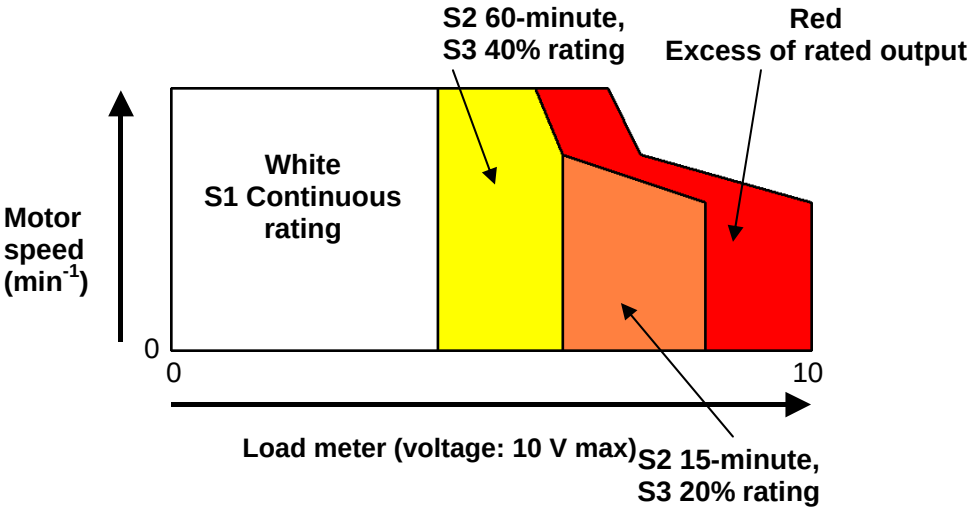
The load meter (dynamometer) shows the percentage of the load (load factor) to the maximum output that the motor can produce. At the maximum output, 10 V is output. It is output on pin 16 of the JY1 connector of the amplifier. (For details, refer to "FANUC SERVO AMPLIFIER β*i*-B series Descriptions" (B-65422EN).) Two types of load meter are available: Load meter (Normalized by max. output) and Load meter (Normalized by cont. rated output). For details, refer to technical report (B-65280EN/08-015), or ask FANUC.

Example

- **Load meter (Normalized by max. output)**



- **Load meter (Normalized by cont. rated output)**



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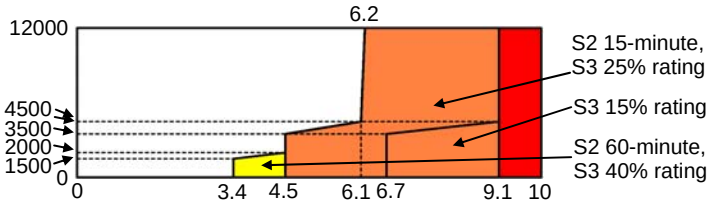
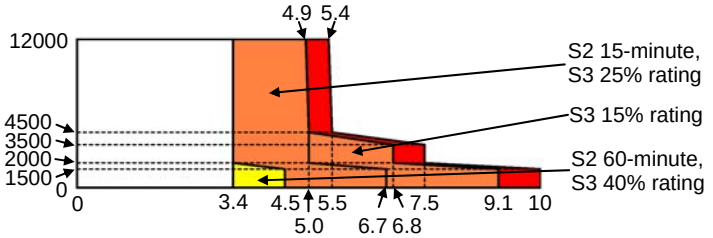
B.1 βiI series 200-V type

βiI 3/12000

Load meter (Normalized by max. output)

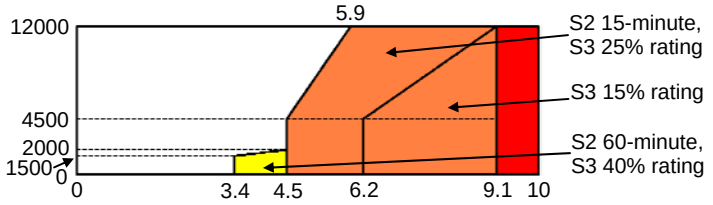


Load meter (Normalized by cont. rated output)

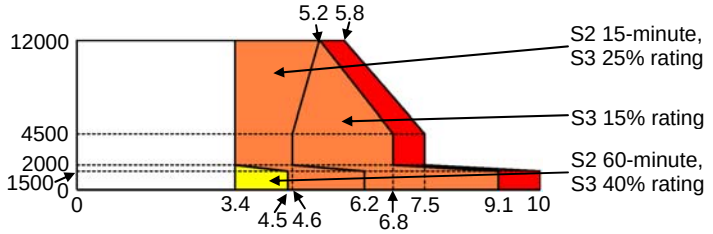


βiI 6/12000

Load meter (Normalized by max. output)

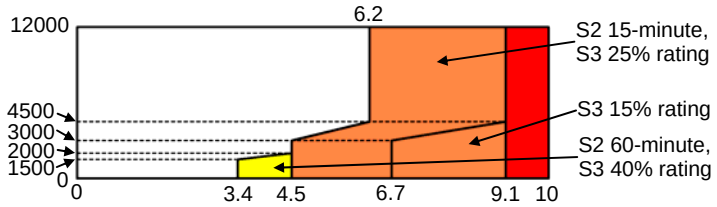


Load meter (Normalized by cont. rated output)

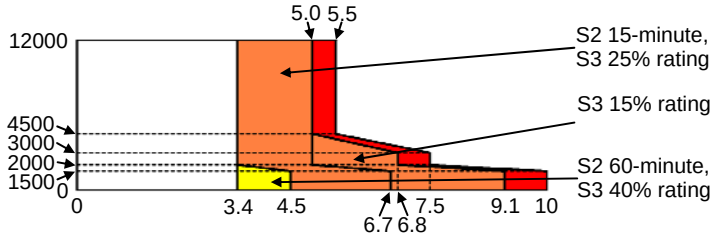


βiI 8/12000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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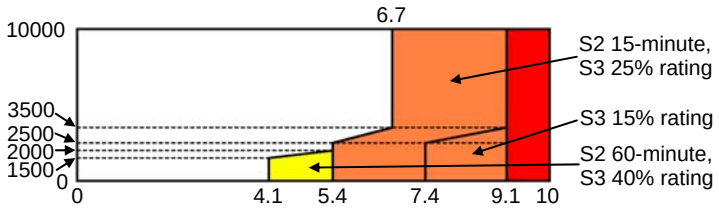
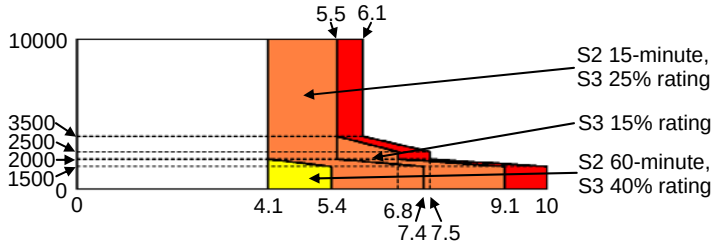
βiI 12/10000

Load meter (Normalized by max. output)

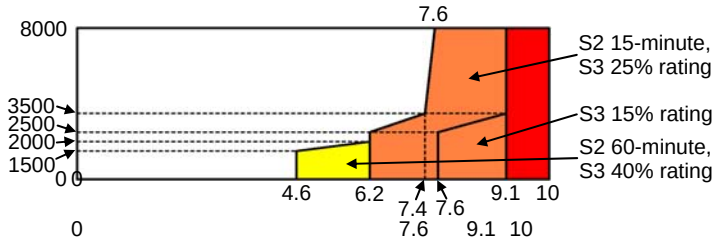


Load meter (Normalized by cont. rated output)

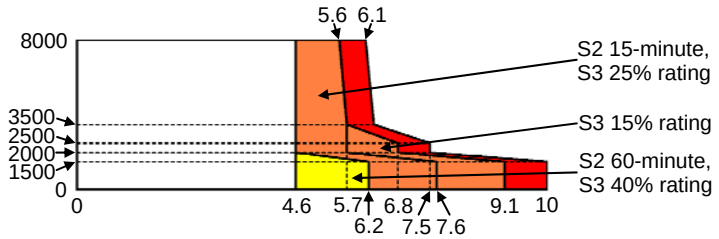


βiI 15/8000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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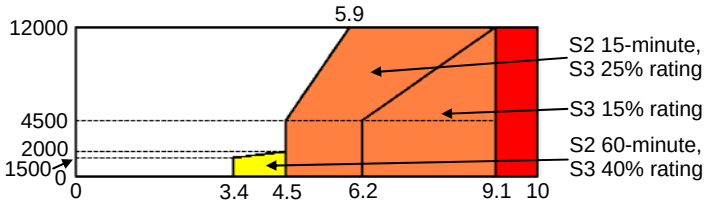
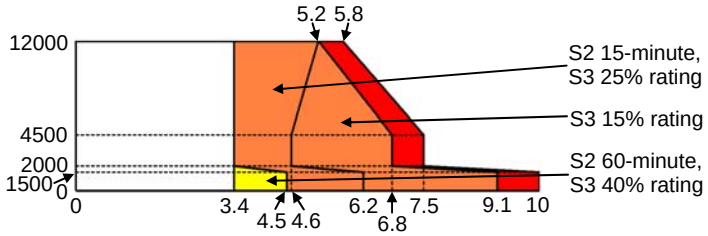
B.2 βiI series 400-V type

βiI 6/12000HV

Load meter (Normalized by max. output)

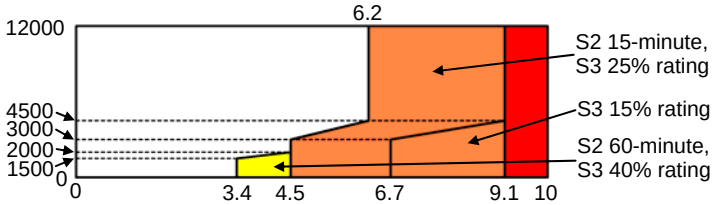


Load meter (Normalized by cont. rated output)

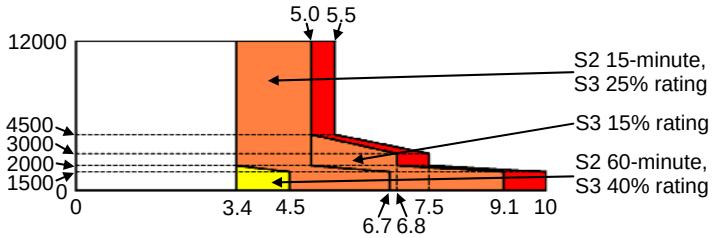


βiI 8/12000HV

Load meter (Normalized by max. output)

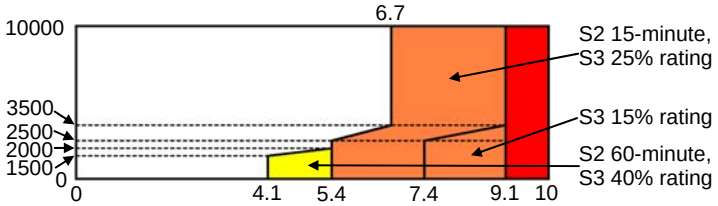


Load meter (Normalized by cont. rated output)

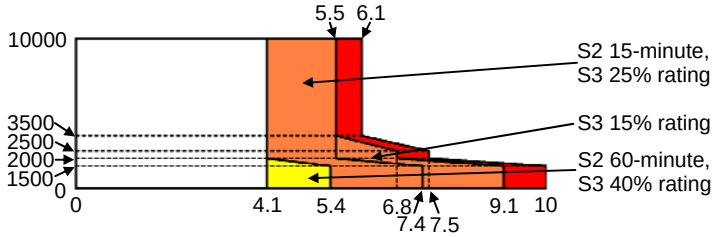


βiI 12/10000HV

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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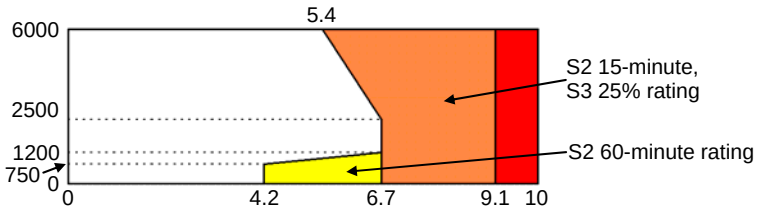
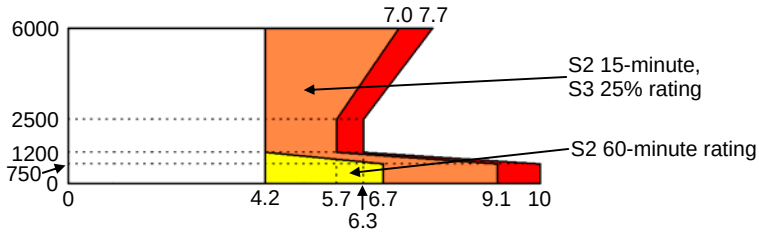
B.3 βiIP series

βiIP 12/6000

Load meter (Normalized by max. output)

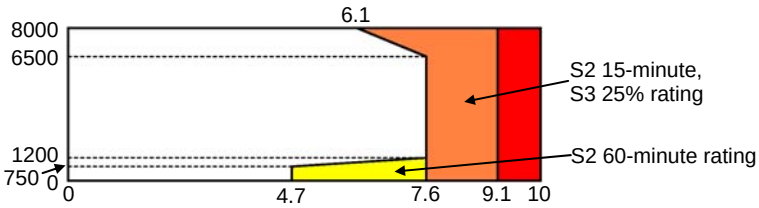


Load meter (Normalized by cont. rated output)

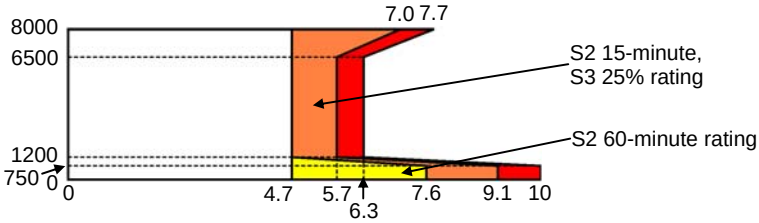


βiIP 15/8000

Load meter (Normalized by max. output)

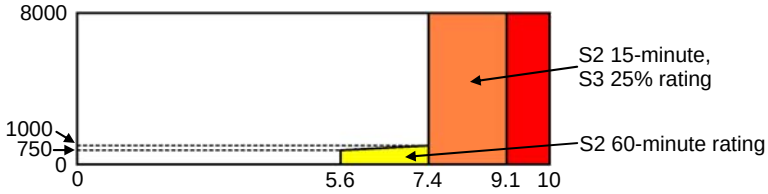


Load meter (Normalized by cont. rated output)

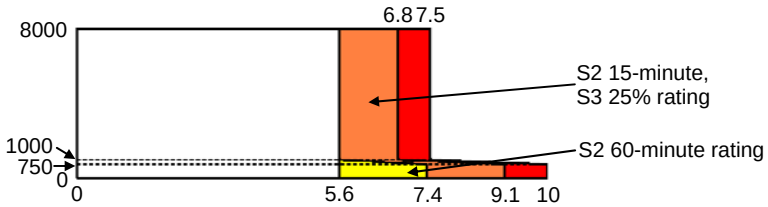


βiIP 18/8000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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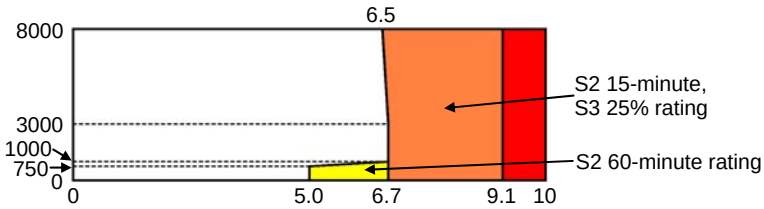
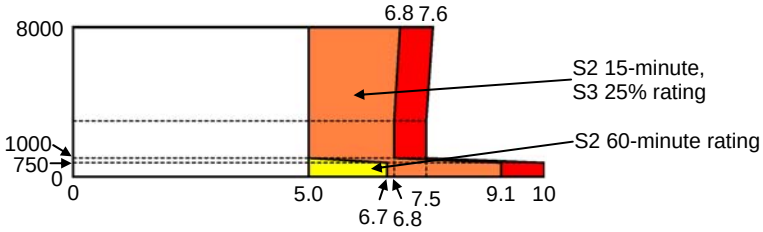
βiIP 22/8000

Load meter (Normalized by max. output)

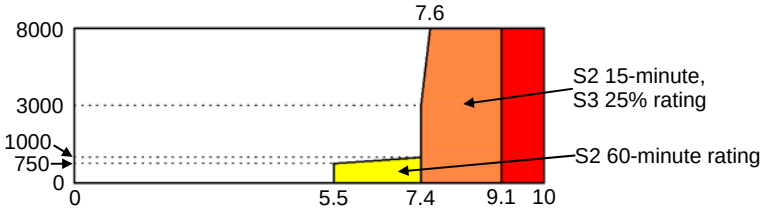


Load meter (Normalized by cont. rated output)

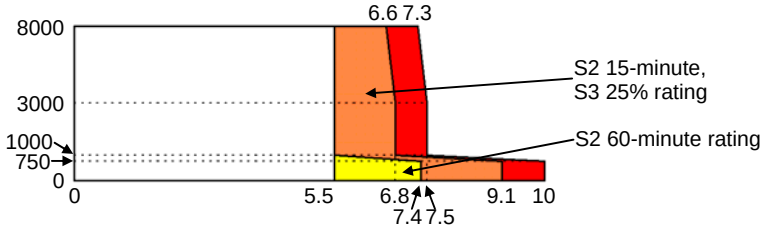


βiIP 30/8000

Load meter (Normalized by max. output)

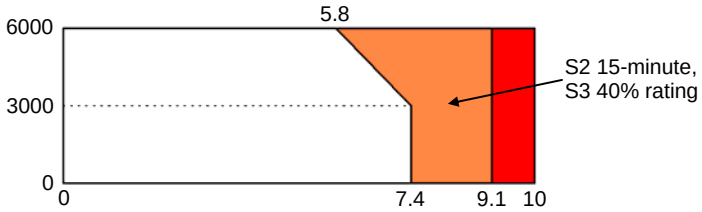


Load meter (Normalized by cont. rated output)

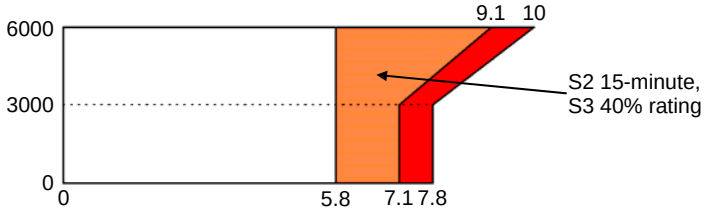


βiIP 40/6000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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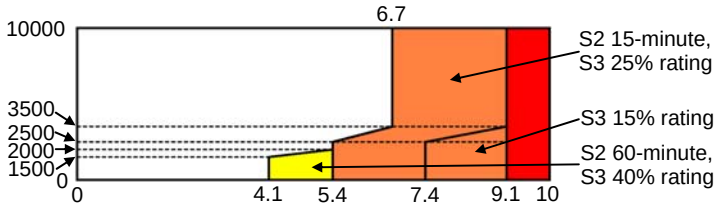
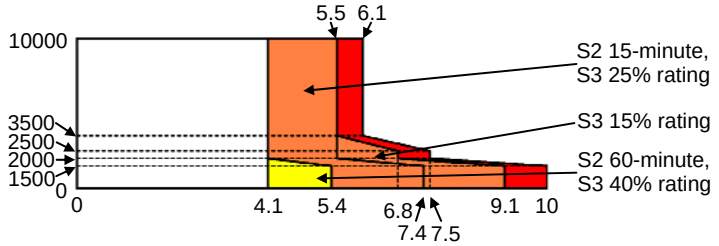
B.4 βiIT series

βiIT 12/10000

Load meter (Normalized by max. output)

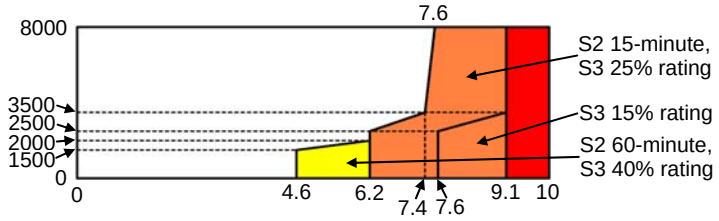


Load meter (Normalized by cont. rated output)

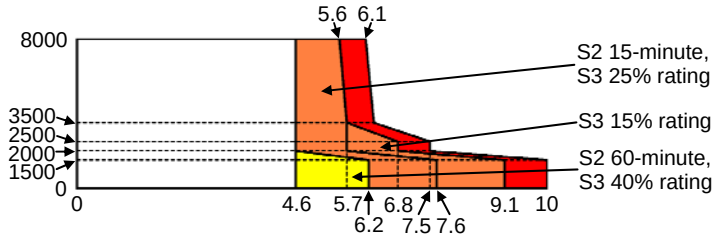


βiIT 15/8000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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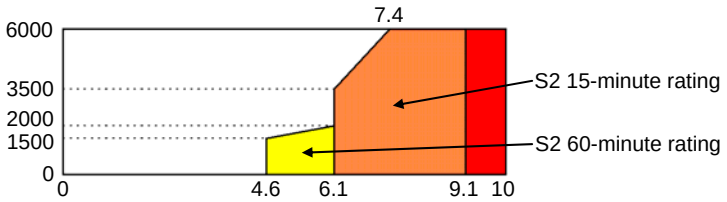
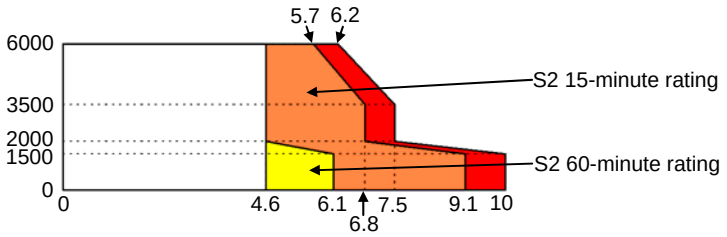
B.5 βiIc series

βiIc 3/6000

Load meter (Normalized by max. output)

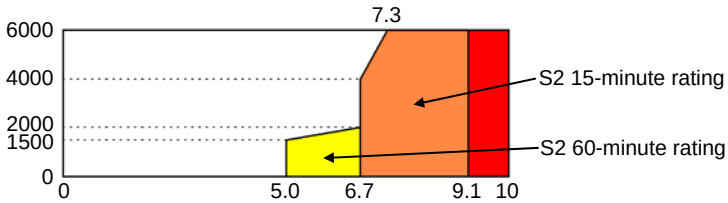


Load meter (Normalized by cont. rated output)

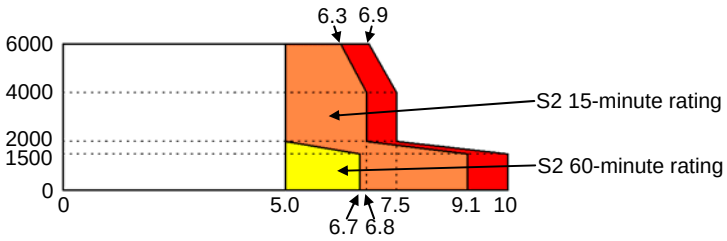


βiIc 6/6000

Load meter (Normalized by max. output)

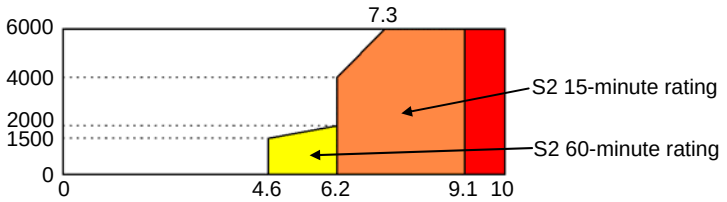


Load meter (Normalized by cont. rated output)

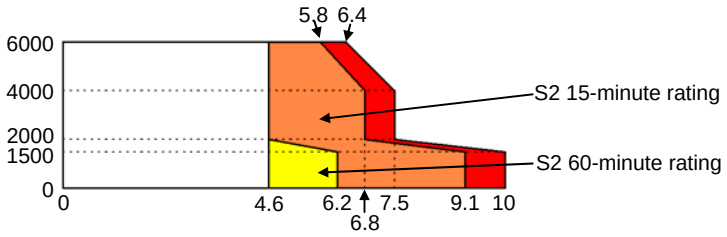


βiIc 8/6000

Load meter (Normalized by max. output)



Load meter (Normalized by cont. rated output)



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ADDITIONAL INFORMATION

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The modification of front flange of AC Spindle motor αiI 0.5 size

1. Type of applied documents

Name	FANUC AC SPINDLE MOTOR αi series DESCRIPTIONS FANUC AC SPINDLE MOTOR βi series DESCRIPTIONS FANUC AC SPINDLE MOTOR αi -B series/βi -B series DESCRIPTIONS
Spec. No./Ver.	B-65272EN/08 B-65312EN/05 B-65452EN/01

2. Summary of Change

Group	Name / Outline	New, Add Correct, Del	Applicable Date
Basic Function	The modification of front flange of AC Spindle motor αiI 0.5 size	Add	2018.6
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

				TITLE The modification of front flange of AC Spindle motor αiI 0.5 size	
01	18.05.24	Y. Mishima		DRAW. No. B-65452EN/01-04_B-65272EN/08-06_B-65312EN/05-01	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 1/2

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The modification of front flange of AC Spindle motor αiI 0.5 etc

1. General

The shape of the front flange αiI 0.5 size is modified.
(A hole to the front flange is added to drain the varnish, and the hole will be filled with a plug.)
Please be sure that this modification has no change on motor installation and external dimensions.
(There is no change on external dimensions described on the DESCRIPTIONS)

2. The reason of modification

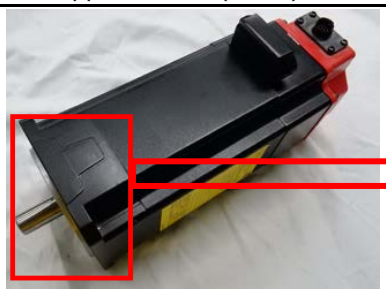
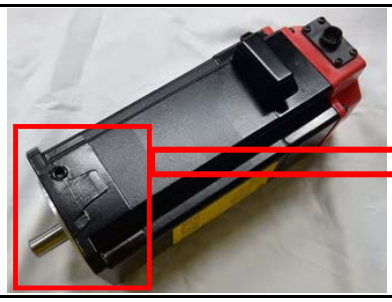
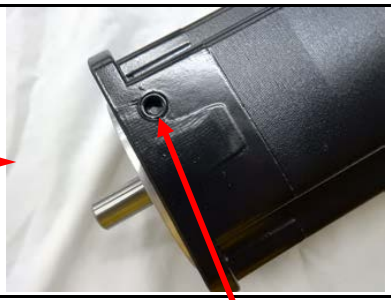
In order to change the manufacturing method of the motor, we added a hole to the front flange to drain the varnish.

3. Application models and application schedule

Application models	Application schedule（※）
Present models（A06B-xxxx-B***） 1400、1401、1481、1501、2400、2401、2481、2501	June 2018

※）The timing of application may differ on different models.

4. Modified part

	Appearance 1 (motor)	Appearance 2 (front flange)
Former front flange		
New front flange		

The hole for draining the varnish is filled with a plug.

				TITLE The modification of front flange of AC Spindle motor αiI 0.5 size	
01	18.05.24	Y. Mishima		DRAW. No. B-65452EN/01-04_B-65272EN/08-06_B-65312EN/05-01	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 2/2

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The modification of AC Spindle motor αiI 0.5 size front flange painting range

1. Type of applied documents

Name	FANUC AC SPINDLE MOTOR αi series DESCRIPTIONS FANUC AC SPINDLE MOTOR βi series DESCRIPTIONS FANUC AC SPINDLE MOTOR αi -B series/βi -B series DESCRIPTIONS
Spec. No./Ver.	B-65272EN/08 B-65312EN/05 B-65452EN/01

2. Summary of change

Group	Name / Outline	New, Add Correct, Del	Applicable Date
Basic Function	The modification of AC Spindle motor αiI 0.5 size front flange painting range	Add	2018.9
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction			
Another			

				TITLE The modification of AC Spindle motor αiI 0.5 size front flange paiting range	
01	18.09.07	Y. Mishima		DRAW. No. B-65452EN/01-06_B-65272EN/08-07_B-65312EN/05-02	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 1/2

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The modification of AC Spindle motor αiI 0.5 size front flange painting range

1. General

The painting range of αiI 0.5 size front flange is modified.
(Painting to the inner side of the mounting part of the motor is added.)
Please be sure that this modification has no change on motor installation and external dimensions.
(There is no change on external dimensions described on the DESCRIPTIONS)

2. The reason of modification

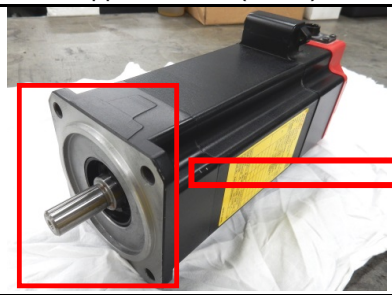
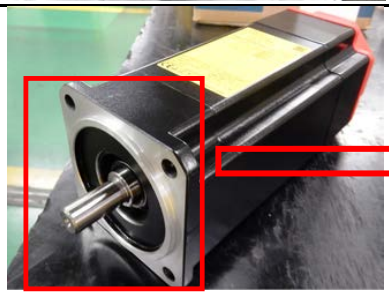
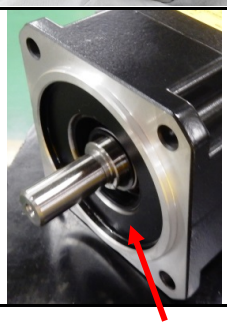
In order to unify the painting range with the spindle motor of other models, we paint the inner side of the mounting part of the motor.

3. Application models and application schedule

Application models	Application schedule（※）
Present models（A06B-xxxx-B***） 1400、1401、1481、1501、2400、2401、2481、2501	Sep. 2018

※） The timing of application may differ on each models.

4. Modified part

	Appearance 1 (motor)	Appearance 2 (front flange)
Former front flange		
New front flange		

New painting range

				TITLE The modification of AC Spindle motor αiI 0.5 size front flange paiting range	
01	18.09.07	Y. Mishima		DRAW. No. B-65452EN/01-06_B-65272EN/08-07_B-65312EN/05-02	CUST.
Ed.	Date	Design.		FANUC CORPORATION	SHEET 2/2

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REVISION RECORD

Edition	Date	Contents
05	Feb., 2016	• Upgrade to specifications with higher output and higher maximum rotation speed • Addition of following model βiI 6/12000HV, βiI 8/12000HV, βiI 12/10000HV • Addition of following series βiIT series
04	Jul., 2014	• Renovation of the overall configuration • Addition of following model βiIP 40/6000
03	Apr., 2012	• Changing of model names of following series βiI 15/7000, βiIP 22/6000, βiIP 30/6000 • Addition of following series βiIC series
02	Jun., 2007	• Changing of model names of following series βiI series • Addition of following series βiIP series
01	Apr., 2003	

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B-65312EN/05

B-65312EN/05.02

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