

FS-1 Humidity Sensor

for measuring relative humidity in machine tool spindles



Version 03

Masthead

Warranty

The instructions do not contain any information on the warranty. This can be found in the General Conditions of Sales, which are available at:
www.skf.com/lubrication.

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Explanation of symbols and signs

Activities that present specific hazards to persons or material assets are indicated with warnings.

Read the instructions completely and follow all operating instructions and the warning and safety instructions.

Warning level	Consequence	Probability
 DANGER	Death / serious injury	Immediate
 WARNING	Serious injury	Possible
 CAUTION	Minor injury	Possible
NOTE	Property damage	Possible

Text formats	
Symbol	Meaning
●	Prompts an action
○	Used for itemizing
	Refers to causes / consequence or other facts
→	Provides additional information within procedures

Possible symbols	
Symbol	Meaning
	Note
	Electric shock hazard
	Slipping hazard
	Hazard from hot surfaces
	Risk of being drawn into machinery
	Crushing hazard
	Danger from suspended load
	Pressure injection hazard
	Explosion-proof component
	Electrostatic sensitive components
	Wear personal safety equipment (goggles)
	Secure (lock) the machine against accidental starting
	Environmentally sound disposal

Instructions placed on a unit, machine, or equipment, such as:

- Rotation arrows
- Fluid connection labels must be followed and kept in fully legible condition.
- Warnings

Read the lifecycle manual thoroughly and follow the safety instructions.

Abbreviations and conversion factors

Abbreviations

re	regarding
approx.	approximately
°C	degrees Celsius
s	seconds
dB (A)	sound pressure level
i.e.	that is
etc.	et cetera
poss.	possibly
<	less than
±	plus or minus
>	greater than
e.g.	for example
if	if necessary
necessary	
etc.	et cetera
usually	usually
∅	diameter
incl.	including
K	Kelvin
kg	kilogram
RH	relative humidity
kW	kilowatt
l	liter
Min.	minute
max.	maximum
min.	minimum
mm	millimeter
ml	milliliter
N	Newton
Nm	Newton meter

oz.	ounce
psi	pounds per square inch
hp	horsepower
lb.	pound
sq.in.	square inch
cu.in.	cubic inch
mph	miles per hour
fpsec	feet per second
°F	degrees Fahrenheit
fl.oz.	fluid ounce
in.	inch
gal.	gallon

Conversion factors

Length	1 mm = 0.03937 in.
Area	1 cm ² = 0.155 sq.in.
Volume	1 ml = 0.0352 fl.oz.
	1 l = 2.11416 pints (US)
Mass	1 kg = 2.205 lbs
	1 g = 0.03527 oz.
Density	1 kg/cm ³ = 8.3454 lb./gal. (US)
	1 kg/cm ³ = 0.03613 lb./cu.in.
Force	1 N = 0.10197 kp
Speed	1 m/s = 3.28084 fpsec
	1 m/s = 2.23694 mph
Acceleration	1 m/s ² = 3.28084 ft./s ²
Pressure	1 bar = 14.5 psi
Temperature	°C = (°F-32) x 5/9
Power	1 kW = 1.34109 hp

1. Safety instructions

1.1 General safety instructions

The operator must ensure that the instructions are read and fully understood by all persons tasked with working on the product or who supervise or instruct such persons. The product described here was manufactured according to the state of the art. Risks may, however, arise from its usage and may result in personal injury or damage to material assets. Any malfunctions affecting safety must be remedied immediately.

In addition to the lifecycle manual, all statutory regulations and other regulations for accident prevention and environmental protection must be observed.

1.2 General behavior when handling the product

- o The product may only be used in awareness of the potential dangers, in proper technical condition, and according to the information in this manual.
- o Personnel must familiarize themselves with the functions and operation of the product. The specified assembly and operating steps and their sequences must be observed.
- o Any unclear points regarding proper condition or correct assembly/operation must be clarified. Operation is prohibited until issues have been clarified.
- o Unauthorized persons must be kept away.
- o All safety instructions and in-house instructions relevant to the particular activity must be observed.
- o Protective and safety mechanisms cannot be removed, modified, nor disabled

during operation and must be checked for proper function and completeness at regular intervals.

If protective and safety mechanisms must be removed, they must be reinstalled immediately following conclusion of work and checked for proper function.

- o Observe the relevant safety data sheets when handling lubricants/equipment.

NOTE



Avoid electrostatic discharge!

The sensor contains electronic components that can be destroyed by electrostatic discharge when touched. Follow the safety measures against electrostatic discharge laid out in DIN EN 61340-1/-3.

1. Safety instructions

1.3 Qualified technical personnel

Only qualified technical personnel may install, operate, and maintain the products described here.

Such persons are familiar with the relevant standards, rules, accident prevention regulations, and assembly conditions as a result of their training, experience, and instruction. They are qualified to carry out the required activities and in doing so recognize and avoid any potential hazards. The definition of qualified personnel and the prohibition against employing non-qualified personnel are laid down in DIN VDE 0105 and IEC 364. Relevant country-specific definitions of qualified technical personnel apply for countries outside the scope of DIN VDE 0105 or IEC 364.

The operator is responsible for assigning tasks and the area of responsibility. The personnel must be trained and instructed prior to beginning work if they do not possess the requisite knowledge.

1.4 Operation

The following must be observed while working on the product.

- o All information within this manual and the information within the referenced documents.
- o All laws and regulations that the operator must observe.

1.5 Assembly / maintenance / malfunction / decommissioning / disposal

- o Assemble the product only outside the operating range of moving parts, at an adequate distance from sources of heat or cold.
 - o Prior to performing work, the product and the machine/system in which the product will be integrated must be depressurized and secured against unauthorized activation.
 - o All work on electrical components may be performed only with voltage-insulated tools.
 - o Fuses must not be bridged. Always replace fuses with fuses of the same type.
 - o Drill holes required for assembly only on non-critical, non-load-bearing parts.
 - o Other units of the machine/the vehicle must not be damaged or impaired in their function by the installation.
- o All relevant persons (e.g., operating personnel, supervisors) must be informed of the activity prior to beginning work. Precautionary operational measures / work instructions must be observed.
 - o Take appropriate measures to ensure that moving/detached parts are immobilized during the work and that no body parts can be pinched by unintended movements.

1.6 Intended use

The FS-1 Humidity Sensor can detect the relative humidity and transmit the reading to the customer's control unit as an electrical signal (4-20 mA).

Any other or additional usage of the FS-1 Humidity Sensor is deemed non-compliant with the intended use.

1.7 Foreseeable misuse

Any usage of the FS-1 differing from the aforementioned conditions and stated purpose is strictly prohibited. Particularly prohibited are use:

- o In a critical explosion protection zone.
- o To monitor Group 1 dangerous fluids according to Directive 67/548/EEC.
- o To monitor gases, liquefied gases, dissolved gases, vapors, or fluids whose vapor pressure exceeds normal atmospheric pressure (1013 mbar) by more than 0.5 bar at their maximum permissible operating temperature.

1.8 Disclaimer of liability

The manufacturer shall not be held liable for damage resulting from:

- o Failure to comply with these instructions.
- o The use of lubricants/media not approved for the unit type.
- o Contaminated or unsuitable lubricants.
- o Inappropriate usage.

- o Improper assembly, configuration, or filling.
- o Improper response to malfunctions.

1.9 Residual risks

Residual risk life cycle:	Remedy
Assembly Commissioning / operation Setup, retrofit Malfunction, troubleshooting, maintenance, repair Shutdown, disposal	
Contamination by foreign substances	<ul style="list-style-type: none"> • Remove any foreign substances and establish a contamination-free environment.
Destruction by electrostatic discharge	<ul style="list-style-type: none"> • Avoid electrostatic charge • Avoid fast discharge

2. Functional description

2.1 Installation in a machine tool spindle

The FS-1 Humidity Sensor detects the relative humidity (RH) inside a spindle and transmits the reading to the customer's control unit as an electrical signal (4–20 mA). Analyzing this information allows maintenance and servicing to be planned promptly, thereby increasing the process reliability and the spindle's service life.

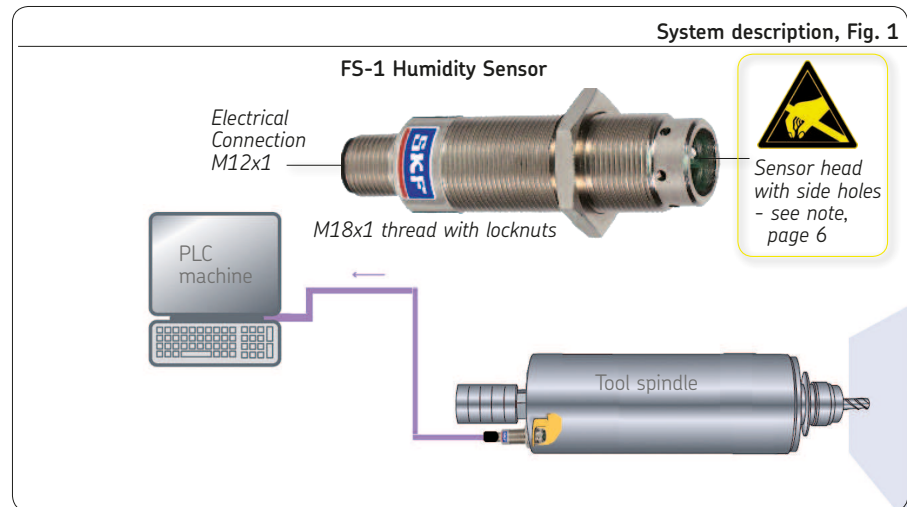
The sensor head is designed so that the ambient atmosphere can easily reach the measuring element. This is provided for by side holes on the circumference of the head or through its open front side. On delivery, a transport cap is affixed to the front side. Remove this cap before installing the humidity sensor.

The customer must determine the engagement depth so that the sensor head cannot come into contact with any moving parts. The ambient air for measurement must be able to reach the head unimpeded. The holes must be freely accessible.

The sensor's housing can be screwed into the spindle body using an M18x1 thread and must be secured using the included locknut.

The electrical connection is established via a standardized M12x1 plug.

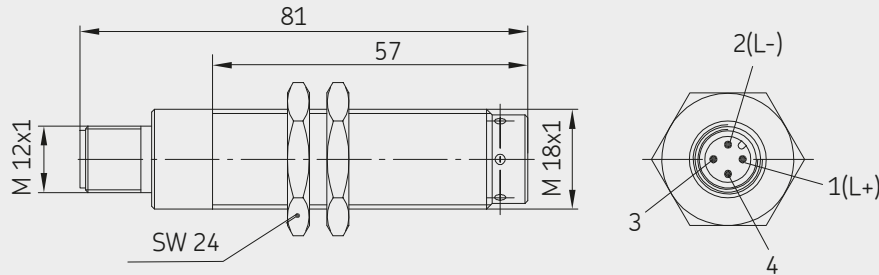
Due to the measurement principle, the measuring element in the housing of the FS-1 must be mounted in an open state and is therefore susceptible to electrostatic charge. The FS-1 Humidity Sensor should therefore not be operated in an environment susceptible to ESD.



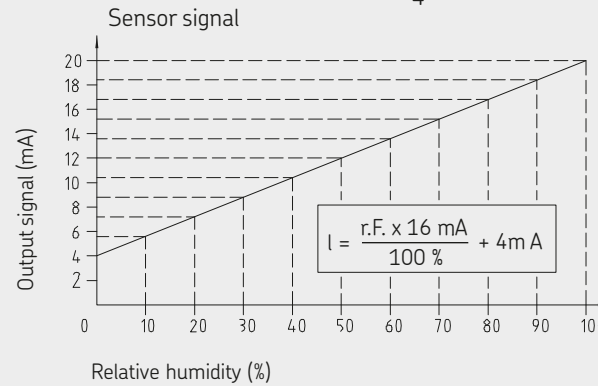
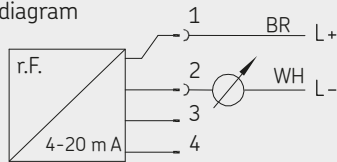
3. Technical data

3.1 General technical data

FS-1 Humidity Sensor, Fig. 2



Terminal diagram



Technical data for Fig. 2

Function	Relative humidity sensor
Measurement principle	Capacitive humidity sensor
Humidity measuring range	0 to 100% RH
Accuracy	± 3% (in range from 15 to 85 % RH at 23°C)
Operating temperature range	-25°C to +85°C
Operating voltage U_B ¹⁾	10 to 26 VDC
Apparent ohmic resistance max.	$(U_B - 10V) \times 50 [\Omega]$
Power consumption	4 to 20 mA (via two-wire line)
Output signal	4 to 20 mA (0 to 100% RH)
Reverse voltage protection	Yes
Short circuit proof	Yes
Housing material	Brass, nickel-plated
RH = relative humidity	

Technical data for Fig. 2

EMC (Electromagnetic Compatibility)

EN 61000-4-2 ESD	4 kV CD / 8 kV AD
EN 61000-4-3 RF radiated	10 V/m
EN 61000-4-4 burst ²⁾	1 kV
EN 61000-4-5 surge ²⁾	0,5/1 kV
EN 61000-4-6 conducted RF	10 V

Order number

Designation
Humidity sensor

Order number
FS-1

1) Safety measures to be applied for correct operation:

“Protective Extra Low Voltage” (PELV)

Standards: DIN EN 60204-1; IEC; 60204-1; HD 60364-4-41; DIN VDE 01000-410;
IEC 60364-4-41

2) Electrical sensor lines are considered signal lines in terms of EMC.

4. Delivery, returns, and storage


4.1 Checking the delivery

Immediately after receipt, the delivery must be checked for completeness according to the shipping documents. Any transport damage must be reported to the transport company immediately. The packaging material should be preserved until any discrepancies are resolved.

4.2 Returns

All parts must be cleaned and properly packed before return shipment (i.e., according to the requirements of the recipient country). There are no restrictions for land, air, or sea transport.

The following must be marked on the packaging of return shipments:

	Do not top load / This side up
	Keep dry
	Handle with care, Do not drop

The following conditions apply to storage:

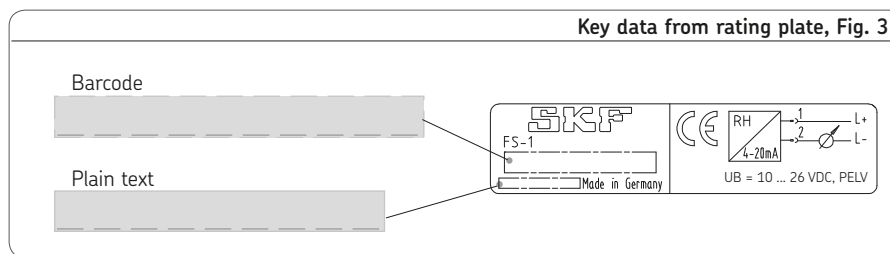
4.3 Storage

- o dry and dust-free surroundings, storage in well ventilated dry area
- o Storage time: Max. 24 months
- o Relative humidity: < 65%
- o Storage temperature: + 10 to +40°C
- o No direct sun or UV exposure
- o Protected against nearby sources or heat or cold

4.4 Note on the rating plate

The rating plate provides important data such as the barcode and serial number. To avoid loss of this data if the rating plate becomes illegible, these characteristics should be entered in the following table.

- Enter key data from rating plate in the following table.



5. Assembly

5.1 General information

The sensor head is designed so that the ambient atmosphere can reach the measuring element through side holes on the head's circumference or through the open front side. By default, a transport cap protecting against mechanical damage is affixed on the front side. It must be removed for measurement operation.

The FS-1 Humidity Sensor comes standard with two locknuts.

Depending on the type of installation, one of the two locknuts can be eliminated.

The humidity sensor does not require calibration.

5.2 Assembly of the FS-1 Humidity Sensor

- Remove the transport cap **(1)**.
- If necessary, remove a locknut **(2)** from the FS-1 Humidity Sensor **(3)**.
- Carefully screw the FS-1 Humidity Sensor into the M18 threaded hole (provided by customer).

☞ The engagement depth of the humidity sensor depends on the customer's installation and must be determined prior to beginning assembly.

☞ The sensor must not be touch moving parts.

☞ The ambient atmosphere for measurement must be able to reach the sensing head unimpeded. Its holes must be open to ambient air.

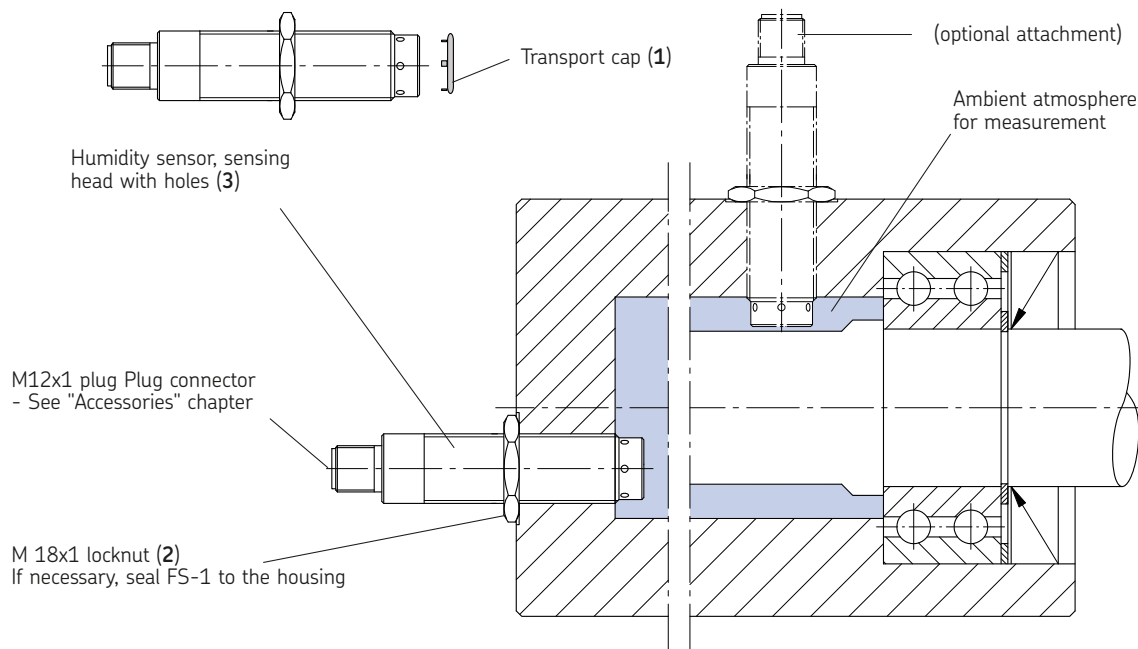
- Align the FS-1 Humidity Sensor according to the determined thread dimension.

- Depending on the customer's installation, seal the FS-1 Humidity Sensor to the housing.
- Secure the humidity sensor using a locknut.
- Connect the electrical power lead on the M12x1 plug of the humidity sensor.
- Ensure the power lead is laid in a stress-free position.

NOTE

Persistent contamination with foreign substances can distort the measuring results. Appropriate measures must therefore be taken to prevent contamination.

FS-1 installation example, Fig. 4



6. Operation/configuration, ecommissioning and disposal

6.1 Operation/configuration

Electrical configuration on the humidity sensor is not provided for.

6.2 Decommissioning and disposal

If the product is to be shut down permanently, observe the legal requirements for disposal.

The product can also be returned to SKF Lubrication Systems Germany AG for disposal, in which case the customer is responsible for reimbursing the costs incurred. The parts are recyclable.

7. Maintenance

7.1 General information

SKF products are low-maintenance. All connections and fittings must be regularly inspected for proper seating to ensure proper function. If necessary, the product can be cleaned using mild cleaning agents that are compatible with the product's materials (non-alkaline, non-soap).

8. Malfunctions, causes, and remedies

The following tables provide an overview of possible malfunctions and their causes.

8.1 Commissioning, product, and system malfunctions

Malfunction	Cause	Remedy
No output signal on customer's PLC	o Plug on the humidity sensor is not connected	<ul style="list-style-type: none"> • Connect the plug
	o Power lead is not wired correctly	<ul style="list-style-type: none"> • Connect cables according to Chapter 3, "Technical data." • Replace cables
	o Power lead is defective	
	o Humidity sensor is not installed correctly	<ul style="list-style-type: none"> • Arrange the FS-1 Humidity Sensor so as to provide adequate clearance around the sensor head.
	o Customer's PLC is not configured for the output signal of 4 to 20 mA.	<ul style="list-style-type: none"> • Configure customer's PLC for the output signal.

9. Accessories



NOTE

Additional data and electrical plug-in connections are available in brochure No. 1-1730-EN, "Electric Plug-and-Socket Connectors."

Accessories

Description	Data	Order No.
M12x1 socket	without cable, with 4 pins, protection class IP 67 (mounted)	179-990-371
M12x1 angle plug	without cable, with 4 pins, protection class IP 67 (mounted)	179-990-372
M12x1 plug, straight	With 5 m cable, 4x 0,25 mm ² , protection class IP 68 (mounted)	179-990-600
M12x1 angle plug	With 5 m cable, 4x 0,25 mm ² , protection class IP 68 (mounted)	179-990-601

951-230-011-EN

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All SKF products may be used only for their intended purpose as described in these assembly instructions with associated operating instructions. If assembly/operating instructions are supplied together with the products, they must be read and followed. Not all lubricants can be fed using centralized lubrication systems. SKF can, on request, inspect the suitability of the lubricant selected by the user for pumping in centralized lubrication systems. Lubrication systems and their components manufactured by SKF are not approved for use in conjunction with gases, liquefied gases, pressurized gases in solution, vapors or such fluids whose vapor pressure exceeds normal atmospheric pressure (1013 mbar) by more than 0.5 bar at their maximum permissible temperature.

Particular attention is called to the fact that hazardous materials of any kind, especially the materials classified as hazardous by EC Directive 67/548/EEC, Article 2, Para. 2, may only be filled into SKF centralized lubrication systems and components and delivered and/or distributed with the same after consultation with and written approval from SKF.

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