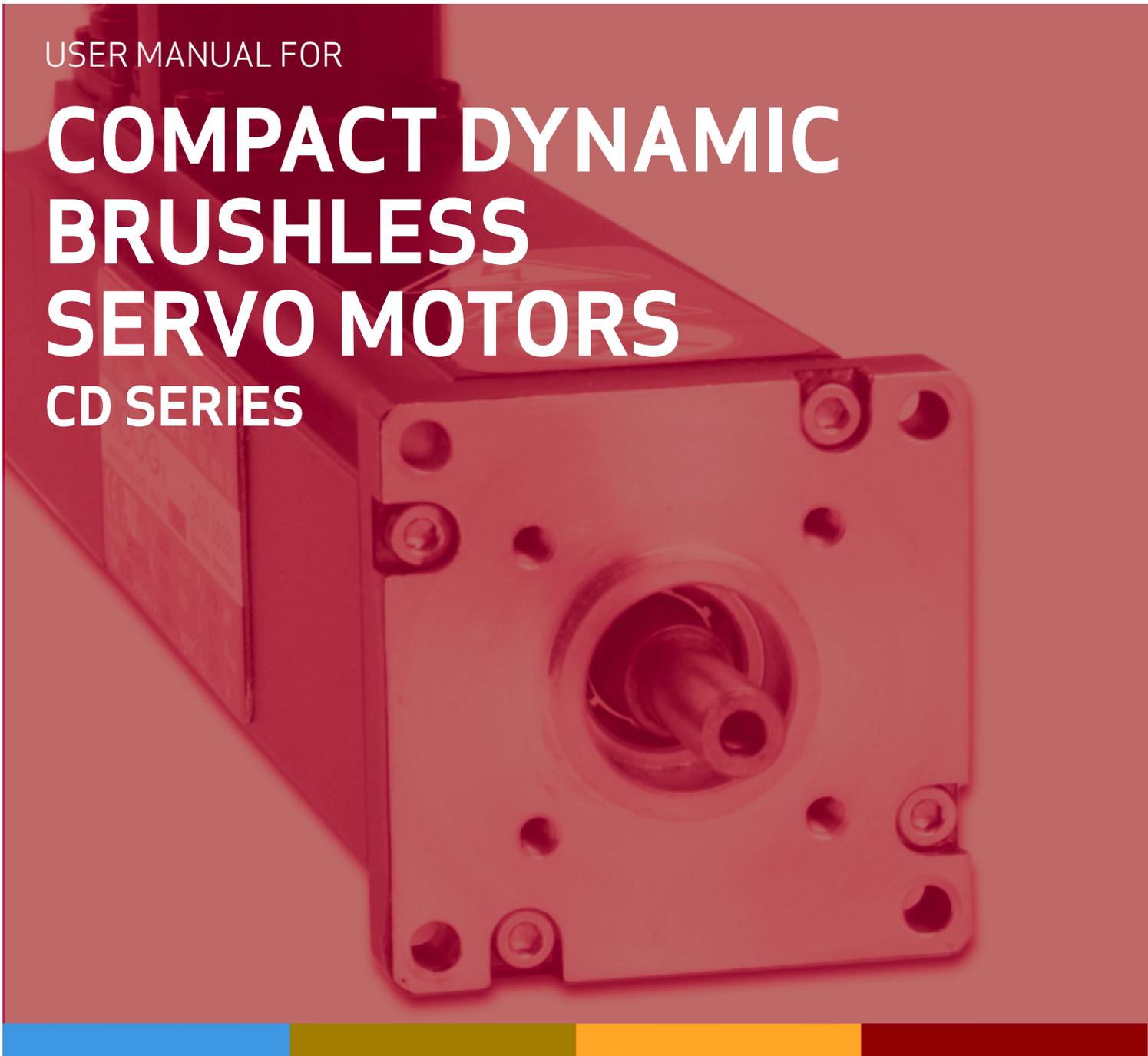


USER MANUAL FOR

COMPACT DYNAMIC BRUSHLESS SERVO MOTORS CD SERIES



Rev. B, May 2015

LOW INERTIA, COMPACT LENGTH, SERVO MOTORS
FOR HIGHLY DYNAMIC APPLICATIONS

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Subject to change without notice.

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Foreword

This manual has been prepared in accordance with IEC 82079-1, "Preparation of instructions for use - Structuring, content and presentation - Part 1: General principles and detailed requirements".

The manual was written and checked at the best experience of Moog.

Moog has written this technical document to comply with the requirements of the Machinery Directive 2006/42/EC.

About Moog

Moog's Industrial Group designs and manufactures high performance motion control solutions combining electric, hydraulic, and hybrid technologies with expert consultative support in a range of applications including test, simulation, plastics, metal forming, and power generation.

Moog customers include leading automotive manufacturers, aerospace manufacturers, testing labs and global automotive racing teams.

We help performance-driven companies design and develop their next-generation machines. Moog's Industrial Group is part of Moog Inc.

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Document version

ES	DA	DE	EL	EN	FR	IT	NL	PT	FL	SV	CS	ET	LV	HU	MT	PL	SK	SL	BG	RO	GA	
				X																		

The language of documents and drawings are subject to contractual negotiations with the customer.

In case of "Translation of the Original Instructions", the manufacturer of the machinery supplies also the "English Instructions".

Revision record

The following table shows the revision record:

Revision	Description	Prepared	Checked	Approved	Date
B	Format and contents changed	Naresh Gupta	Prashanth Bhatt	Volker Schmitt	February 2015

1 Introduction

1.1 About this Document

This document gives the safe working instructions while working with the CD Series Servo Motors. It describes how to install, operate and maintain the CD Series servo motors.

All personnel working on with the motor should have this user manual available during work and should check for the relevant information before start of the work.

1.2 Documents on CD Series Servo Motor

In addition to this user manual the other documents that are available on CD Series Servo Motor are:

- Installation drawing - provides information on motor mounting and wiring schematics for electrical installation.
- Data sheet - provides information on technical data.
- Catalogue on CD Series Servo Motor – Compact Dynamic Brushless Servo Motor – provides product description, bearing load diagrams, Servo Motor selection and sizing.

For the catalogue refer to

http://www.moog.com/literature/ICD/Moog-ServoMotors-CD_Series-Catalog-en.pdf



If the information and notes provided in this documentation do not meet your requirements please contact Moog personnel.

1.3 Typographical Conventions

DANGER

Identifies safety instructions that are intended to warn of an immediate and impending danger to life and limb.

Failure to observe these safety instructions will inevitably lead to death, serious personal injury (disablement)!

WARNING

Identifies safety instructions that are intended to warn of potential danger to life and limb.

Failure to observe these safety instructions might lead to death, serious personal injury (disablement)!

CAUTION

Identifies safety instructions that are intended to warn of slight personal injury.

Failure to observe these safety instructions might lead to slight personal injury.

NOTICE

Failure to observe this safety notice can result in property damage!



Identifies important information

• / - Identifies listings

⇒ Identifies references to another chapter, page, table or figure in this manual

blue text Identifies a hyperlink within the PDF file

1., 2., ... Identifies steps in a procedure that should be performed in consecutive order

"..." Used for references

1.4 Structure of Warning Notices

The warning notices in this user manual have the following structure:



Figure 1: Structure of a warning notice

Legend

- 1 Warning symbol
- 2 Signal word
- 3 Type and source of hazard
- 4 Possible consequences of a potential hazard
- 5 Hazard prevention measures

1.5 Abbreviations

Abbreviation	Explanation
CD	Compact Dynamic
DC	Direct Current
MSD	Moog Programmable Multi-Axis Servo Drive System
IM B5	Motor mounting without feet with Front flange
IM V1	Motor mounting without feet with Front flange with drive shaft vertically downwards
IM V3	Motor mounting without feet with Front flange with drive shaft vertically upwards
ESD	Electro Static Discharge

Table 1: Abbreviations

2 Safety Instructions

Do not attempt to install, operate, maintain or inspect the servo motor until you have read through this user manual and appended document carefully and can use the equipment correctly. The CD Series Servo Motor may only be set up and operated in conjunction with this manual.



Human safety and equipment safety must be the first considerations when performing the installation procedures for the servo motor and drive system. When it comes to electronics in your factory or workplace, you want to make sure both your facility and the employees in it are safe. The following gives safety instructions which should be followed when you are working on the servo motor.

WARNING

Danger of high voltage and electrical shock hazard!

This creates the danger of death, severe injury, or extensive material damage.

- ▶ It is vital that you ensure the motor is safely earthed to the PE (Protective Earth). Electrical safety is impossible without a low-resistance earth connection.
- ▶ Do not unplug any connectors during operation.

NOTICE

- ▶ Observe and adhere to the technical data and in particular the information given on the motor nameplate.
- ▶ The installation must comply with the local regulations and use of equipment and installation practices that promote electromagnetic compatibility and safety.
- ▶ Safety equipment - To protect yourself against personal injury by falling motor, always wear suitable safety equipment, such as work shoes, when handling the motor.



Use this document if you are responsible for installing or troubleshooting motors. As with any electro-mechanical device, safety should be considered during the installation and operation. Throughout this manual you will see safety messages marked with CAUTION and WARNING signal words. Follow the given actions to avoid the hazardous situation.

2.1 Safety Oriented Systems

The use of control technology in safety-oriented systems calls for special measures. When planning to use control technology in a safety-oriented system, the user should seek detailed advice in addition to referring to all the potentially available standards or guidelines on safety-engineering installations.

2.2 Qualified Personnel

Only properly qualified personnel are permitted to perform such tasks as transport, assembly, setup and maintenance.

Qualified personnel are those who are specialized with required knowledge and experience, who have been trained to perform such work and authorized to commission, systems and circuits in accordance with established safety practices and standards. The qualified personnel must know and observe the following standards and regulations:

- IEC 60364 or DIN VDE 0100
- IEC 60664 or DIN VDE 0110
- National regulations for safety and accident prevention e.g. for Germany BGV A3

2.3 Electrical Hazards

Certain electrical systems have to be maintained and cleaned by staff. Before they can be accessed, the systems have to be disconnected from the mains supply to eliminate electrical hazards to operating staff. According to the state of technology, this is accomplished with the five safety rules of DIN VDE 0105-100.

- Disconnect the mains
- Secure against reconnection
- Verify that the system is dead
- Carry out earthing and short circuiting
- Provide protection from adjacent live parts.

2.4 Thermal Hazards

CAUTION



Burn hazard!

The surface temperature of the motor may reach up to 100 °C (212 °F) and may become very hot in operation, according to their protection category.

- ▶ Do not touch hot surfaces, measure the temperature, and wait until the motor has cooled down below 40 °C (104 °F) before touching it.

3 Product Information

- Moog CD Series Servo Motors have Brushless construction which means that they are maintenance free. The longevity of the motors is limited only by the life of the bearings, which have lifetime lubrication (a L10h life of 20,000 operation hours with the recommended maximum axial and radial loads).
- The servo motors correspond to the harmonized standards of the EN 60034 (VDE 0530) series EN 60034-1, EN 60034-5, EN 60034-9 and EN 60204-1.
- The CD Series Servo Motors are designed and manufactured in accordance with strict CE standards, using ruggedized components with proven reliability in harsh thermal and shock load environments.

3.1 Manufacturer Name and Address

The following table shows all the information regarding the manufacturer:

Info	Description
Moog Company	Moog Controls (India) PVT. LTD.
Address	No. 41P, 99 & 100 P, KIADB Industrial Area, Electronic City Phase II, Hosur Road, Bangalore - 560100, India
Phone	+91 80 3327 6300
Fax	+91 80 2852 7309
E-Mail	info.india@moog.com
Web site	www.moog.com/industrial

Table 2: Manufacturer name and address

4 Shipment and Storage

Please check the contents of delivery are as ordered and that no damage, especially the areas of the shaft and connectors, has occurred during transit. Any problems should be immediately addressed to Moog representative with a description of the fault or damage.

 **CAUTION****Danger of personal injury and damage to property!**

Failure to observe these safety procedures could result in personnel injury or equipment damage.

- ▶ Do not forget to observe the safety signs indicated on the motor.
- ▶ Destruction of the paint seals on the screws will make the warranty void.
- ▶ Do not open or attempt to open the motor.

4.1 Transport and Storage

WARNING



Heavy weight!

Danger during lifting and transporting procedures!

- ▶ Improper handling, unsuitable or defective devices, tools etc. can cause injuries and/or property damage. Lifting devices, ground conveyors and lifting tackle must correspond to the valid regulations.
- ▶ Lifting eye provided should not be used for lifting entire machine. Only the component attached to this support may be safely lifted by the support.

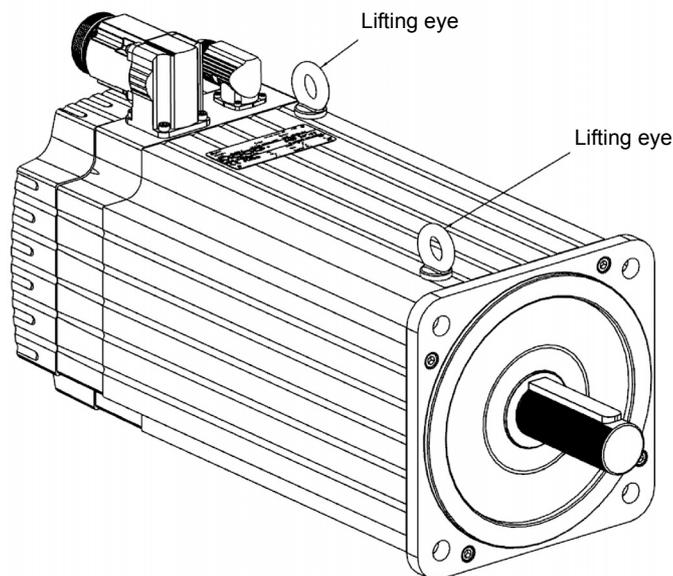


Figure 2: Hosting points

Use suitable suspension and load devices for transportation and assembly. Use lifting eyes if necessary provided by the manufacturer. Improper handling may lead to serious injury.

In the case of intermediate storage, observe the following storage conditions:

- Recommended ambient temperature: +15 to +25 °C (+60 to +78 °F), permissible temperature: -40 to +80 °C (-40 to +176 °F), temperature fluctuation: < 10 °C (18 °F) per day.
- Relative humidity: < 65 % non-condensing is recommended, 90 % is permissible.
- Ensure there are minimal vibration and shock where servo motors are stored.

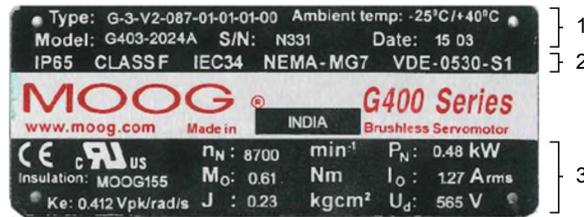
NOTICE

Damage due to dirt, moisture

Storage outside or under the wrong climatic conditions can cause corrosion and other damage to the servo motor. Condensation due to temperature fluctuations can result in electronic malfunctions.

5 CD Series Motor Codification

The motor nameplate data are used for the setting of the servo drive. In case of contact with Moog, identification data of the motor must be supplied.



Pos.	Description	
1	General data	
	Type	Motor type (Note: for motors built before July 2008 this may vary)
	Ambient temp	Ambient temperature
	Model	Motor model number (ordering number)
	S/N	Serial number
	Date	Week and year of production
2	Standards	
	IP65	Degree of protection. Motor protection against jets of water (at shaft with seal option)
	CLASS F	Motor listed for insulation class F (155 °C (311 °F))
	IEC34	Motor fulfills IEC34 (standard defines rating and performance of rotating electrical machines)
	VDE-0350-S1	Performance measurements are done according to VDE-0530
CE	Conformity certificate will be supplied on request	
3	Technical data (data are measured at 25 °C ambient temperature)	
	n_N	Nominal speed at P_N
	P_N	Nominal power (max continuous output power)
	M_O	Continuous stall torque
	I_O	Continuous stall current (at M_O)
	K_e	Back emf (voltage constant)
	J	Rotor moment of inertia
	U_d	Nominal operating voltage (bus voltage)
UL	Motor c-UL Recognized, file number E137630	

Table 3: Motor nameplate



Description	
Brake data (brake is optional, data provided refers to holding torque)	
Type	Permanent magnet brake
Voltage	DC voltage to unlock shaft
Current	Nominal current A _{DC}
Caution	Caution on voltage polarity

Table 4: Motor brake data

More details on type: ⇒ [Chapter "11 Ordering Code", page 23](#)

6 Installation

WARNING

Danger of personal injury!

Working with and on the motor without the required basic electrical knowledge may cause injuries or parts may be damaged.

- ▶ The motor is intended for installation and use by qualified personnel, familiar with electrical machines and safety requirements.
- ▶ The safety equipment necessary to prevent accidents and electrical shocks must be provided by the installer.
- ▶ Ensure that the installation drawing and data sheet are available.

Following care must be taken while installing the motor:

- Read the name plate, warning and caution plates on the motor carefully.
- Permissible radial and axial loads should be known to the personnel handling.
- Screwed-in lifting eye bolts can be removed after installation.
- Refer installation drawing before installing.

CAUTION



Electrical hazard!

Moog motors may consist ESD sensitive parts. For motors with such parts additional care is required.

- ▶ Do not touch these motor connector pins with bare hands.
- ▶ If the user carries out a HI pot test, then pins must be short circuited before the test is carried out. The polarity must be carefully observed. Avoid currents > 4 mA in the KTY circuit.

NOTICE

Risk of damage

- ▶ Release the brake before starting the motor by supplying proper voltage as defined by the manufacturer.
- ▶ Do not use holding brake to stop the motor. It is not permitted to be used as working brake.



When installing and mounting the motor, ensure that the shaft extension is protected against impact and pressure.



Observe the technical data on the labeling plates on the motor enclosure.

6.1 Recommended Drives

The Moog motors are designed to be used together with a sinusoidal servo drive. The best performance will be achieved by using a fully digital controller with extremely high bandwidth capability like the Moog MSD Servo Drive System.

Because of high quality feedback signals, the MSD Servo Drive can compute his powerful control algorithms at a very high frequency which increases the precision and the dynamics of the axis.

Some remarkable points about the MSD Servo Drive are listed below:

- Wide range of power
- Single and Multi axes solutions available
- High frequency control loops (current 62,5 μ s, speed 125 μ s, and position loops 125 μ s) with result in high current, velocity and position loop bandwidths
- High encoder interpolation factor to ensure adequate speed and position resolution with error compensation
- Advanced control algorithms and additional features: like feed-forward, observers, notch filters compensation of cogging torque, stick slip, and others
- CE and UL certification

6.2 Mounting

- The motor shaft should be degreased carefully before mounting a coupling. When using a degreaser (grease dissolving substance), prevent it from flowing into the bearing as this will destroy the lifetime lubrication. A clamp coupling or a shrink connection is recommended to provide a reliable torque transmission. For direct drive, use flexible couplings. Alignment to be coaxial, poor alignment will lead to mechanical vibration during operation. The resulting damage to the bearings can reduce the motor's life.
- Excessive axial force on the rotor shaft can result in bearing failure and impair the functionality of brake in case of brake motors. This leads either to reduced braking force or brake failure. Therefore excessive pressure and shocks on the front end of the shaft and the back housing must be avoided under all circumstances. The impulse of any hammer blow always exceeds the maximum permissible axial and radial forces.
- Moog recommends the use of socket screws according to ISO 4762 (old DIN 912) 8.8. The mounting of Moog motors especially size 2 and 3 motors can be eased considerably by the use of hexagonal ball ended Allen key (like the picture below).
With the motor sizes 2 and 3 the length of the screws used should not exceed 40 mm (1.57 in) if the screws are mounted from the motor side as shown in the below image.

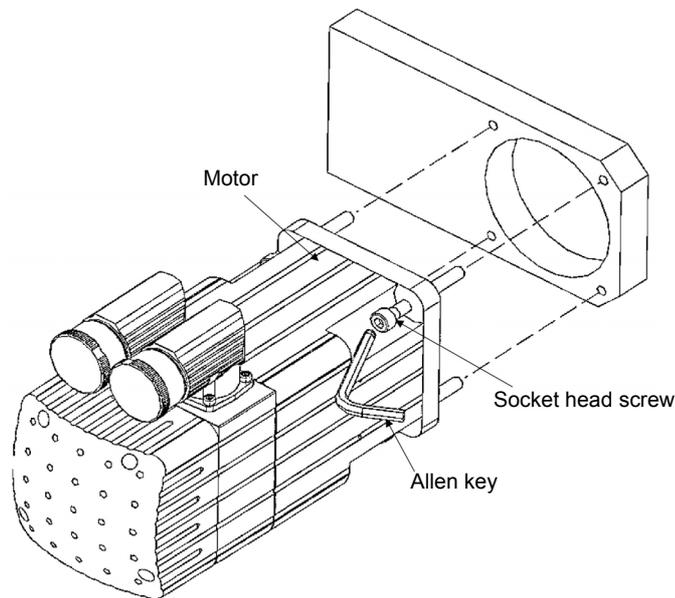


Figure 3: Mounting

6.3 CD Series Servo Motor Mounting Orientations

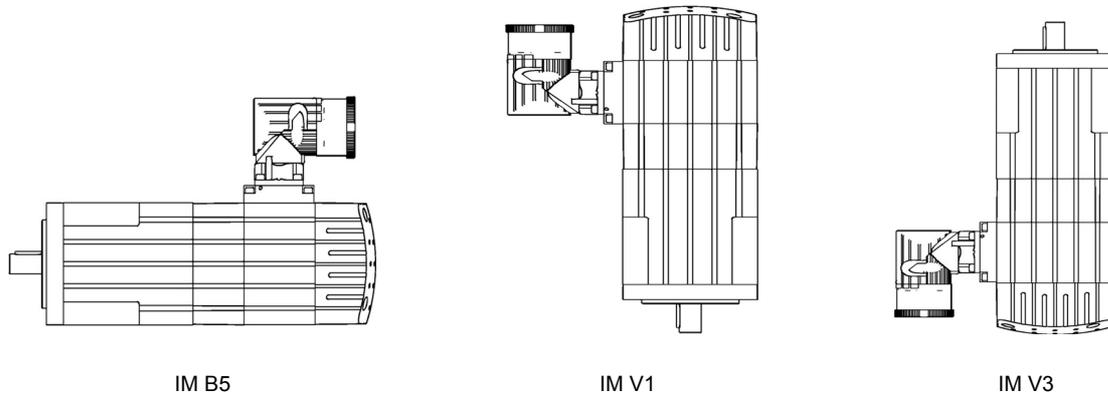


Figure 4: Mounting orientations

Type	G-1	G-2	G-3	G-4	G-5	G-6
Axial Load ¹⁾	60	150	150	300	400	500
Radial Load ¹⁾	300	500	500	1,000	1,600	2,000

Table 5: Maximum permissible axial and radial loads (N) for Moog CD Series motors during installation

¹⁾ During installation:
 Less load is allowed when the motor is rotating [refer to catalog].

6.4 Fan Cooled Motors

Fan cooled option is available with motor sizes 4, 5 and 6. Additional precautions that have to be considered for fan cooled motors are:

- Fan termination should be checked for correct polarity before starting the motor.
Connection details: ⇒ [Chapter "7 Electrical Interfaces", page 17](#)
- Motor should not be rested on the cowl which otherwise may get damaged.
- The air passage inside the cowl should be free from blockage to enable free flow of air and proper functioning of fan.
- Back of the cowl area should be free for air to circulate.
- Fan cooled motors should not be lifted using cowl.

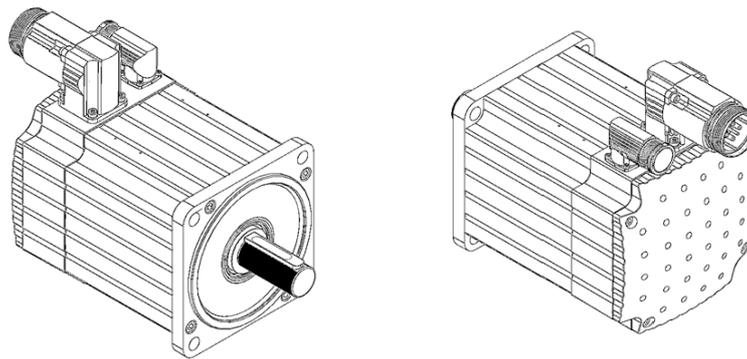


Figure 5: Natural cooled motor

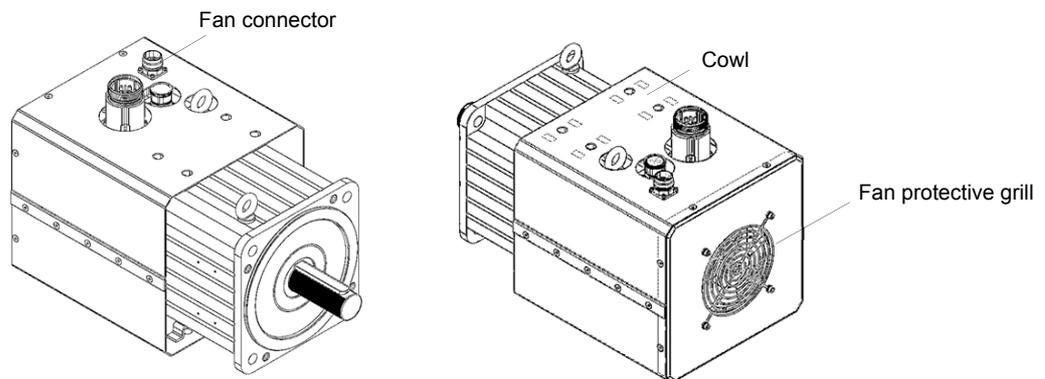


Figure 6: Fan cooled motor

NOTICE

If proper precaution is not taken while installing, the motor fan protective grill may get damaged which in turn might result in fan noise and vibration sometimes even failure.

7 Electrical Interfaces

For connection of CD Series Moog motors, it is best to use the mating connectors and cable characteristics indicated in the tables. When using non Moog components, the cable specifications must be fulfilled in every way.

WARNING

Hazardous voltage!

The rotating motor can generate high voltages.

- ▶ Always make sure that there are no exposed cables.

Connection and disconnection of the motors must be made with the controller switched off. Simply disabling the controller is not sufficient. During installation, special attention should be paid to the diameter of the protective earth (PE) conductor, which must be sized according to legal safety rules.

We recommend shielding of power and signal cables. The shielding should be connected to earth at both ends.

NOTICE

Small wire diameters lead to an unacceptable heating in the cable. This results in power loss to the motor, especially when the cables are long.

7.1 Wiring Schematics

For wiring schematics refer to the installation drawing provided along with the motor.

Below tables give information on cable schemes and mating connectors for power and signal connectors.

Power connector - Type G-1, G-2, G-3, G-4, G-5, G-6

Cable scheme	4 x 1.5 mm ² Power (G1-G4) 4 x 2.5 mm ² Power (G-5-x2 up to G-5-x6) 4 x 4.0 mm ² Power (G-5-x8 up to G-5-x) 2 x 1.0 mm ² Brake outer shield
Mating connector loose (recommended)	Moog part number: C08365-001 (up to 2.5 mm ²) C08365-002 (up to 4.0 mm ²)

Table 6: Power connector - type G-1, G-2, G-3, G-4, G-5, G-6

Power connector - Type G-5-x9, G-6

Cable scheme	4 x 6.0 mm ² Power (565 V _{DC} motors) 4 x 10.0 mm ² Power (325 V _{DC}) 2 x 1.0 mm ² Brake outer shield
Mating connector loose (recommended)	Moog part number: B47711-001

Table 7: Power connector - type G-5-x9, G-6

Resolver signal connector

Cable scheme	8 x 0.25 mm ² , stranded wires, twisted paired, outer shield
Mating connector loose (recommended)	Moog part number: C08485-001/CA46373-001/CA46373-003

Table 8: Resolver signal connector

Encoder signal connector

Cable scheme	17 x 0.25 mm ² , stranded wires, twisted paired, outer shield
Mating connector loose (recommended)	Moog part number: C08666-001

Table 9: Encoder signal connector

Feedback option: ⇒ [Chapter "11 Ordering Code", page 23](#)

7.2 Connectors

Moog motors have Threaded, Speedtec and Speedtec-ready connectors mounted on it. The Threaded and Speedtec-ready connectors will have O-ring installed in them.

The mating connectors are of two types Threaded and Speedtec plug type.

If a Speedtec-ready connector is used with a Threaded plug mating connector, the O-ring needs not be removed from the motor connector, i.e., the connector can be used as is.

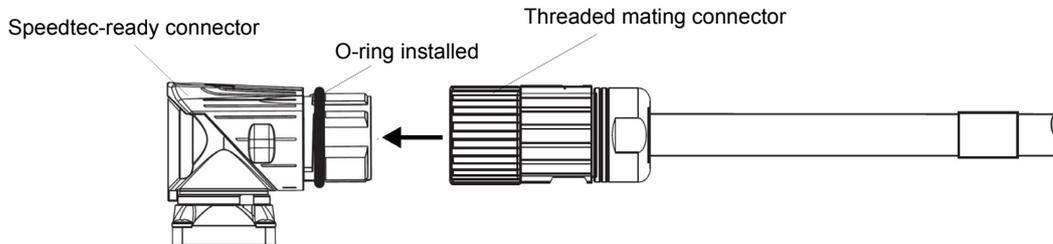


Figure 7: Speedtec-ready motor connector with O-ring

If a Speedtec-ready connector is used with a Speedtec plug mating connector, the O-ring should be removed from the motor connector.

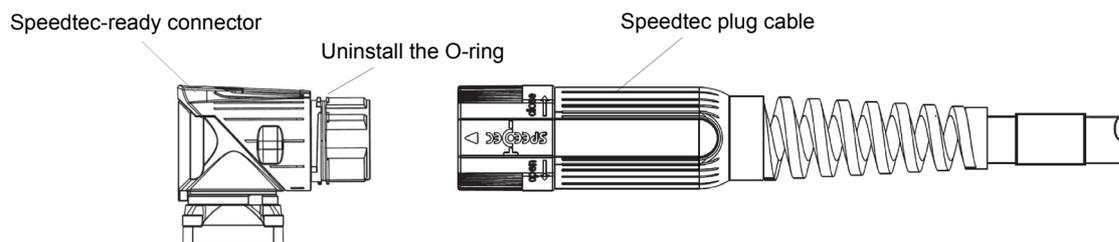


Figure 8: Speedtec-ready motor connector with O-ring uninstalled

⇒ For more details on connectors please contact Moog personnel.

8 Maintenance

WARNING

Risk of injury!

- ▶ In case of motor disassembly make sure that all electrical power motor windings and any accessory device from the motor is disassembled which otherwise may lead to fatal injury.

NOTICE

Because of product liability issues any motor damage should be repaired by Moog. Non Moog staff may be unable to comply with safety rules (e.g. VDE guide lines) and Moog quality standards.

Any unexpected mechanical rotation of parts can cause severe damage during maintenance operation.

NOTICE

Each time the motor is disassembled care should be taken that encoder system phasing is done properly by Moog personnel.

Observe the following:

- Before performing any maintenance procedure make sure that shaft rotation is locked. Make sure that the equipment connected to the shaft does not cause any shaft rotation. Disconnect the load if necessary before performing maintenance.
- Check for bearing noise and vibrations for normal operation of motor at regular intervals.
- Bearing service life is approx. -20,000 hours.
- Brakes should be checked on fixed regular intervals to ensure safe and trouble free running of motor.
 - Check for full engagement and disengagement functioning of brake.
 - Check brake torque for holding the motor. If torque is below as specified in the name plate, brake may have to be re-burnished. For more details on this please contact Moog personnel.
- Keep the motor clean in order to ensure free ventilation and cooling.
- Check that motor is not noisy during operation and vibration does not exceed standard levels.
- To detect and correct any irregularities at early stage it is recommended to carry out inspection at first 50 to 75 operation hours.

9 Troubleshooting

Problem	Cause	Action
Motor does not start	Wrong connections	Check the connections of the motor power and signal cables.
	Mechanical brake	Check that the brake is supplied with the voltage (V_{DC}) as defined by the manufacturer.
	Mechanical failure	Check that the mechanics coupled to the servo motor allow free rotation.
	Parameters	Check the parameter settings of the drive system.
	Overload	Reduce the load or contact application engineer for more details.
Motor does not reach the rated speed	Parameters	Check the parameter settings of the drive system.
	Overload	Reduce the load or contact application engineer for more details.
Motor runs in wrong direction	Connections	Check both the power and signal connections on the motor and drive side.
Motor overheats	Overload	Reduce the load or contact application engineer for more details.
	Wrong connections	Check that no phase is incidentally open or grounded.
	Harmonic distortion	High harmonic distortion in the frequency converter output is not allowed.
Vibrations or loud noise	Bearing failure	Contact Moog for repairs.
	Misalignment	Check the correct alignment of the motor and load. Ignoring misalignment can cause serious damage of bearings, shaft and mechanics.
Fan does not start (in case of fan cooled motors)	Wrong connections	Check the polarity and proper connection sequence.
	Obstruction in the fan kit	Clean dust particle entrapped between fan blades.
Vibrations or loud noise in fan (in case of fan cooled motors)	Bearing failure in the fan kit	Contact Moog for repairs.

10 Motor Disposition

Motors may contain environmentally regulated materials, such as lead solder and circuit boards. When disposing of a motor, please recycle motors per regulations applicable at your region (National/International standards or regulations). You may choose to return a motor for disposal by contacting Moog personnel. Please contact Moog site for supplied motor warranty, non-warranty, or disposal work.

10.1 What to do if repairs are required?

If a repair of a Moog motor should prove necessary, all parts such as gear, toothed wheels, pinions etc. not fitted by Moog should be removed because Moog cannot guarantee correct disassembly. Grease and dirt on the front flange should be removed. Moog would appreciate a detailed failure or breakdown report attached to the delivery paperwork. "For Repair" should be clearly stated on the delivery note.

11 Ordering Code

G - [] - [] - [] - [] - [] - [] - [] - [] - [] - []

Motor size	
1	40 mm (Flange)
2	55 mm (Flange)
3	70 mm (Flange)
4	100 mm (Flange)
5	140 mm (Flange)
6	190 mm (Flange)

Cooling options	
-	Natural cooling
F	Fan cooling for size 4/5/6

DC link voltage	
M	Low voltage: 325 V _{DC} With NTC thermal sensor
V	High Voltage: 565 V _{DC} With PTC thermal sensor

Stack length ¹⁾						
Code	Motorsize					
	1	2	3	4	5	6
0	Special					
2	L20	L05	L05	L05	L10	L15
4	L40	L10	L15	L10	L20	L30
6	L60	L20	L25	L20	L30	L45
8	-	L40	L40	L40	L50	L60
9	-	-	-	L60	L70	L90

Rated speed ²⁾	
xxx	r/100 min
²⁾ Example: r/min = 3500/100 = 035	

Special version	
00	Standard version

Electrical options ³⁾					
	Brake options		Rotable connector	Straight connector	Fixed angled connector
	1	2			
00					
01					
02					
03					
04					
05					
06					
07					
08					
09	Special				

Mechanical option		
	Keyway	Shaft exit seal
00		
01		
02		
03		
04	Special	

Brake options							
		Motor size					
		1	2	3	4	5	6
1	Low torque	0.4 Nm	1 Nm	2 Nm	9 Nm	14 Nm	22 Nm
2	High torque	-	-	4.5 Nm	14 Nm ⁴⁾	22 Nm	72 Nm

¹⁾ Active length in 0.1 inch (for G-1 in mm)

³⁾ Resolver motors come with fixed angled connectors
Encoder motors come with rotatable angled connectors

⁴⁾ With encoder holding torque 14.5 Nm (128.5 lb)

Feedback options							
	Motor size						Resolver/ Encoder type
	1	2	3	4	5	6	
00	Not allowed						Incremental
01	2 poles resolver						
02	-	-	-	-	-	Steg- mann	
03	-	SKS36	-	SRS50	-		Absolute single turn
04	-	SKM36	-	SRM50	-		Absolute multi turn
05	-	ERN1185	-	ERN1387	-	Incremental	
06	-	ECN1113	-	ECN1313	-	Absolute single turn	
07	-	EQN1125	-	EQN1325	-	Absolute multi turn	
08	Special						Heiden- hain

TAKE A CLOSER LOOK.

Moog designs a range of products that complement the performance of those featured in this user manual. Visit our Web site for more information and the Moog facility nearest you.

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