SEW EURODRIVE

Addendum to the Operating Instructions

Safety-Rated Encoders

Functional Safety for AC Motors

DR.71-225, 315

Edition 06/2011

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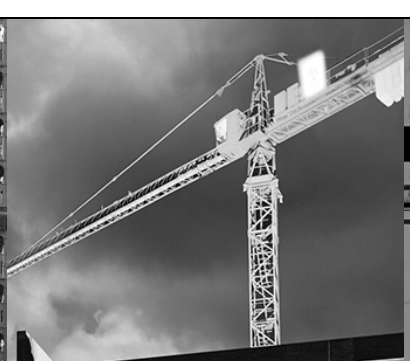


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Contents

1 General Notes

1.1 How to use the operating instructions

The present addendum to the "Safety-Rated Encoders – Functional Safety for AC Motors DR.71-225, 315" operating instructions provide specific information regarding the safety-rated encoders of DR motors.

The "AC Motors DR.71-225, 315" operating instructions provide all the information regarding AC motors without safety-rated attachments.

The documentation for a motor with safety-rated encoders comprises

- the "DR.71-225, 315 AC Motors" operating instructions
- the "Safety-Rated Encoders – Functional Safety for AC Motors DR.71-225, 315" addendum to the operating instructions

The operating instructions and the addendum to the operating instructions are an integral part of the product and contain important information for operation and service. They are intended for staff responsible for the assembly, installation, startup and maintenance of the product.

The operating instructions and the addendum to the operating instructions must be legible and accessible at all times. Make sure that staff responsible for the plant and its operation, as well as persons who work independently on the unit, have read the operating instructions and the addendum to the operating instructions carefully and understood them. If you are unclear about any of the information in this documentation, or if you require further information, contact SEW-EURODRIVE.

Make sure you always use the latest documentation and software version.

Our documentation is available in various languages for download from the SEW homepage (www.sew-eurodrive.com). Consult SEW-EURODRIVE if you are unclear about any of the information in this documentation, or if you require further information.

You can also order the printed documentation from SEW-EURODRIVE.

1.2 Standards

The safety assessment of the encoder is based on the following standards and safety classes:

Underlying standards for safety-rated encoders	
Safety class / standard	• Safety Integrity Level (SIL) according to IEC 62061 • Performance Level (PL) according to EN ISO 13849-1

1.3 Structure of the safety notes

1.3.1 Meaning of the signal words

The following table shows the grading and meaning of the signal words for safety notes, notes on potential risks of damage to property, and other notes.

Signal word	Meaning	Consequences if disregarded
⚠ **DANGER**	Imminent danger	Severe or fatal injuries
⚠ **WARNING**	Possible dangerous situation	Severe or fatal injuries
⚠ **CAUTION**	Possible dangerous situation	Minor injuries
NOTICE	Possible damage to property	Damage to the drive system or its environment
INFORMATION	Useful information or tip: Simplifies the handling of the drive system.	

1.3.2 Structure of the section-related safety notes

Section safety notes do not apply to a specific action, but to several actions pertaining to one subject. The used symbols indicate either a general or a specific hazard.

This is the formal structure of a section safety note:

⚠ SIGNAL WORD

Type and source of danger.

Possible consequence(s) if disregarded.

- Measure(s) to prevent the danger.

1.3.3 Structure of the embedded safety notes

Embedded safety notes are directly integrated in the instructions just before the description of the dangerous action.

This is the formal structure of an embedded safety note:

- ⚠ **SIGNAL WORD** Nature and source of hazard.

  Possible consequence(s) if disregarded.

  – Measure(s) to prevent the danger.

1.4 Rights to claim under limited warranty

Compliance with the provisions in the addendum to the operating instructions is a prerequisite for maintaining the guaranteed functional safety properties for this drive.

Performing any actions that go beyond those described in the addendum to the operating instructions, or failure to comply with the requirements, will shift the responsibility for the traceability of the safety components and the liability for functional safety to the operator.

A requirement of fault-free operation and fulfillment of any rights to claim under limited warranty is that you adhere to the information in the operating instructions and the addendum to the operating instructions. Read the operating instructions and the addendum to the operating instructions before you start working with the unit.

1.5 Exclusion of liability

You must comply with the information contained in the operating instructions and the addendum to the operating instructions to ensure safe operation of the electric motors and to achieve the specified product characteristics and performance features. SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of the operating instructions and the corresponding addendum. In such cases, any liability for defects is excluded.

1.6 Copyright

1.7 Product names and trademarks

The brands and product names contained within this publication are trademarks or registered trademarks of the titleholders.

2 Safety Notes

The following basic safety notes must be read carefully to prevent injury to persons and damage to property. The operator must ensure that the basic safety notes are read and observed. Make sure that persons responsible for the plant and its operation, as well as persons who work independently on the unit, have read through the operating instructions and the addendum to the operating instructions carefully and understood them. If you are unclear about any of the information in this documentation, please contact SEW-EURODRIVE.

2.1 Preliminary information

The following safety notes are primarily concerned with the use of the following components: DR.. AC motors. If using gearmotors, please also refer to the safety notes in the corresponding operating instructions for:

- Gear unit

Also observe the supplementary safety notes in the individual sections of this documentation.

2.2 General information

⚠ WARNING

During operation, the motors and gearmotors can have live, bare (in the event of open connectors/terminal boxes) and movable or rotating parts as well as hot surfaces, depending on their enclosure.

Severe or fatal injuries.

- All work related to transportation, storage, installation, assembly, connection, startup, maintenance and repair may only be carried out by qualified personnel, in strict observance of:
  - The relevant detailed operating instructions
  - The warning and safety signs on the motor/gearmotor
  - All other project planning documents, operating instructions and wiring diagrams related to the drive
  - The specific regulations and requirements for the system
  - The national/regional regulations governing safety and the prevention of accidents
- Never install damaged products
- Immediately report any damage to the shipping company

Removing the required protection cover or the housing without authorization, improper use as well as incorrect installation or operation may result in severe injuries to persons or damage to property.

This documentation provides additional information.

2.3 Target group

Any mechanical work may only be performed by adequately qualified personnel. Qualified personnel in this context are persons who are familiar with the setup, mechanical installation, trouble-shooting and maintenance for this product. Further, they are qualified as follows:

- Completed apprenticeship in the field of mechanical engineering (e.g. mechanic or mechatronic technician).
- Knowledge of the content of the detailed operating instructions.

Any electric work may only be performed by adequately qualified personnel. Qualified electricians in this context are persons who are familiar with the electronic installation, startup, trouble shooting and maintenance for this product. Further, they are qualified as follows:

- Completed apprenticeship in the field of electrical engineering (e.g. electric or mechatronic technician).
- Knowledge of the content of the detailed operating instructions.

Any activities regarding transportation, storage, operation, and disposal must be carried out by persons who have been instructed appropriately.

All qualified personnel must wear appropriate protective clothing.

2.3.1 Functional safety (FS)

If you perform any work on safety-rated encoders (identified by the FS logo on the nameplate) yourself, note that disassembly and assembly work on the safety-rated encoder may only be performed by qualified personnel, and that the responsibility for the traceability of the safety-rated encoder and the liability for functional safety shifts to the operator.

In addition to the qualifications listed above, these persons must be familiar with:

- Functional safety
- The relevant safety regulations and laws, especially with the requirements of EN ISO 13849-1 and all other standards, directives and laws specified in this documentation.
- The content of the publication "Addendum to the Operating Instructions: "Safety-Rated Encoders – Functional Safety for AC Motors DR.71-225, 315"
- The content of the detailed operating instructions.

For working with safety-rated brakes, also observe the publication "Addendum to the operating instructions: "Safety-Rated Brakes – Functional Safety for AC Motors DR.71-225, 315"

2.4 Designated use

The DR.. electric motors are intended for industrial systems.

When installed in machines, startup of the motors (i.e. start of designated operation) is prohibited until it is determined that the machine meets the requirements stipulated in EC Directive 2006/42/EC (Machinery Directive). SEW-EURODRIVE recommends to stop the drive with stop category 1 according to EN 60204-1 (SS1) if possible; no STO.

Using these products in potentially explosive atmospheres is prohibited, unless specifically designated otherwise.

Air-cooled types are dimensioned for ambient temperatures of -20 °C to +40 °C and installation altitudes ≤ 1000 m above sea level. Note that information on the nameplate may differ. The ambient conditions must comply with all the specifications on the nameplate.

For DR.. motors with BE.. brake, the brake must solely be used as a holding brake, consequently the designated use would be an engagement in standstill (< 50 rpm). Operating the motor beyond its designated use may permanently affect the encoder performance. Sporadic emergency braking processes (voltage drop, emergency switching-off) can be performed without affecting the encoder.

2.5 Functional safety (FS)

Observe the notes and measures described below.

2.5.1 Labeling

If functional safety is integrated in the motor, this is indicated with an FS symbol on the nameplate.

2.5.2 Encoder mounting

The connection between the encoder and the motor is a safety-rated frictional connection.

The mechanics and the corresponding connections can be included in the safety consideration as fault elimination. Observe the mechanical limits in section "Technical Data" (page 29).

2.5.3 Encoders in general

The safety-rated encoders described in this addendum may only be used in conjunction with the DR.. motors listed below. It is not possible to adapt them to other motors.

The safety-rated use of encoders or encoder systems is necessary for implementing safety-rated functions regarding speed, direction of rotation and standstill from the encoder that is coupled directly with the motor shaft. In addition, a suitable higher-level encoder evaluation unit is required, as the encoder with its encoder-internal diagnostic function is not able to trigger responses such as initiating a safe status on its own initiative.

There are higher requirements regarding the electrical and mechanical connection, e.g. the shielded twisted-pair connection lead with correct EMC-compliant wiring and the strict observance of the (dis)assembly, e.g. the observance of the tightening torques for the screws.

Encoders AS7W, AS7Y, AG7W, AG7Y, EG7S, ES7S

The RS485 interface cannot be used in connection with safety technology for transferring absolute position data and other data (nameplate, diagnostics). This information can be used for general diagnostic purposes.

Motor type	Encoder type	Part number		Safety class	Safety function
		Without connection cover	With connection cover		
DR.71 – DR.132	ES7S	1 363 073 3	1 363 074 1	SIL2 according to IEC 62061 Up to PL d according to EN ISO 13849-1	SLS, SDI, SLA, SS1, SS2, SOS, SLI
	AS7W	1 363 076 8	1 363 077 6		
	AS7Y	1 363 078 4	1 363 079 2		
DR.160 – DR.315	EG7S	1 363 080 6	1 363 081 4		
	AG7W	1 363 084 9	1 363 085 7		
	AG7Y	1 363 086 5	1 363 087 3		

When placing a repeat order for an encoder with functional safety technology, you can order it without connection cover.

2.6 Transport/storage

Inspect the shipment for any damage that may have occurred in transit as soon as you receive the delivery. Inform the shipping company immediately. It may be necessary to preclude startup.

Tighten the eyebolts securely. They are designed to only carry the weight of the motor/gearmotor; do not attach any additional loads.

The built-in lifting eyebolts comply with DIN 580. Always observe the loads and regulations listed in this standard. If the gearmotor is equipped with two eyebolts, then both should be used for transportation. In this case, the tension force vector of the slings must not exceed a 45° angle according to DIN 580.

Use suitable, sufficiently rated handling equipment if required. Reattach these in the case of further transportation.

Store the motor/gearmotor in a dry, dust-free environment if it is not to be installed straight away. You must not store the motor/gearmotor outdoors or on the fan guard. The motor/gearmotor can be stored for up to 9 months without requiring any special measures before startup.

2.7 Installation

Make sure that the supports are even, the foot and flange mounting is correct and if there is direct coupling, align with precision. Resonances between the rotational frequency and the double network frequency caused by the structure are to be avoided. Release the brake (if installed), turn rotor manually, check for unusual grinding noise. Check the direction of rotation in decoupled status.

Only install or remove belt pulleys and couplings using suitable devices (heat up) and cover with a touch guard. Avoid improper belt tension.

Make the pipe connections that may eventually be required. Mounting positions with shaft ends pointing upwards should be equipped with a cover to prevent foreign objects from falling into the fan. Ensure that ventilation openings are not obstructed and that used air, including air from adjacent units, cannot be drawn in again straight away.

2.8 Electrical connection

All work may only be carried out by qualified personnel. During work, the low-voltage machine must be at standstill, enabled, and safeguarded against accidental restart. This also applies to auxiliary circuits (e.g. anti-condensation heating or forced cooling fan).

Check that the motor is de-energized!

Exceeding the tolerances in EN 60034-1 (VDE 0530, part 1) – voltage + 5%, frequency + 2%, curve shape, symmetry – increases the heating and influences electromagnetic compatibility. Also comply with EN 50110 (where necessary, observe other applicable national regulations, such as DIN VDE 0105 for Germany).

Observe the wiring information and differing data on the nameplate as well as the wiring diagram in the terminal box.

The connection should be a continuous secure electrical connection (no protruding wire ends); use the cable end equipment intended for this purpose. Establish a secure protective earth connection. When the motor is connected, the distances to non-insulated and live parts must not be shorter than the minimum values according to IEC 60664 and national regulations. With low voltage, the distances should be no shorter than the following values, in compliance with IEC 60664:

Nominal voltage V_N	Distance
≤ 500 V	3 mm
≤ 690 V	5.5 mm

The terminal box must be free of foreign objects, dirt and humidity. Unused cable entry openings and the box itself must be closed so that they are dust and water proof. Secure keys for test mode without output elements. When operating low-voltage machines with brakes, check that the brake is functioning correctly before startup.

Observe the notes in the "Electrical Installation" chapter.

2.9 Startup/operation

Whenever changes to normal operation occur, such as increased temperatures, noise, vibrations, etc., you should determine the cause. Consult the manufacturer if required. Never deactivate protection devices, even in test mode. Switch off the motor if you are not sure.

Regularly clean air ducts in dusty or dirty environments.

3 Scope of Delivery and Unit Design

3.1 Functional safety technology (FS)

SEW-EURODRIVE drives can be supplied with safety-rated components.

MOVIMOT®, encoders or brakes, or other accessories, can be integrated in the AC motor as safety-relevant components either individually or in combination.

SEW-EURODRIVE indicates such an integration by the FS mark and a number on the nameplate.

The number is a code that indicates which components in the drive are safety-related. See the following code table for all products:

Functional safety	Inverter (e.g. MOVIMOT®)	Brake	Manual brake release monitoring	Brake monitoring	Motor protection	Encoder
01	x					
02		x				
03					x	
04						x
05	x	x				
06	x				x	
07	x					x
08		x	x			
09		x		x		
10		x			x	
11		x				x
12					x	x
13	x	x				x
14	x				x	x
15		x	x			x
16		x		x		x
17		x			x	x
18	x	x	x		x	
19	x	x	x			x
20	x	x		x	x	
21	x	x		x		x
22	x	x			x	x
23	x	x	x		x	x
24	x	x		x	x	x
25	x	x	x	x	x	x
26		x	x	x		
27		x	x	x		x
28		x	x		x	
29		x		x	x	
30		x	x	x	x	
31		x	x		x	x
32		x		x	x	x
33		x	x	x	x	x
34	x	x	x			
35	x	x		x		

Functional safety	Inverter (e.g. MOVIMOT®)	Brake	Manual brake release monitoring	Brake monitoring	Motor protection	Encoder
36	x	x	x	x		
37	x	x	x	x		x
38	x	x			x	
39	x	x	x	x	x	

For example, if the FS logo on the nameplate shows "FS 07", the motor is equipped with a MOVIMOT® inverter with Safe Torque Off (STO) and safety-rated encoder.

If the drive bears the FS mark on the nameplate, you must adhere to the information in the following documents:

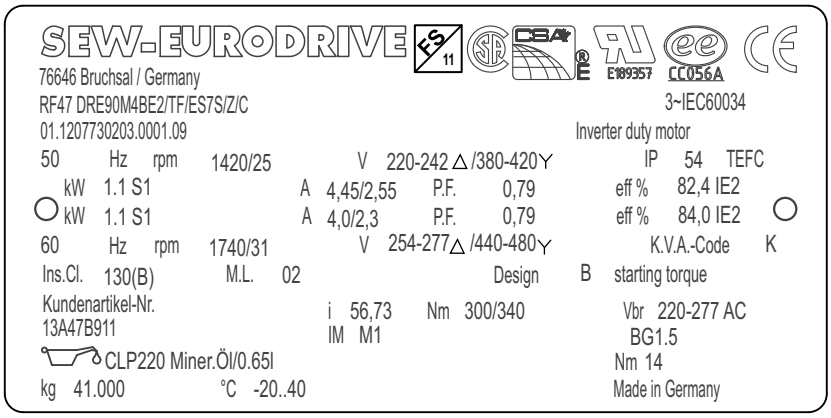
- "Safety-Rated Encoders – Functional Safety for AC Motors DR.71-225, 315" addendum to the operating instructions
- "Safety-Rated Brakes – Functional Safety for AC Motors DR.71-225, 315" addendum to the operating instructions
- "MOVIMOT® MM..D Functional Safety" manual

You can determine the safety level of machines and plants using the safety parameters provided in chapter "Technical Data"

The characteristic safety values of SEW components are also available on the SEW homepage on the Internet and in the SEW library for the Sistema software of the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA, formerly BGIA).

3.2 Nameplate

3.2.1 FS logo on the nameplate of DR gearmotors



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The labels on the upper edge of the nameplate are only present if the motor has been designed accordingly and if it includes at least one safety-rated component.

The FS logo on the nameplate is based on the combination of safety-related components that is installed, see code table above.

4 Mechanical Installation

The use of safety-rated components does not affect mechanical installation.

INFORMATION

It is important that no grease or oil comes in contact with the encoder connection during installation or operation.

5 Electrical Installation

INFORMATION

- Observe the safety notes in chapter 2 during installation.
- Use switch contacts in utilization category AC-3 according to EN 60947-4-1 for switching the motor and the brake.

⚠ WARNING

Disabling functional safety devices.

Severe or fatal injuries.

- Only qualified personnel is allowed to carry out work on functional safety components.
- Any work on functional safety components must be carried out by strictly observing the specifications in the operating instructions at hand and the respective addendum to the operating instructions. Else, the right to claim under warranty will become invalid.

Note the information and explanations about correct wiring in the corresponding operating instructions.

SEW-EURODRIVE recommends to use prefabricated cables for connecting encoders, see the "AC Motors DRE/DRS/DRP/DRL" catalog.

6 Startup

6.1 Requirements

INFORMATION

- Observe the safety notes in chapter 2 during installation.
- In case of problems, refer to chapter "Malfunctions" in the operating instructions.

⚠ WARNING

Disabling functional safety devices.

Severe or fatal injuries.

- Only qualified personnel is allowed to carry out work on functional safety components.
- Any work on functional safety components must be carried out by strictly observing the specifications in the operating instructions at hand and the respective addendum to the operating instructions. Else, the right to claim under warranty will become invalid.

6.2 Changing the blocking direction

The backstop is used to block a direction of rotation of the motor. The direction of rotation is indicated by an arrow on the fan guard of the motor or on the gearmotor housing.

⚠ WARNING

Risk of crushing if the drive starts up unintentionally.

Severe or fatal injuries.

- Before starting work, isolate the motor and, if installed, the forced cooling fan from the power supply.
- Safeguard against accidental startup.
- Carefully observe the steps described below.

Proceed as follows to change the blocking direction:

1. Disassemble the encoder and, if applicable, the forced-cooling fan, see chapter "Removing/installing encoders (page 20)".
2. Proceed according to the operating instructions to change the blocking direction.

7 Inspection / Maintenance

⚠ WARNING

Risk of crushing if the hoist falls or in the event of uncontrolled unit behavior.

Severe or fatal injuries.

- Secure or lower hoist drives (danger of falling)
- Safeguard and/or protect the driven machine against touching
- Isolate the motor, brake, and forced cooling fan, if installed, from the power supply before starting work, safeguarding them against unintentional re-start.
- Only use genuine spare parts in accordance with the valid parts list.
- Always install a new brake controller at the same time as replacing the brake coil.

⚠ WARNING

Disabling functional safety devices.

Severe or fatal injuries.

- Only qualified personnel is allowed to carry out work on functional safety components.
- Any work on functional safety components must be carried out by strictly observing the specifications in the operating instructions at hand and the respective addendum to the operating instructions. Else, the right to claim under warranty will become invalid.

⚠ CAUTION

The surface temperatures on the drive can be very high during operation.

Danger of burns.

- Let the motor cool down before you start your work.

NOTICE

For assembly, the ambient temperature and the oil seals themselves may not be colder than 0 °C, else the oil seals might be damaged.

7.1 Functional safety (FS)

Certain demands on the mechanical coupling of the encoder system to the motor must be met so that the encoder can be used for safety-relevant tasks.

SEW-EURODRIVE assumes responsibility for the delivered motor with safety-rated encoder in terms of compliance with the functional safety regulations. Safety-rated connection elements are sealed to ensure that the delivery condition is not changed.

There are two options for performing work on the encoder or motor during which these sealed screw connections must be opened:

- Ask SEW-EURODRIVE Service to perform this work.
- Perform the work yourself. Note that all work on the safety-rated encoder and its mechanical coupling is carried out at your own risk. The responsibility for the traceability of the safety-rated encoder and for the safety-rated functions, in particular the connection on the motor, and the liability for functional safety shifts to the operator.

  Additionally observe the following notes regarding disassembly and assembly work on the encoder:

  Only qualified staff is permitted to perform disassembly and assembly work on the safety-rated encoder – indicated by the FS logo on the nameplate. Those persons must be familiar with:

  – Functional safety
  – The relevant safety regulations and laws, especially with the requirements of EN ISO 13849-1 and all other standards, directives and laws specified in this documentation.
  – The content of the publication in hand "Addendum to the Operating Instructions: "Safety-Rated Encoders – Functional Safety for AC Motors DR.71-225, 315"
  – The content of the detailed operating instructions.

7.2 Removing/installing encoders

INFORMATION

During assembly, observe the tightening torques specified in this documentation to provide for a fault elimination of the mechanical connection between the drive component and the rotary encoder according to EN 61800-5-2.

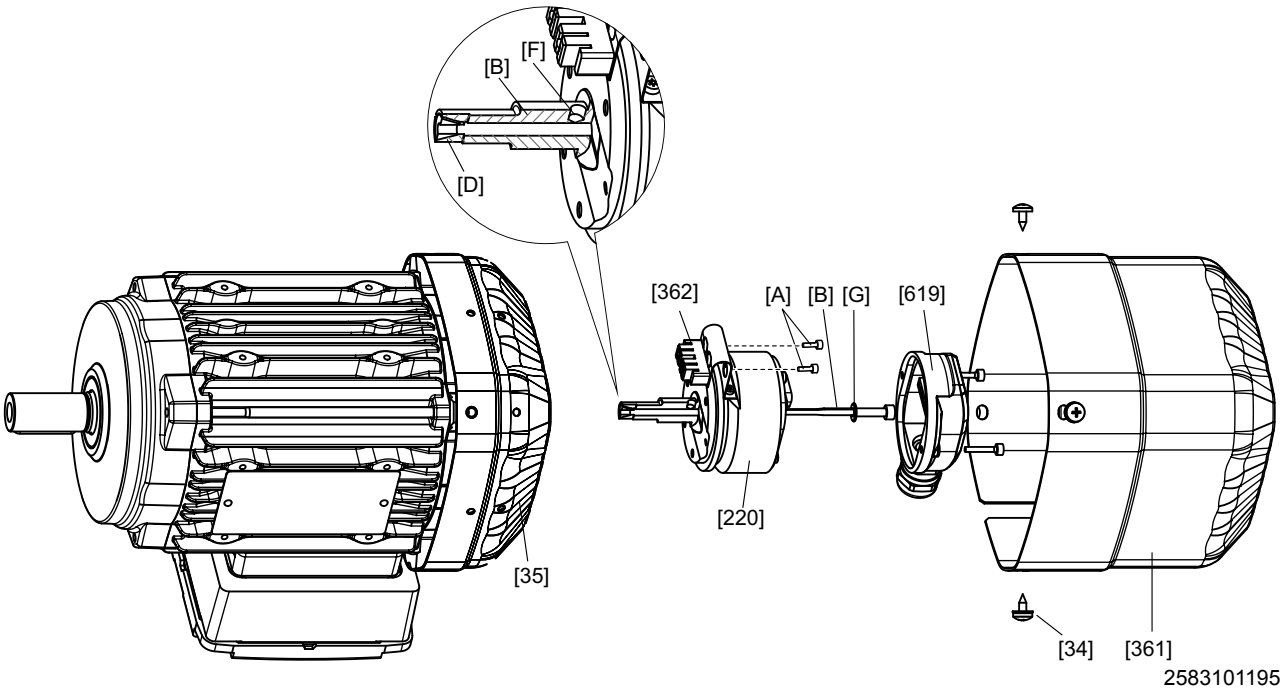
7.2.1 Required tools

You need the following tools to remove or install an encoder. Make sure that all the tools are available before you remove/install an encoder.

- New expansion anchor [362]. You can order the expansion anchor from SEW-EURODRIVE by quoting part number 13617311.
- Compound against contact corrosion, such as NOCO® fluid
- Various sizes of hex keys
- Various sizes of outer hexagon wrenches
- Torque wrench for tightening torques of 2.0 Nm (17.7 lb-in) to 8.0 Nm (70.8 lb-in)
- Sensor with a measuring range of 1/100 mm for measuring the wobble

7.2.2 Removing/installing encoders for DR.71 – DR.132

The following figure illustrates disassembly using the ES7. encoder as an example:



[34]	Tapping screw	[361]	Extended fan guard	[A]	Retaining screws for the torque arm	[D]	Cone
[35]	Fan guard	[362]	Expansion anchor			[F]	Bore
[220]	Encoder	[619]	Connection cover	[B]	Central retaining screw	[G]	Lock washer

Disassembling ES7./AS7.

1. Remove the extended fan guard [361] and, if installed, the forced cooling fan.
2. Unscrew and remove the connection cover [619]. Do not disconnect the encoder connection cable.

3. Unfasten the expansion anchor [362] by unscrewing the screws [A] from the cover grid.

   Dispose of the expansion anchors.

4. Unscrew the central retaining screw [B] by about 2 to 3 turns (do not remove) and unfasten the cone [D] of the spread shaft by tapping lightly on the head of the screw.

5. Pull the encoder [220] from the rotor bore.

   If the encoder is hard to loosen, you can loosen or counterhold the encoder shaft at the bore [F].

Re-assembly

SEW-EURODRIVE recommends that you use the checklist from the appendix (page 33) to install an encoder and return the checklist to SEW-EURODRIVE, if required.

Proceed as follows to re-assemble the encoder:

1. Apply a contact corrosion prevention compound, e.g. NOCO® fluid to the encoder pin.
2. Install the washer [G] and tighten the central retaining screw [B] with a tightening torque of 2.9 Nm (25.7 lb-in).
3. ⚠ **WARNING** Disabling the functional safety device.

   Severe or fatal injuries.

   – You must tighten the central retaining screw with the specified tightening torque.

4. Press the expansion anchor into the fan guard and make sure that it is fitted properly.

   Always use a new expansion anchor when installing the encoder again.

5. Screw the retaining screws [A] of the torque arm [362] into the expansion anchor all the way and tighten it with a tightening torque of 2.0 Nm (17.7 lb-in).
6. ⚠ **WARNING** Disabling the functional safety device.

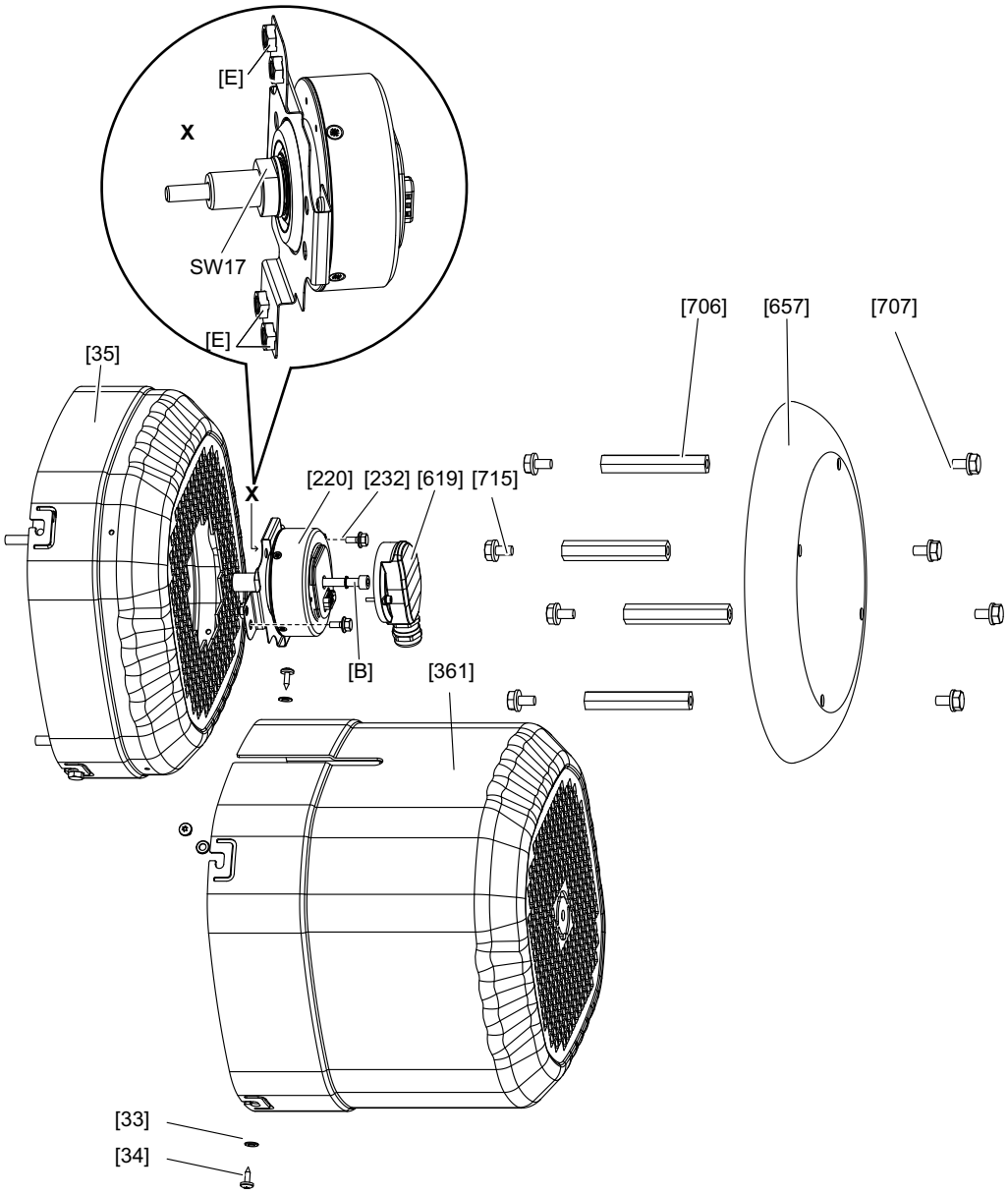
   Severe or fatal injuries.

   – You must tighten the retaining screws for the torque arm with the specified tightening torque.

7. Install the connection cover [619].
8. Measure the wobbling as described in chapter "Measuring wobbling" (page 24).
9. Install the forced cooling fan, if present.
10. Install the extended fan guard [361].

7.2.3 Removing/installing encoders for DR.160 – DR.225

The following figure illustrates disassembly using the EG7. encoder as an example:



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[33]	Washer	[361]	Extended fan guard	[715]	Hex head screws
[34]	Tapping screw	[619]	Connection cover	[B]	Central retaining screw
[35]	Fan guard	[657]	Canopy		
[220]	Encoder	[706]	Spacer bolt	[E]	Nuts
[232]	Retaining screws for the torque arm	[707]	Hex head screws		

Disassembling EG7./AG7.

1. Perform one of the following steps depending on the housing design:
   - Loosen the screws [707] and remove the canopy [657].

     Use SW13 spacer bolts [706] to counterhold.

     Remove forced cooling fan, if installed.
   - Loosen the screws [34] and remove the extended fan guard [361].

     Remove the forced cooling fan, if installed.
2. Unscrew and remove the connection cover [619].
3. Remove the screws [232].
4. Remove the fan guard [35].
5. Force off the encoder [220] by loosening the central retaining screw [B].

   If the encoder is hard to loosen, you can loosen or counterhold the encoder shaft at the installed SW17 spanner flat.

Re-assembly

SEW-EURODRIVE recommends that you use the checklist from the appendix (page 33) to install an encoder and return the checklist to SEW-EURODRIVE, if required.

Proceed as follows to re-assemble the encoder:

1. Apply a contact corrosion prevention compound, e.g. NOCO® fluid to the encoder shaft.
2. Apply the encoder in the rotor bore and screw it in with the central retaining screw [B] all the way and tighten the screw with 8 Nm (70.8 lb-in).
3. ⚠ **WARNING** Disabling the functional safety device.

   Severe or fatal injuries.
   - You must tighten the central retaining screw with the specified tightening torque.
4. Remove any residues of the old thread locking compound from the threads of the retaining screws of the torque arm [232].
5. Apply a medium thread locking compound, e.g. LOCTITE® 241, to the 2 screws and screw the torque plate of the encoder to the fan grille with a tightening torque of 6 Nm (53.1 lb in).
6. ⚠ **WARNING** Disabling the functional safety device.

   Severe or fatal injuries.
   - You must tighten the retaining screws for the torque arm with the specified tightening torque.
7. Install connection cover [619].
8. Measure the wobbling as described in chapter "Measuring wobbling" (page 24).
9. Install the forced cooling fan, if present.
10. Install the canopy [657] with the screws [707], or install the extended fan guard [361] with the screws [34].

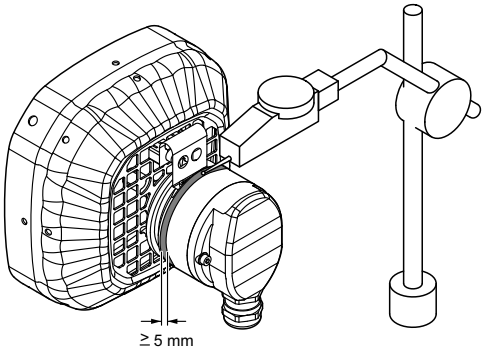
7.3 Measuring wobbling

Wobbling must be measured each time an encoder is installed to ensure it is seated properly.

Proceed as follows to measure wobbling:

7.3.1 Encoders for DR.71 – DR.132

1. Place the sensor on the upper edge of the encoder as shown in the figure below:



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The measurement must be carried out within the marked zone (max. width = 5 mm).

2. Turn the motor shaft. If required, start up the motor at low speed (< 60 rpm).
3. Check the wobble at the sensor. The maximum permitted wobble on the rotary encoder must be ≤ 0.07 mm when turning the motor shaft.

Repeat the test if the measured value is exceeded. Proceed as follows:

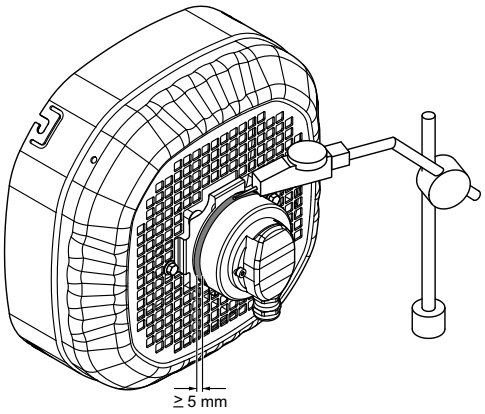
1. Loosen the central retaining screw [B] and unfasten the cone [D] by tapping lightly on the head of the retaining screw [B].
2. Turn the motor shaft or the encoder shaft on the bore [F] by 120°.
3. Tighten the central retaining screw [B] as described in the "Removing/installing encoders" chapter.
4. Measure the wobble again.

INFORMATION

If it is not possible to carry out the measurement below the permitted wobble, please contact SEW-EURODRIVE.

7.3.2 Encoders for DR.160 – DR.225

1. Place the sensor on the upper edge of the encoder as shown in the figure below:



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The measurement must be carried out within the marked zone (max. width = 5 mm).

2. Turn the motor shaft. If required, start up the motor at low speed (< 60 rpm).
3. Check the wobble on the sensor. The maximum permitted wobble on the rotary encoder must be ≤ 0.1 mm when turning the motor shaft.

Repeat the test if the measured value is exceeded. Proceed as follows:

1. Remove the encoder as described in the "Removing/installing encoders" chapter.
2. Turn the motor shaft or the encoder shaft on the SW17 spanner flat on the encoder by 120°.
3. Install the encoder as described in the "Removing/installing encoders" chapter.
4. Measure the wobble again.

INFORMATION

If it is not possible to carry out the measurement below the permitted wobble, please contact SEW-EURODRIVE.

7.4 DR.. (brake)motor – inspection procedure

⚠ WARNING

Risk of crushing if the drive starts up unintentionally.

Severe or fatal injuries.

- Isolate the motor and forced cooling fan, if installed, from the power supply before starting work, safeguarding them against unintentional re-start.
- Carefully observe the steps described below.

Proceed according to the corresponding operating instructions for all steps – except when working on the encoder.

For all steps that require the encoder to be removed, proceed according to chapter "Removing/installing encoders" (page 20).

7.4.1 Brakemotors

If the drive is equipped with a combination of a brake and a safety-rated encoder, the values regarding the maintenance intervals and the maximum working air gap differ from the standard. For the exact values, refer to chapter Technical Data (page 31).

The maintenance intervals have to be recalculated with the values specified in the addendum to the operating instructions at hand.

If the drive is equipped with a combination of a safety-rated brake and a safety-rated encoder, the addendum to the operating instructions "Safety-Rated Brakes – Functional Safety for AC Motors DR.71-225, 315" must also be observed.

8 Technical Data

8.1 Characteristic safety values

Characteristic safety values for encoders ES7S and EG7S

	Characteristic safety values according to	
	EN 62061 / IEC 61508	**EN ISO 13849-1**
Classification/underlying standards	SIL2 according to EN 62061	PL d according to EN ISO 13849-1
System structure	HFT = 1	2 channels (corresponds to category 3 according to EN ISO 13849-1)
Probability of a dangerous failure per hour (PFH_d value) [1]	8.5×10^{-9} 1/h	
Mean time to dangerous failure ($MTTF_d$ value)[2]	–	1306 years
Mission time / service life	20 years	
Proof test interval	Not required	–
Safe error contribution (SSF)	95%	–
Motor/encoder connection	In the drive with FS identification, fault exclusion according to EN ISO 13849-1	

1) The specified value refers to a diagnostics coverage of 90% that must be achieved by an encoder evaluation unit. For corresponding error presumptions, refer to the EN 61800-5-2 standard. The encoder evaluation unit must at least meet the requirements for SIL 2.

2) Ambient temperature 40 °C

Characteristic safety values for encoders AS7W and AG7W

	Characteristic safety values according to	
	EN 62061 / IEC 61508	**EN ISO 13849-1**
Classification/underlying standards	SIL2 according to EN 62061	PL d according to EN ISO 13849-1
System structure	HFT = 1	2 channels (corresponds to category 3 according to EN ISO 13849-1)
Probability of a dangerous failure per hour (PFH_d value) [1]	6.4×10^{-9} 1/h	
Mean time to dangerous failure ($MTTF_d$ value)[2]	–	1566 years
Mission time / service life	20 years	
Proof test interval	Not required	–
Safe error contribution (SSF)	95%	–
Motor/encoder connection	In the drive with FS identification, fault exclusion according to EN ISO 13849-1	

1) The specified value refers to a diagnostics coverage of 90% that must be achieved by an encoder evaluation unit. For corresponding error presumptions, refer to the EN 61800-5-2 standard. The encoder evaluation unit must at least meet the requirements for SIL 2.

2) Ambient temperature 40 °C

Characteristic safety values for encoders AS7Y and AG7Y

	Characteristic safety values according to	
	EN 62061 / IEC 61508	**EN ISO 13849-1**
Classification/underlying standards	SIL2 according to EN 62061	PL d according to EN ISO 13849-1
System structure	HFT = 1	2 channels (corresponds to category 3 according to EN ISO 13849-1)
Probability of a dangerous failure per hour (PFH_d value) [1]	6.4×10^{-9} 1/h	
Mean time to dangerous failure ($MTTF_d$ value)[2]	–	1566 years
Mission time / service life	20 years	
Proof test interval	Not required	–
Safe error contribution (SSF)	95%	–
Motor/encoder connection	In the drive with FS identification, fault exclusion according to EN ISO 13849-1	

1) The specified value refers to a diagnostics coverage of 90% that must be achieved by an encoder evaluation unit. For corresponding error presumptions, refer to the EN 61800-5-2 standard. The encoder evaluation unit must at least meet the requirements for SIL 2.

2) Ambient temperature 40 °C

The characteristic safety values of non-SEW encoders must be obtained from the respective manufacturer.

8.2 Encoders

8.2.1 ES7S / AG7S / AS7Y / EG7Y / AS7W / AG7W

Designation	Value
Operating ambient temperature for the encoder	-30 °C to +85 °C
Operating ambient temperature for the motor	-20 °C to +40 °C
Storage temperature	-15 °C to +70 °C
Maximum speed	6000 rpm
Vibration resistance (EN 60068-2-6)	≤100 m/s^2 ≈ 10 g (at 10 Hz to 2 kHz)
Maximum angular acceleration	10^4 rad/s^2
Degree of protection (EN 60529)	IP66

8.2.2 ES7S / EG7S

Designation	Value
Operating voltage	DC +7 to +30 V
Current consumption without load	100 mA
Resolution	sin/cos interface
	1024 periods / revolution
Accuracy	0.0194° (70 angular seconds) [1)]
Shock resistance (EN 60068-2-27)	ES7S: ≤ 1000 m/s^2 ≈ 100 g (6 ms)
	EG7S: ≤ 2000 m/s^2 ≈ 200 g (6 ms)

1) Due to the stiffness of the torque arm, you have to take into account an automatically resetting ± 0,6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.

8.2.3 AS7Y / AG7Y

Designation	Value
Operating voltage	DC +7 to +30 V
Current consumption without load	100 mA
Resolution of the incremental section	sin/cos interface
	2048 periods/revolution
Accuracy of the incremental section	0.0194° (70 angular seconds) [1]
Resolution of the absolute section	SSI interface, gray-coded
	12 bit = 4096 increments (single-turn)
	12 bit = 4096 increments (multi-turn)
Accuracy of the absolute section	± 1 LSB (Least Significant Bit)
Cycle frequency of the absolute section	100 kHz to 800 kHz
Shock resistance (EN 60068-2-27)	AS7Y: ≤ 1000 m/s^2 ≈ 100 g (6 ms)
	AG7Y: ≤ 2000 m/s^2 ≈ 200 g (6 ms)

1) Due to the stiffness of the torque arm, you have to take into account an automatically resetting ± 0.6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.

8.2.4 AS7W / AG7W

Designation	Value
Operating voltage	DC +7 to +30 V
Current consumption without load	100 mA
Resolution of the incremental section	sin/cos interface
	2048 periods/revolution
Accuracy of the incremental section	0.0194° (70 angular seconds) [1]
Resolution of the absolute section	RS-485 interface
	13 bit = 8192 increments (single-turn)
	16 bit = 65 536 increments (multi-turn)
Accuracy of the absolute section	± 1 LSB (Least Significant Bit)
Shock resistance (EN 60068-2-27)	AS7W: ≤ 1000 m/s^2 ≈ 100 g (6 ms)
	AG7W: ≤ 2000 m/s^2 ≈ 200 g (6 ms)

1) Due to the stiffness of the torque arm, you have to take into account an automatically resetting ± 0.6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.

8.3 Encoder evaluation unit

Designation	Value
Safety requirements	≥ SIL 2 (IEC 61508)
Error detection rate	DC ≥ 90%
Error presumptions	according to EN 61800-5-2
Signal amplitude monitoring[1]	DC 0.7 V to 1.4 V (peak-peak)

1) In the encoder evaluation unit, signals A, $\overline{A}$, B and $\overline{B}$ must be high-resistance (> 1 kΩ) to the supply voltage and 0 V.

8.4 Work done, working air gap, braking torques of the BE.. brakes

If you use a safety-rated encoder in conjunction with a brake, the maximum working air gaps and the maintenance intervals for the BE.. brakes are reduced according to the table below, replacing the values in the operating instructions.

Brake Type	Braking work until maintenance	Working air gap [mm]		Brake disk [mm]	Braking torque settings				
					Braking torque	Type and number of brake springs		Order number of brake springs	
	[10^6 J]	min. [1]	max.	min.	[Nm (lb-in)]	Standard	Blue	Standard	Blue
BE05	120	0.25	0.6	10.5	5.0 (44) 3.5 (31) 2.5 (22) 1.8 (16)	2 2 - -	4 2 6 3	0135 017 X	1374 137 3
BE1	120	0.25	0.6	10.5	10 (88.5) 7.0 (62) 5.0 (44)	6 4 2	- 2 4	0135 017 X	1374 137 3
BE2	180	0.25	0.6	10.5	20 (177) 14 (124) 10 (88.5) 7.0 (62) 5.0 (44)	6 2 2 - -	- 4 2 4 3	1374 024 5	1374 052 0
BE5	260	0.25	0.7	10.5	55 (487) 40 (354) 28 (248) 20 (177) 14 (124)	6 2 2 - -	- 4 2 4 3	1374 070 9	1374 071 7
BE11	285	0.3	0.7	11.5	110 (974) 80 (708) 55 (487) 40 (354)	6 2 2 -	- 4 2 4	1374 183 7	1374 184 5
BE20	445	0.3	0.7	12.0	200 (1770) 150 (1328) 110 (974) 80 (708) 55 (487)	6 4 3 3 -	- 2 3 - 4	1374 322 8	1374 248 5
BE30	670	0.3	0.7	12.0	300 (2655) 200 (1770) 150 (1328) 100 (885) 75 (667)	8 4 4 - -	- 4 - 8 6	0187 455 1	1374 435 6
BE32	670	0.4	0.8	12.0	600 (5310) 500 (4425) 400 (3540) 300 (2655) 200 (1770) 150 (1328)	8 6 4 4 - -	- 2 4 - 8 6	0187 455 1	1374 435 6
BE120	260	0.4	0.8	12.0	1000 (8851) 800 (7081) 600 (5310) 400 (3540)	8 6 4 4	- 2 4 -	1360 877 0	1360 831 2
BE122	260	0.5	0.9	12.0	2000 (17701) 1600 (14161) 1200 (10621) 800 (7081)	8 6 4 4	- 2 4 -	1360 877 0	1360 831 2

1) When checking the working air gap, note: Parallelism tolerances on the brake disk may cause deviations of ± 0.15 mm after a test run.

9 Declaration of Conformity

The following figure shows the declaration of conformity for safety-rated encoders:

EC Declaration of Conformity

SEW EURODRIVE

900810110

SEW-EURODRIVE GmbH & Co KG
Ernst-Blickle-Straße 42, D-76646 Bruchsal

declares under sole responsibility that the following products

motors of the series	**DR..**	
in connection with encoders of the type	**ES7S / EG7S** **AS7W / AG7W** **AS7Y / AG7Y** **XS7S / XG7S**	
possibly in connection with gear units of the series	**R..; RES** **F..** **K..; KES** **W..** **S..** **H..** **VARIMOT®** **VARIBLOC®**	
are in conformity with		
Machinery Directive	**2006/42/EC**	**1)**
Low Voltage Directive	**2006/95/EC**	
Applied harmonized standards	**EN 13849-1:2008** **EN 61800-5-2: 2007** **EN 12100-1:2003** **EN 12100-2:2003** **EN 13857: 2008** **EN 60034-1:2004** **EN 60034-5: 2007** **EN 60664-1:2008**	**5)** **5)**

1) The products are intended for installation in machines. Startup is prohibited until it has been established that the machinery into which these products are to be incorporated complies with the provisions of the aforementioned Machinery Directive.

5) All safety-relevant requirements of the product-specific documentation (operating instructions, manual, etc.) must be met over the entire product life cycle.

Bruchsal	01.09.10	Johann Soder	
Place	Date	Managing Director Technology	a) b)

a) Authorized representative for issuing this declaration on behalf of the manufacturer
b) Authorized representative for compiling the technical documents

10 Appendix

10.1 Checklist for "Replacing encoders with functional safety technology"

Date, place:		
Name:		
Company:		
Project / customer system:		
Motor type designation:		
Motor serial number:		
Encoder (new)	Type:	
	Part no. / ident. no.:	
	Serial no.:	
Encoder (old)	Type:	
	Part no. / ident. no.:	
	Serial no.:	

INFORMATION

Using impact screwdrivers, impulse wrenches and torque wrenches requires that these tools are inspected at regular intervals.

INFORMATION

First, attach the screws manually (using an appropriate tool), then tighten them to tightening torque.

INFORMATION

This checklist only includes the safety-relevant installation steps for documenting that an encoder with functional safety has been replaced.

The installation steps described in chapter 7 of the addendum at hand must also be adhered to.

	Description	Yes	No	Measured value
1.	Do you have the latest edition of the operating instructions at hand?			–
2.	Is the same encoder type available for replacement as the installed one?			–
3.	Was the torque arm replaced?			–
4.	Was the torque arm tightened with the specified tightening torque?			..... Nm
5.	Was the central retaining screw tightened with the specified tightening torque?			..... Nm
6.	Were the screws of the connection cover tightened with the specified tightening torque?			..... Nm
7.	Was encoder wobble measured as desribed in chapter 3?			..... mm
8.	Was SEW-EURODRIVE informed about what has happened with the replaced encoder with functional safety technology?	Return to SEW-EURODRIVE ☐		Disposed ☐

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SEW-EURODRIVE
Driving the world

SEW-EURODRIVE GmbH & Co KG
P.O. Box 3023
D-76642 Bruchsal/Germany
Phone +49 7251 75-0
Fax +49 7251 75-1970
sew@sew-eurodrive.com

➞ **www.sew-eurodrive.com**