Procedure
Installation, Operation and Maintenance
SES-1 Subsea Erosion Sensor

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458752, rev. 01

Restricted

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Revision List

Rev	Date	Description	Author	Reviewed	Approved
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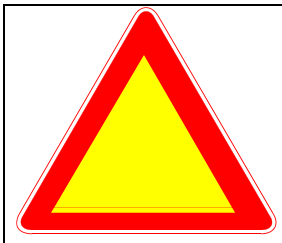
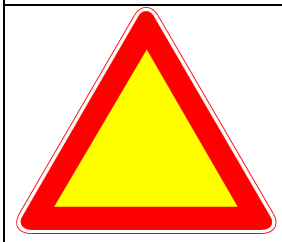
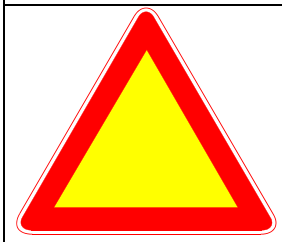
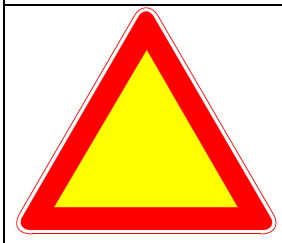
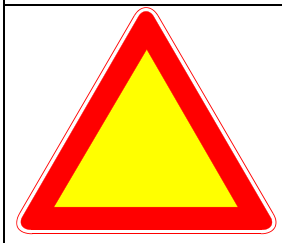
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1 CAUTIONS

	PLEASE READ THE COMPLETE INSTALLATION, OPERATION AND MAINTENANCE MANUAL BEFORE ANY WORK START.
	Avoid manual handling ! Manual Handling by an individual at high weight should be avoided at all times. Suitable mechanical lifting aids should be identified, and used for the movement of sensors, avoiding musculoskeletal damage to the operator. The weight of the sensor will be found on the weight certificate.
	Unless the sensor is within its transport case, it shall only be handled by personnel authorised by the client. Installation shall only be undertaken by personnel authorised by the client.
	Never use air tools when fixing the main body bolts. Avoid other types of shock and vibration impacts
	At any time during any type of welding operations in vicinity of the sensor, all cables shall be grounded. Twist all leads of the sensor and ensure that they are properly connected to the sensor housing.
	The probe tip with the erosion sensing element is sensitive to electrostatic discharge. Do not touch the probe tip without proper ESD protection.

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2 ABBREVIATIONS

Abbreviation	Description
API	American Petroleum Institute
BOM	Bill of Material
CAN	Controller Area Network
CANopen	CAN Standard based on EN50325
CFD	Computational Fluid Dynamics analysis
CiA	CAN in Automation
CRC	Cyclic Redundancy Check
EU	European Union
FT	Fault Tolerant
GA	General Assembly
GDPR	General Data Protection Regulation
PDO	Process Data Object
PPE	Personal Protective Equipment
SDO	Service Data Object
SES-1	Brand name, “Subsea Erosion Sensor”

3 REFERENCES

Ref	Doc. No.	Version	Title
[1]	CiA-443	4.0.4	CANopen Device Profile for SIIS level-2 devices
[2]	CiA-309-3	1.1.0	CANopen access from other networks
[3]	API 6A	2019	Specification for Wellhead and Christmas Tree Equipment
[4]	262319	O	Procedure for Packing, Preservation, Handling and Shipping of Subsea Pressure, Temperature and Erosion Sensors
[5]	459259	01	Software Manual SES-1 Erosion Sensor
[6]	461220	01	Specification Sheet SES-1 Erosion Sensor
[7]	(EU) 2023/2854	2023	REGULATION (EU) 2023/2854 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 December 2023 on harmonised rules on fair access to and use of data and amending Regulation (EU) 2017/2394 and Directive (EU) 2020/1828 (Data Act)

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4 INTRODUCTION

The SES-1 is a subsea sensor that provides accurate measurements of metal loss. The sensor has an intrusive probe that includes an erosion sensing element, a reference element and a temperature sensor. The sensor electronic is retracted from the process and can measure electronic temperature, tilt and vibration. The sensor is qualified for up to 15K psi process pressure and to 4000 meters water depth.

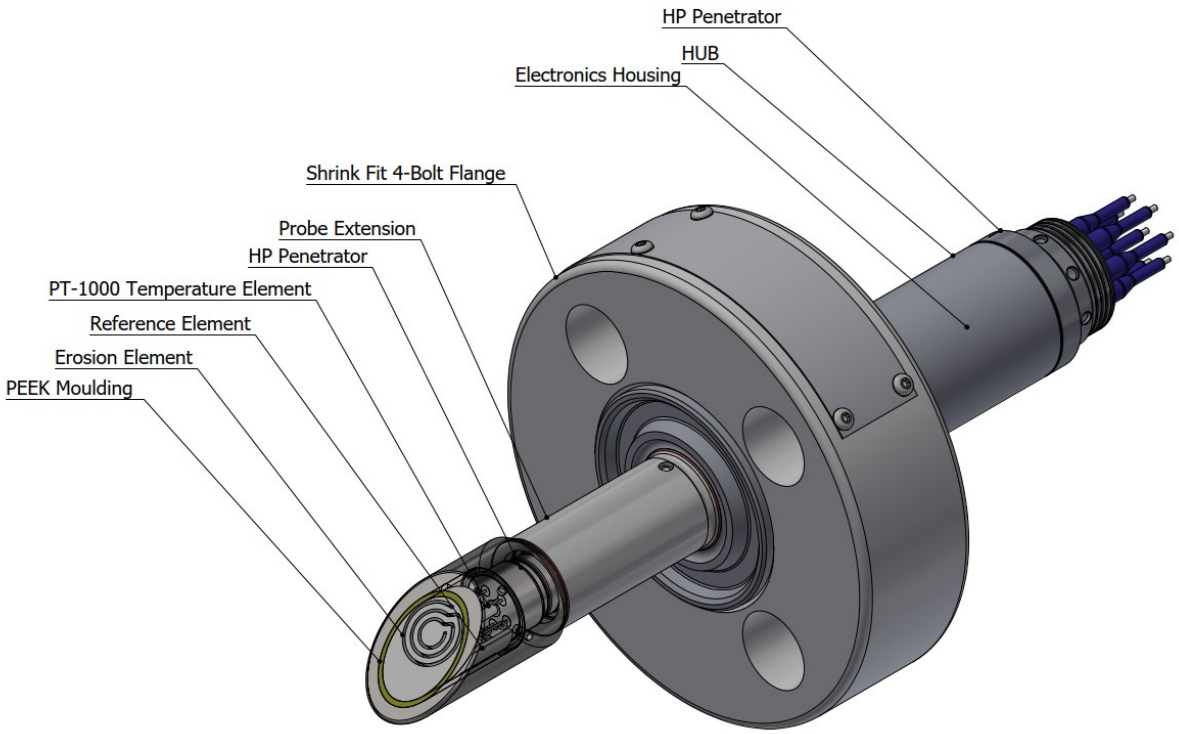


Figure 1, SES-1 sensor, illustrative view with 4-bolt flange

For further specification details see the specification sheet, ref. [6] and the project specific GA drawing.

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5 PACKING AND TRANSPORTATION

Avoid excessive shock and vibrations during transport and handling, even though the equipment itself is resistant towards shock and vibration, this is only true when the units are properly fixed and secured.

A special transport case is prepared for packing, storing and transport of the subsea sensor. We strongly advise that the unit is kept secured in this box until the final installation destination is reached.

The transportation case must be in its upright position at all times (see marking on the case).

The weight of a transportation case with subsea sensor makes a dangerous combination if the transportation case is handled roughly (dropped, turned from upright positions etc).

Storage temperature limits are defined as -40 to +70°C, however it is recommended to store the subsea sensors at room temperature if possible. Humidity control is not required.

Note: For further information regarding packing, handling and storage specifications, see ref. [4].

	The probe tip with the erosion sensing element is sensitive to electrostatic discharge. Do not touch the probe tip without proper ESD protection.

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6 HEALTH AND SAFETY STATEMENTS

It is recommended that the client performs a risk assessment for all aspects of the sensor Installation from initial delivery to final dispatch, to identify the hazards associated with the work.

Each SES-1 sensor weighs between 12 to 20 Kgs. Staff preparing to move a sensor unit from the delivery box must ensure that they assess the identified hazards for each movement of the sensor.

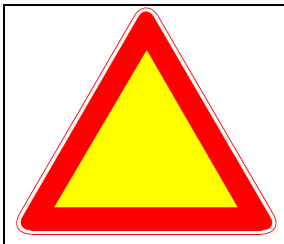
Personal Protective Equipment in the form of:

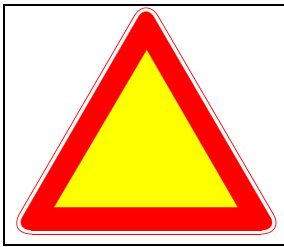
- Safety Shoes/ Boots
- Protective Gloves

Is highly recommended for the protection of staff whilst working with the SES-1 sensor. Additional PPE may be required for the working environment / Client Safety Rules.

The SES-1 sensor do not contain any chemicals or compositions that could be hazardous upon exposure.

During soldering operations it is recommended that fumes are removed from the immediate working area to avoid inhalation by the operator.

	Any soldering shall not take place unless the soldering procedure and/or soldering company have the appropriate skills and are approved by Siemens Energy.

	Care in the selection of the correct tools for the final “Torque Setting of the API Bolts” is important to avoid accidents through damaged/poorly maintained tooling. See API 6A ref. [3]

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7 INSTALLATION

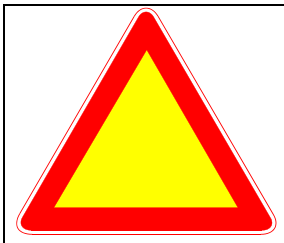
7.1 INSTRUCTIONS

CAUTION: **UNLESS THE SUBSEA SENSOR IS WITHIN ITS *TRANSPORT CASES/CRADLE IT SHALL ONLY BE HANDLED BY PERSONNEL AUTHORISED BY THE CLIENT.***

INSTALLATION SHALL ONLY BE UNDERTAKEN BY PERSONNEL AUTHORISED BY THE CLIENT.

HANDLE THE SUBSEA SENSOR WITH CARE - HEAVY SHOCK AND/OR VIBRATIONS, HIGH TEMPERATURES MAY DAMAGE THE UNIT.

7.2 MECHANICAL INTERFACE

	Never use air tools when fixing the remote seal- and main body bolts. Also avoid other types of shock and vibration impact.

The Subsea Erosion Sensor, SES-1, shall be installed with BX Ring in accordance with the respective mechanical interface drawing for the Subsea Sensor.

Available flanges according to API 6A, ref. [3]:

- 2 1/16”, 10k PSI, BX-152, 8 bolt.
- 1 13/16”,10k PSI, BX-151, 8 bolt.
- 2 1/16”, 15k PSI, BX-152, 8 bolt.

In addition following flange alternatives:

- 1 11/16”, 10k PSI, BX-150, 4 bolt.
- 1 11/16”, 15k PSI, BX-150, 6 bolt.

Nuts and bolts used for installation : According to clients specifications.
Material : According to clients specifications.
Torque Settings : According to clients specifications.

Nuts, bolts and gaskets are not part of Siemens Energy delivery, however sensors are designed to be used with nuts, bolts and gaskets according to API 6A ref. [3].

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7.3 ORIENTATION

All surfaces shall be cleaned and inspected for damage before installation.

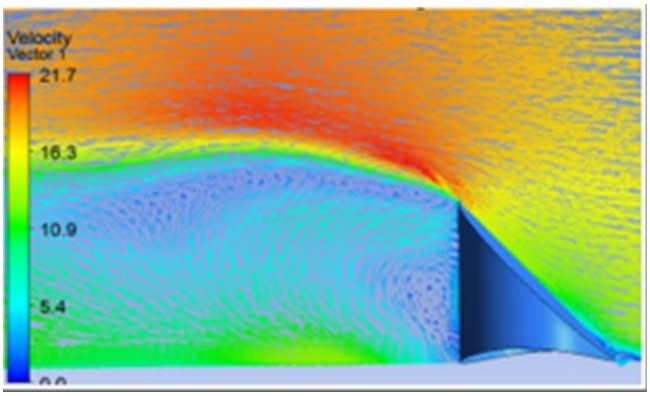


Figure 2, 45 degrees angle of the probe tip is considered optimal for an even detection of erosion

CFD analysis should be performed to optimize the placement of the probe.

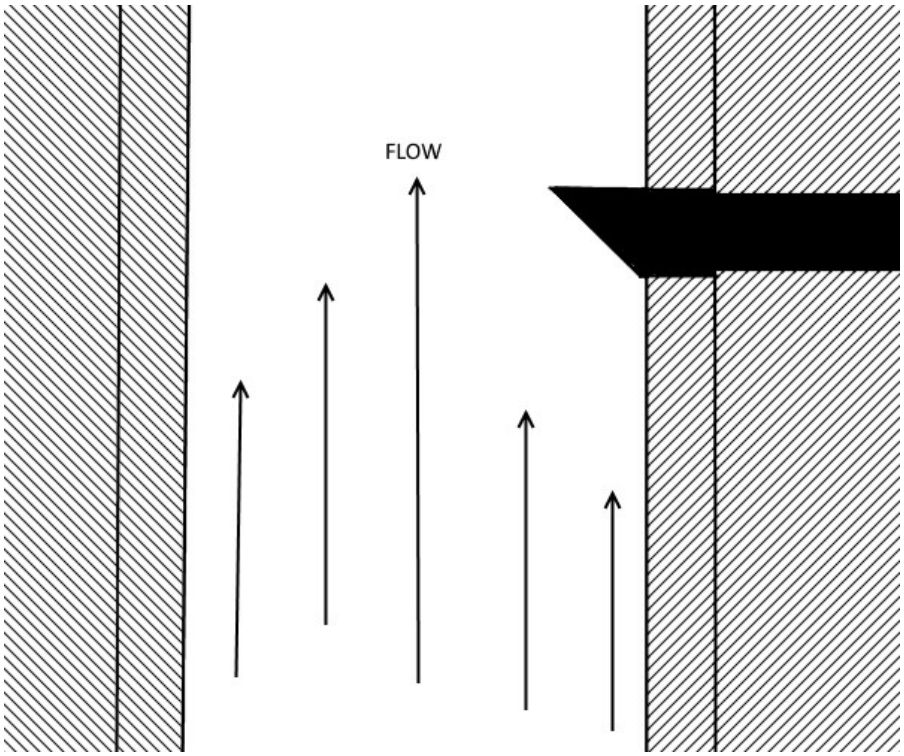
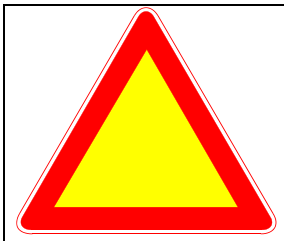
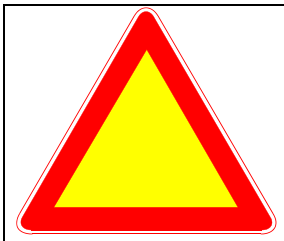


Figure 3 Probe tip orientation towards flow direction

	Make sure the orientation of the 45 degree Erosion Sensor Probe Tip is correct, i.e. the spiral in front facing the flow.

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8 INSULATION RESISTANCE TESTING



Insulation Resistance Test:
Test voltage shall never exceed 50 VDC.

If there is a need to conduct insulation resistance testing of the sensor on site, the following best practice routine is to be followed.

1. Hook up the EUT as per the sketch below.

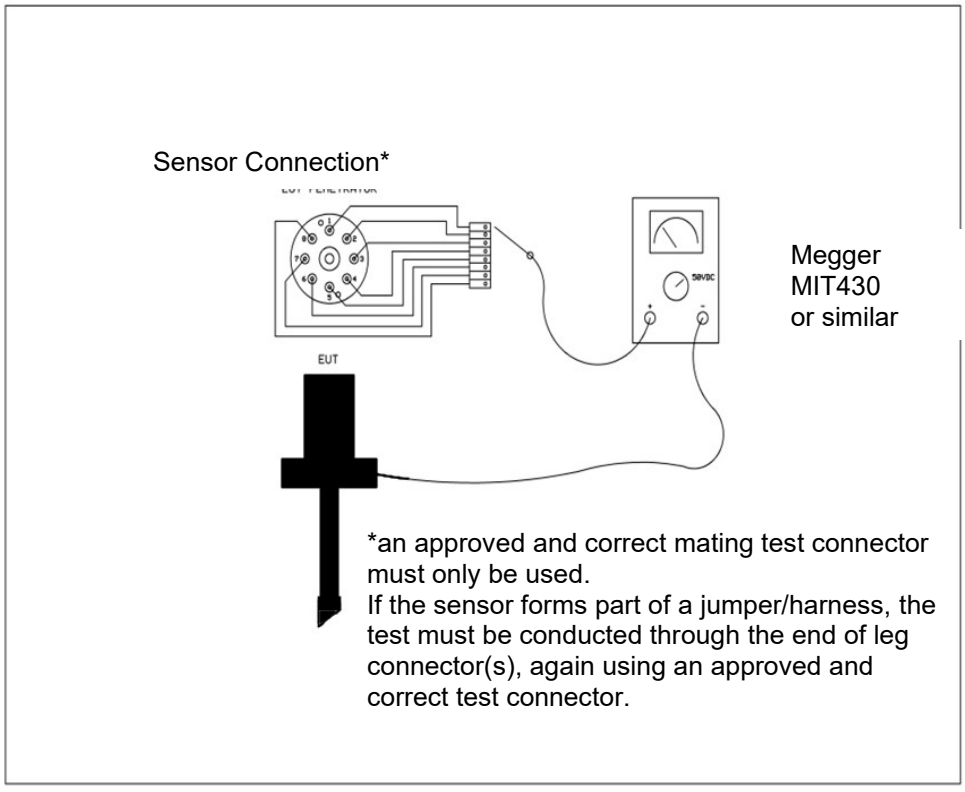


Figure 4: Sketch demonstrating EUT hook up to Megger

2. Connect the insulation tester with the negative terminal to the metallic body of the sensor. Connect all pins to the insulation tester positive terminal.

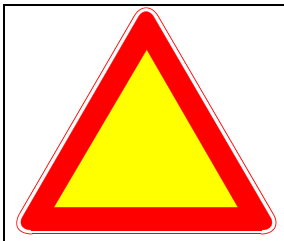
3. Measure the insulation resistance at 50VDC @ dry conditions for 1 minute.

4. If the insulation resistance value is below the acceptance criteria, contact Siemens Energy for further assistance.

Acceptance Criteria: IR ≥ 1Gohm

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9 WELDING ON STRUCTURE

	Always ensure sensor is removed from the structure or grounded before commencing any welding.

At any time during any type of welding operations in the vicinity of the SES-1 sensor, the sensor needs to be removed from the structure being welded entirely or grounded.

9.1 GROUNDING SENSOR WITH NO FLYING LEADS

For sensors supplied with no flying leads the sensor is grounded by wire between the pins and the sensor housing. This wiring is performed by Siemens Energy before shipping.



Figure 5: Example of wire grounding penetrator pins.

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9.2 GROUNDING SENSOR WITH FLYING LEADS

All flying leads must be grounded before welding can start.

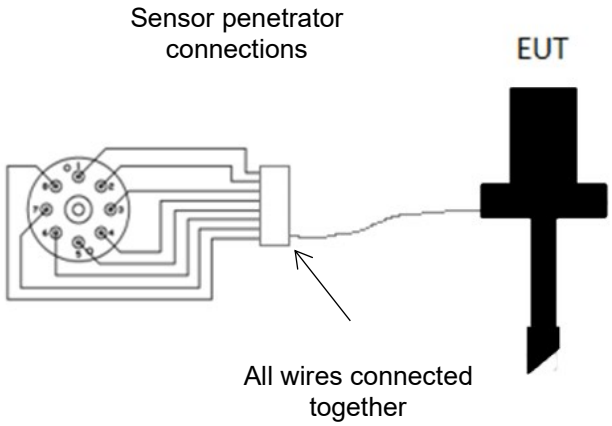


Figure 6: Sketch demonstrating grounding of all pins.

Remove the isolation from the end of the leads, as demonstrated in picture below. About 1cm should be sufficient.

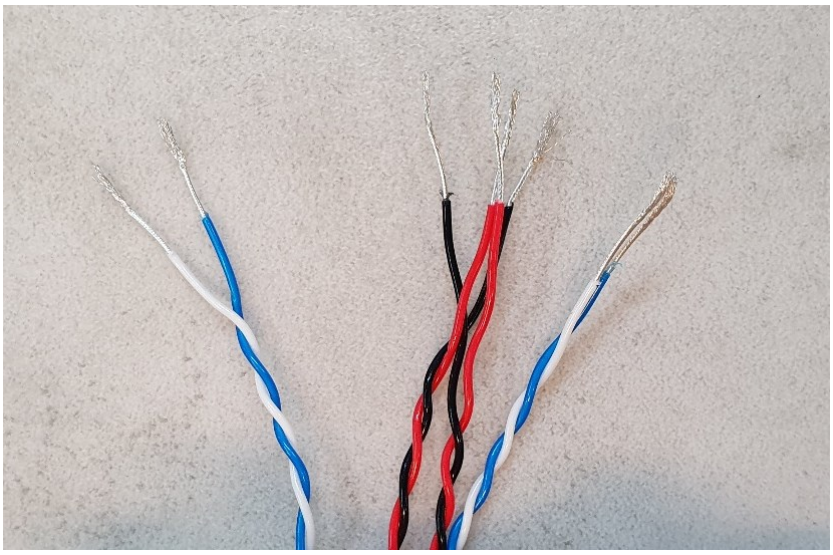


Figure 7: Example of flying leads with isolation removed at ends.

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Wind a steel wire around (max) four flying leads at a time. The steel wire mounted onto the flying leads and supplied by Siemens Energy before shipping can be used for this.

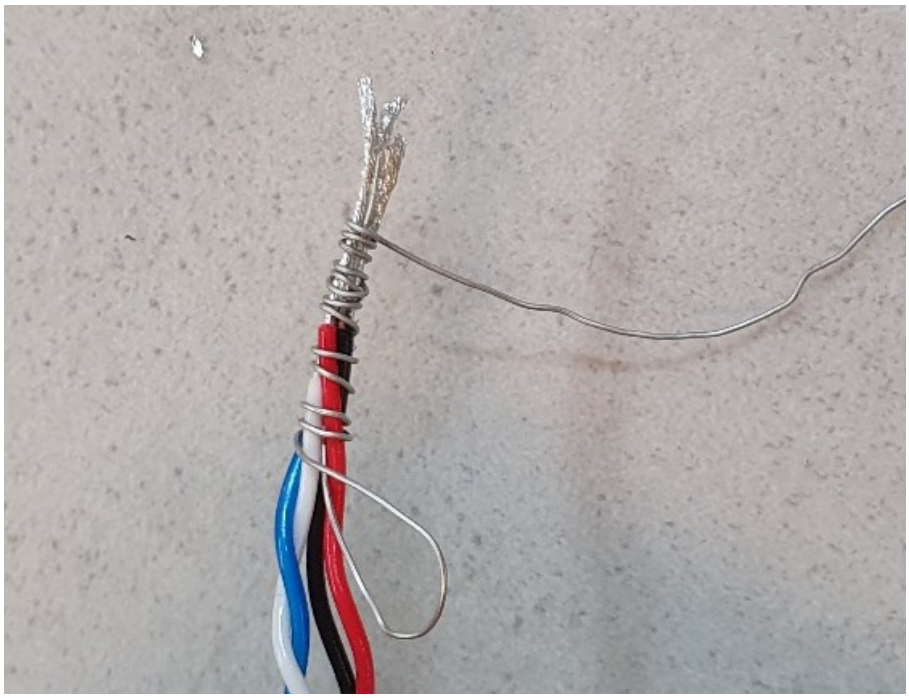


Figure 8: Example of steel wire winded around a set of four flying leads.

Use the same steel wire to ground several sets of four (or less) flying leads. This is demonstrated in picture below.

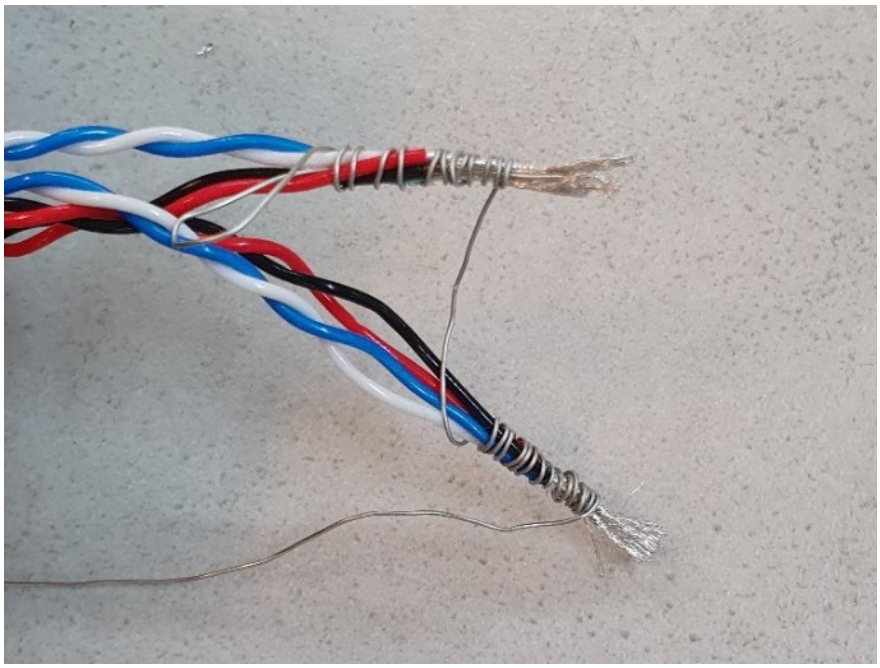


Figure 9: Example of steel wire wound around several sets of four flying leads.

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Note: It is also possible to use phoenix connectors to ground flying leads. The leads are then assembled to the phoenix connector. A steel wire is used to connect all leads inside the connector and then connected to metal part of sensor as demonstrated below.

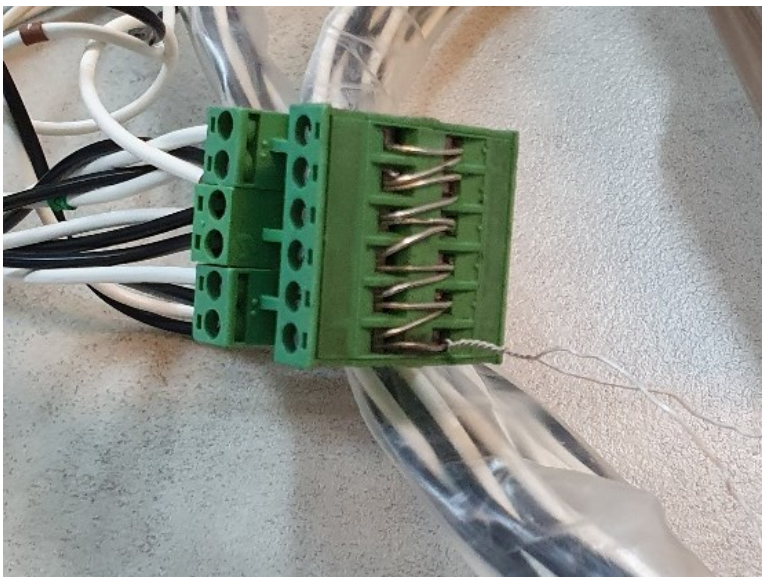


Figure 10: Example of grounding using phoenix connector.

The sensor is grounded when all the flying leads are in contact with a steel part of the sensor. Best practise is to use a clamping tool as demonstrated in the picture below. The steel wire which is in contact with all flying leads is winded around the clamp to ensure contact with steel part of sensor.



Figure 11: Example of how to ensure flying lead contact with steel part of sensor. Steel wire clamped to housing.

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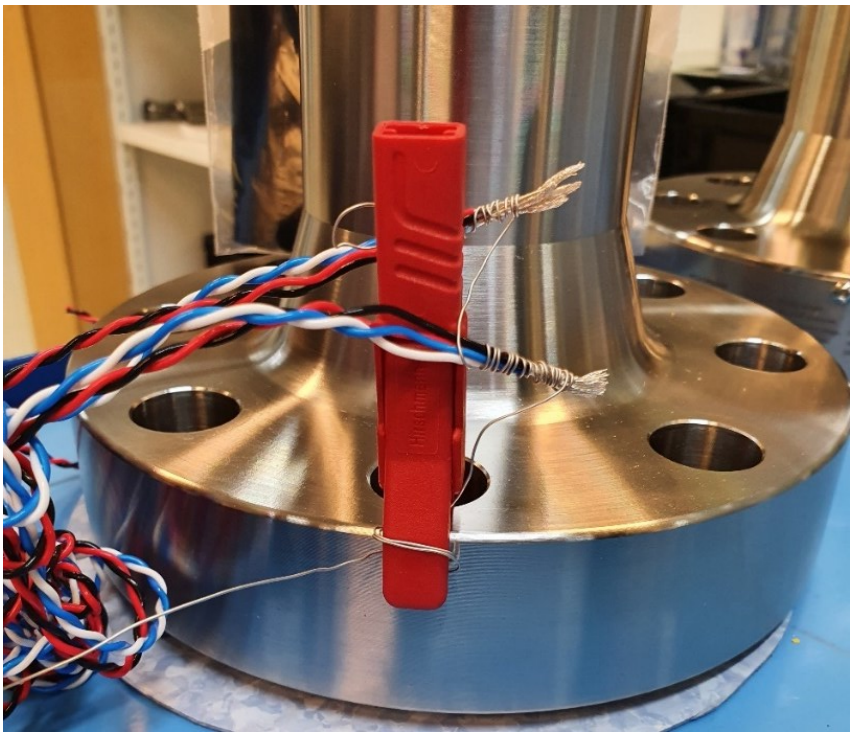


Figure 12: Example of how to ensure flying lead contact with steel part of sensor. Steel wire clamped to flange.

Test connectors with flying leads are grounded in the same manner.



Figure 13: Example of test connector – grounded using phoenix connectors

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9.3 GROUNDING SENSOR SUPPLIED WITH CONNECTOR

For sensors supplied with connector best practice is to use a test connector with flying leads. The flying leads are then grounded. Please refer to chapter 9.2 for information on how to ground flying leads.

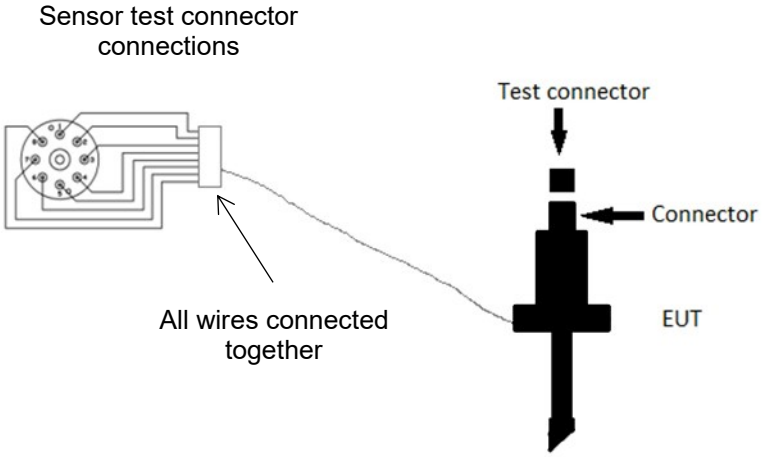
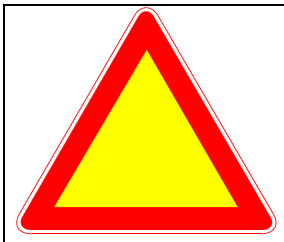


Figure 14: Sketch demonstrating grounding of sensor using test connector.

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9.4 GROUNDING SENSOR HARNESS

	Always use test connectors to ground sensor harnesses.

Sensor harness, both 1 leg and multiple leg harness must be grounded using test connectors. Please refer to chapter 9.2 for information on how to ground flying leads and test connector.

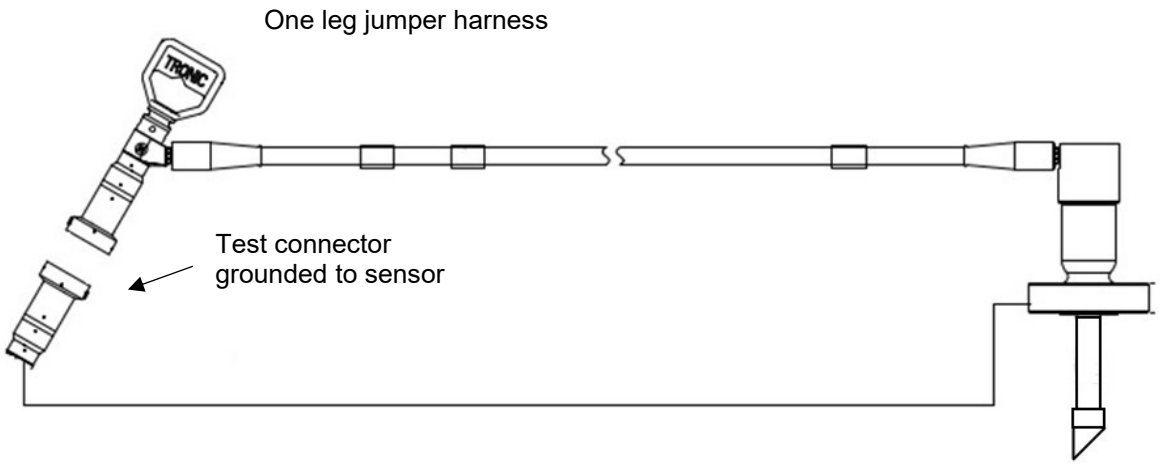


Figure 15: Sketch demonstrating grounding of sensor 1 leg jumper harness using test connector.

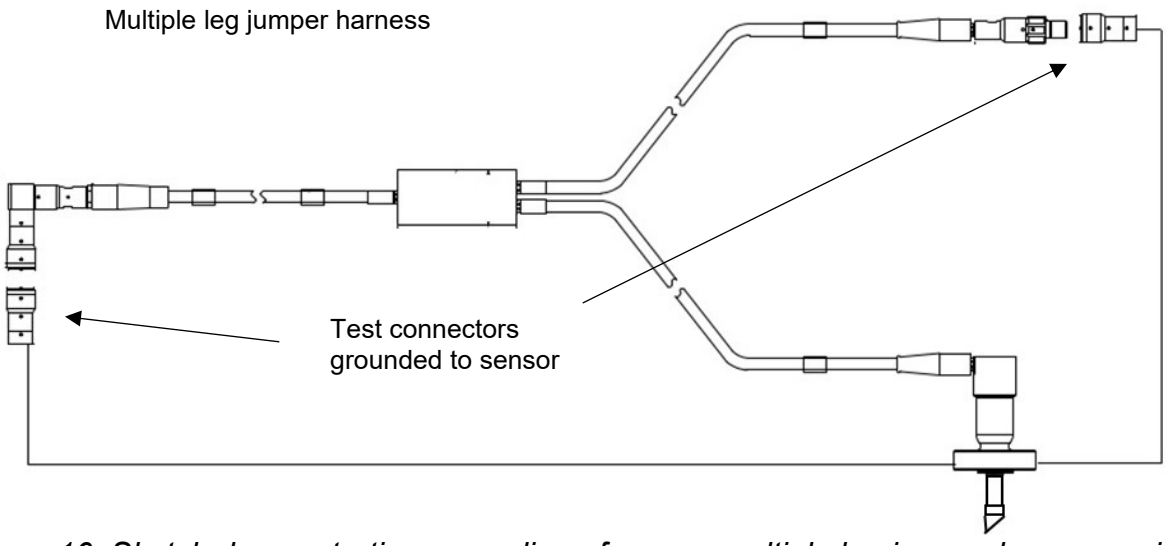
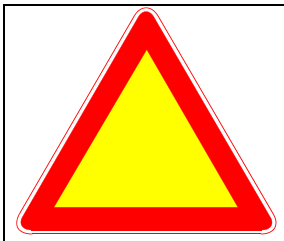


Figure 16: Sketch demonstrating grounding of sensor multiple leg jumper harness using test connectors.

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10 PAINTING ON STRUCTURE



Always ensure that the sensor is either removed from the structure or properly grounded before commencing any sandblasting operations.

If the sensor is supplied un-painted, the sensor can be prepared and painted along with the host structure. During surface preparation, e.g. blasting, Pin Hole Tests or other test methods that utilising an electrical method, the sensor needs to be grounded as described in section 9.

Special consideration should be taken towards masking of the electrical connector.

11 OPERATING INSTRUCTIONS

After installation, perform a communication test SES-1 sensor(s) at ambient pressure and/or temperature to verify that the sensor is functioning properly.

The sensor is calibrated and factory adjusted before delivery. In addition it is recommended with an initial field adjustment of accumulate erosion and offset for tilt measurements through CANopen protocol. The master system needs to support CANopen SDO commands either directly on CAN Bus or through CiA-309 (transparent link), ref. [2], to be able to carry out this adjustment. See Software Manual, ref. [5] for details.

After installation subsea, the signal from the subsea sensor will form a part of the client's main system, and all operational instructions should be according to the client's procedures.

11.1 CANOPEN SENSORS

The SES-1 sensors will communicate on CANopen according to CiA-443, ref. [1], see Software Manual, ref. [5] for details.

Interface	:	CAN FT (two-wire)
Protocol	:	CANopen CiA-443
Baud rate	:	50kbit (default) and 125kbit (supported)
Node ID	:	Project dependent.

The SES-1 measurements are transmitted in CANopen PDOs in engineering units. Accumulated metal loss is transmitted in nanometres, erosion rate in mm/year and temperature in °C. The sensor can also optionally support accelerometer values for vibration analysis and can calculate tilt in degrees.

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12 MAINTENANCE

Before installation a visual inspection of the sensor should be carried out to ensure that there are no dents or marks from physical damage or loose components.

If the SES-1 sensor has been stored for more than six - 6 - months, a communication test of the sensor signal should be carried out.

After installation subsea, it will not be possible to carry out any physical maintenance of the sensor. However, it is possible to perform field adjustment of accumulate erosion and offset for temperature measurements through CANopen protocol. See Software Manual, ref. [5] for details.

A periodical test of the sensors should be carried out. If it is possible to compare sensor temperature readings to a known temperature reference, a test could be carried out for the process temperature measurement. In case of any drift, the sensor signal could be corrected using the sensors inbuilt field offset through CANopen. The master system needs to support CANopen SDO commands through CiA-309 (transparent link), ref. [2], to be able to carry out this adjustment.

If the structure for any reason should be retrieved after installation, the sensor should be controlled as in section 10, (Operating Instructions) or returned to the manufacturer for a complete check/recalibration.

13 DATA SECURITY

This product complies with the European Union Regulation (EU) 2023/2854 (Data Act), ref. [7]. Data generated by the SES-1 is subject to the EU Data Act.

The client has the right to access and share sensor generated data with third parties.

All firmware and configuration files for the sensor are made available for the client on request. Siemens Energy keeps a copy of the firmware and configuration files for each delivered sensors as a backup. Each file can be compared to the original with a CRC check to ensure data integrity.

The firmware and configuration can be securely updated through CANopen.

Siemens Energy monitors all software components and will notify the client within 24 hours if any software vulnerabilities issues arises. Siemens Energy will also share the software BOM with the client on request.

The SES-1 sensors does not contain any GDPR data. This firmware in the sensor has been thoroughly tested and is guaranteed to be free from malicious code, viruses, and time bombs.

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