INSTRUCTIONS

FOR

THE INSTALLATION AND THE USE

OF THE

SERVOINCLINOMETER

Mod. ES 261 **S/N**

DS Europe s.r.l.
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Instructions N°211001 E
dated October 21, 2001

1) P R E L I M I N A R Y R E M A R K S

1-1) This *instruction manual* is an integral part of the supply-order and it is delivered with the material, even if not listed in the invoice.

Moreover, it is sent, during the negotiation, whether the Customer tells about the installation and about the use of this product.
When several pieces are supplied, the quantity of manuals could decrease to one copy, if not requested the contrary.

1-2) RESPONSIBILITY FOR THE USE:

The servotransducers, even if supplied with external electronics or indicators, are *only components and parts* of systems and of plants; they are sold in elevated annual quantities, for different uses and they have to satisfy to several standards and recommendations often unknown to the Supplier.
Under these circumstances DS Europe is compelled to refuse any responsibility for the use.
In this manual are listed the most and common precautions for a correct use of its products.
In case of use with risks of damages to Persons and things and damages for stops of machineries it is precise duty of the User to make a complete and focused insurance coverage and to inform the Supplier so that he can suggest the safe tricks or he may refuse the order and the supply.

1-3) QUALITY AND RELIABILITY:

The servotransducers of DS Europe are high professional quality products; they are rugged and designed for the best safety and reliability and the limitations and cautions listed in this manual want to give prominence to the User the importance of a correct use and the need to put into action also all the law recommendations.

2) PRINCIPLE OF OPERATION

The servoinclinometers ES 261 Series include a seismic mass (= target) which inclination, referred to the horizon line, is sensed by two optoelectric sensors in differential circuit.
A feed-back "torque motor", connected to the sensors by an amplifier, keeps the target in its rest position.
The current flowing into the torque motor, translated in voltage, is filtered, amplified and ready at the output connection.
The output signal is proportional directly to the linear acceleration of the transducer or to the sine of the angle referred to the horizon line.

E.g.: *Model ES 261-90°*; At full scale = + 90° = + 5,002 V = 1 g;
half the signal output is: +5,002 x 0,5 = 2,501 V; where +0,5 = sine of +30° = + 0,5 g = = 2,501 V output.

The inclination directly in degrees, etc. is displayed by a *signal conditioner* (e.g.: Mod. AN 401) with microprocessor of conversion V/sine.

3) TERMINOLOGY (main terms)

3-1) ***Model***: it lists the Model.

3-2) ***Axis***: it lists the axis of sensitivity

3-3) ***Range***: it is the measuring range of the inclinometer.
E.g.: ±90° = ± 1 g (linear acceleration).

3-4) ***Full range output***: it is the full scale ± of the inclinometer with value in Volts and with polarity plus and minus.

3-5) ***Zero offset:*** it is the remaining signal output due to the mechanical and electrical misalignments of the inclinometer when on a plane in rigging position.

3-6) ***Calibration***: see paragraph 4-7.

4) INSTALLATION OF THE SERVOINCLINOMETER

4-1) CLAMPING:

Place the inclinometer on a fine and plane machined surface fastening it by 2 screws M3.

Important: never apply to the external case mechanical forces in any direction.

4-2) ORIENTATION OF THE INCLINOMETER:

As shape, the inclinometer is a parallelepiped with two flanges.
In its zero position the inclinometer axis coincides with the gravity, the top sees the sky and the base sees the earth centre.

In this position has been done the alignment during the construction and to this is corresponding the minimum of zero and of cross-sensitivity.

4-3) MEASURE AXIS:

The direction (axis) of measure is shown on the target by an arrow.
The exact axis of measure is the line connecting the 2 marks, hand-made, during the calibration, on the thickness of the 2 flanges near the fastening holes.

4-4) MEASURE OF THE ANGLE:

- *The fig. 1 shows the correct installation of the servoinclinometer.*
  In this condition the signal output is proportional to the sine of the angle and it is magnified the difference of measures of low angles.

  Example N°1:

  sine of 0 degrees = 0,00000; sine of 1 degrees = 0,01745; difference = 0,01745;
  cosine of 0 degrees = 1,0000; cosine of 1 degrees = 0,99985; difference = 0,00015.

- *The fig. 2 shows a wrong installation of the servoinclinometer.*
  In this condition the signal output is proportional to the cosine of the angle and it is magnified the difference of measures of angles near 90 degrees.

  Example N°2:

  sine of 90 degrees = 1,0000; sine of 89 degrees = 0,99985; difference = 0,00015;
  cosine of 90 degree = 1,0000; cosine of 89 degree = 0,99985; difference = 0,00015.

  Note: as overwritten (par. 4-2) the inclinometer has been calibrated as for the example N°1 (fig. 1).

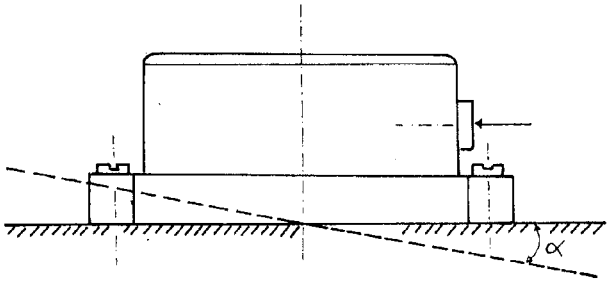

Fig. 1 correct

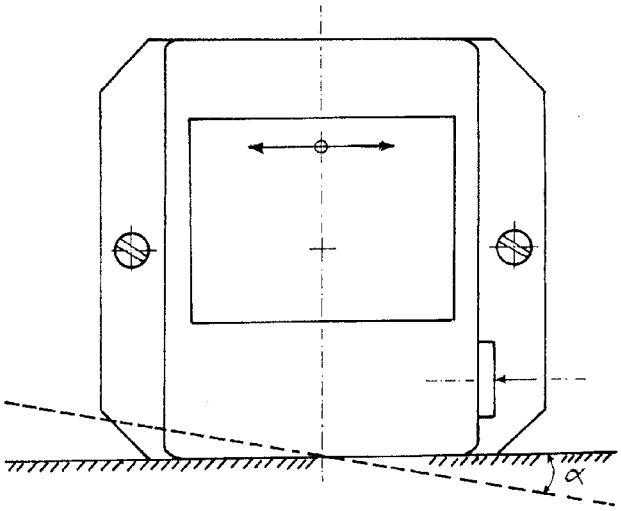

Fig. 2 wrong

4-5) ALIGNMENT OF AN HORIZONTAL PLANE:

It could be *necessary to line up on an horizontal plane* a box enclosing a servoinclinometer and the respective electronics.
For obtaining it, it is needed a reference horizontal plane.

This *plane* has to be very stiff, fine machined (ground), with plumbing screws.

The User can level the plane by the following procedures:

4-5-1) *Using the precision spirit level DS Europe Mod. ES 601.*

The level has a length: 300 mm and a sensitivity: 0,02 mm/1000 mm/ division.
The plane is horizontal when putting the level on the plane and turning it around the vertical axis of the plane, the bubble remains always in its central position of zero. This condition is obtained by the plumbing screw regulations.

4-5-2) *Using the servoinclinometer* itself and proceeding separately for X axis and, after, for Y axis (at 90 degrees, horizontal).

Proceed as follows:

Turn the sensitivity direction of the inclinometer around its vertical axis (gravity) from zero to 180 degrees. Adjust the inclination of the plane until the output signal, in both the directions, is the same, herewith inverted polarity (±), the nearest to zero.
Further proceed for the other axis (Y, if before X axis has been done).
When the horizontal plane is obtained, settle the box of the system, enclosing the servoinclinometer, over the plane and proceed to its alignment before mechanically and, at the end, cancelling the residual zero-offset by the electronics.

4-6) ALIGNMENT OF THE SENSITIVE AXIS:

To coincide the sensitive axis of the inclinometer with that of rod, put the system on an horizontal plane and from the horizontal position tilt it of a certain angle (e.g.: full scale) on the positive angle and after negative angle.

The sensitive axis of the inclinometer is lined up with the axis of the rod when the positive and negative signal outputs have the maximum and same absolute values.
If not, adjust the coincidence of the two overmentioned axes.

4-7) CALIBRATION :

The calibration has two separated functions:

4-7-1) The *electrical simulation* of a geometrical inclination of the transducer.

4-7-2) The *measuring chain control.* This function is the most common and necessary in important applications.

The calibration acts directly on the "torque motor" so that the operation of the inclinometer is fully controlled.
This calibration simulates electrically a mechanical inclination which exact value is written in the "final test certificate".
The calibration value is listed in Volts (= Vcal) and it is proportional to the sine of the inclination.
The value of the angle is obtained by the sine tables.

4-7-3) The calibration imposes to put the servoinclinometer on an horizontal plane and that all the measuring system in reset zero.
Connect the lead yellow with green (cable = -OC).
Connect the pin 3 with 6 (connector = - OP).

Caution: Do not apply any voltage to the calibration connection.
Voltages greater than 15 millivolts will damage the internal torque motor.

E.g: ES 261-90° at +90° (full scale = FS); sine FS = 1;
full range output (V_{FS}) = +5,002 V;
calibration (= Vcal) = +2,501 V
sine cal = Vcal x sine FS/V_{FS} = 2,501 x 1/5,002 = + 0,5 = + 30°.

5) ELECTRICAL CONNECTIONS

5-1) SUPPLY VOLTAGES : ± 15 VOLTS

The supply is double: ± 15 Volts (± 10 %).
Stabilized voltages, with low ripple and with equal positive and negative value are suggested.
Different values between them will cause zero electrical shift on the output signal.
Voltages different from ± 15 Volts will cause only a greater (+) or lower (-) effect on the feedback of the torque motor.
Supply voltages within ± 1 % do not bring any significant change on the output signal.

Table 1

DESCRIPTION	LEAD COULOR	N° PIN CONNECTOR
Supply voltages : + 15V.	Red	4
Supply voltages : - 15V.	Black	5
Common: Supply and output	Green	6
Signal output	White	1
Calibration	Yellow	3
Earth	Metal base of the inclinometer	

The table 1 refers to the electrical connections by cable (- OC) or by connector (-OP).

6) DECLARATION OF CONFORMITY

Council Directive applied: 89/336/CEE modified with directives 92/31/CEE, 93/68/CEE

Standards for which conformity has been declared:

EMC:	EN 50081-1: 1992 – General standards on emission IEC 61000-6-2: 1999 - General standards on immunity EN 55022 EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-8

Manufacturer: DS Europe srl

Address: via F. Russoli, 6 Milan (Italy)

Type of equipment: Servoinclinomiter

Models: Series ES 260

Year of marking 2001

Th equipment has been tested with the typical installation configuration, as prescribed by the product instruction manual.

DS Europe srl declares that the aforementioned equipment satisfies the requirements of the EMC Directive specified above.

Milan, 24/09/01

DS Europe srl
Technical Management

Note: the compatibility test EMC have been done with the connection " Common" (green or 6) to earth.

7) WARRANTY

From raw material through in-process operations to finished transducer, a DS Europe unit is subject to rigorous inspections and to continuos quality controls to assure the product free from defects in parts, materials and workmanship. When the unit is submitted to warranty claims and it results defective for normal use within 6 months from the date of shipment, it will be repaired or substituted free of charge in our factory; the transport and insurance expenses are to be prepaid and borne by Customer.
The responsibility is strictly restricted to the above provision and DS Europe declines any liability for the damages or for the use of this product.

Instructions N° 211001-E dated October 21 2001. The information of this instruction manual is confidential and it cannot be diffused in the whole or in part without written approval of DS Europe.
This manual, even after the sale for the transducer, remains propriety of DS Europe.

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