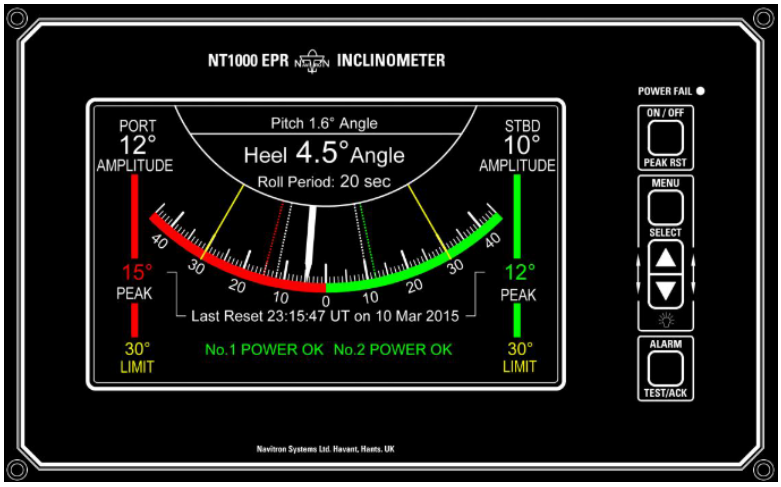
Electronic Inclinometer, made mandatory by MSC 107

Introduction

During MSC 107, it was determined that Container ships and Bulk Carriers with a gross tonnage of 3000 and upwards, constructed on or after January 1st 2026, be mandated to carry an electronic inclinometer or other means to determine, display and record the ship roll motion. This was added to the SOLAS convention under regulation 19 (Carriage requirements for shipborne navigational systems and equipment) as 19.2.12.

This regulation was added by Resolution MSC.532 (107), adopted on 8th of June, 2023. A Full report on this document has been published by ICS Convention and Legislation department under the title TI-23-04 and is available on our website.

This document gives a summary on the electronic inclinometer, how the device operates, required performance standards and regulations concerning the installation and operation of this device.



Overview

Electronic inclinometers operate using solid-state sensors, most commonly MEMS (Micro-Electro-Mechanical Systems) accelerometers or electrolytic tilt sensors. These sensors detect changes in gravitational acceleration along one or more axes. The sensor output is processed electronically to calculate the vessel's heel (athwart ships inclination) and, in some designs, trim (fore-and-aft inclination). The processed signal is then displayed digitally, often with damping algorithms applied to reduce the effect of roll motions and vibrations. Many systems provide both numerical values and graphical representations, and some are capable of transmitting data to integrated navigation or monitoring systems.

Performance Standard

Referenced Document: IMO Resolution MSC.363 (92) Performance Standards for Electronic Inclinometers / ISO 19697:2016 – Ships and marine technology

These standards define the minimum functional, accuracy, environmental, and testing requirements that an electronic inclinometer must meet in order to be accepted as a statutory instrument under SOLAS. Compliance is normally demonstrated through type approval, using ISO 19697:2016 as the test and verification standard.

1. **Functional Performance Requirements**

   The electronic inclinometer shall be capable of measuring the actual heel angle of the ship over a minimum range of ±90 degrees, in accordance with IMO Resolution MSC.363 (92).

That instrument shall continuously measure and indicate the ship's heel angle relative to the horizontal plane. The indication must be:

- Continuous and real-time, without interruption during normal ship operations
- Clearly readable at all times from the intended operating position
- Presented in degrees of inclination, with appropriate resolution

In addition to heel angle indication, the electronic inclinometer shall be capable of determining and providing the ship's roll period over a minimum range of 4 to 40 seconds.

The system shall provide a direct indication of heel and must not require manual interpretation or calculation by the operator. If damping or averaging is applied, it must not mask significant or dangerous changes in heel.

2. Accuracy Requirements

The inclinometer must meet defined accuracy limits throughout its operational range:

- The maximum permissible error of heel indication is ±1 degree or better over the specified measurement range
- Accuracy must be maintained under steady heel and during moderate rolling conditions
- The system must correctly indicate both port and starboard heel

Accuracy must be verified during type testing and must remain stable over time, subject to normal calibration and maintenance.

3. Measurement Range and Resolution

The electronic inclinometer must:

- Be capable of measuring heel angles at least within the range –45° to +45°, unless a smaller range is justified and approved
- Provide sufficient resolution to allow small changes in heel to be clearly detected (typically 0.1° or better)

The displayed range must be appropriate for stability monitoring and emergency response.

4. Dynamic Performance and Damping

The system must be capable of operating correctly under normal ship motions, including rolling and pitching. To achieve this:

- The inclinometer may incorporate signal filtering or damping, but
- Such damping must not delay or suppress the indication of a dangerous heel condition

The performance standard requires a balance between signal stability and responsiveness, ensuring that the displayed value reflects the ship's true condition without excessive fluctuation or lag.

5. Environmental and Operational Conditions

Electronic inclinometers must operate correctly under the full range of environmental conditions normally encountered at sea, including:

- Temperature variations
- High humidity
- Mechanical vibration and shock
- Electrical power supply fluctuations

Environmental performance must be demonstrated through testing in accordance with IEC 60945, as supplemented or superseded by ISO 19697 where applicable.

6. Power Supply and Reliability

The electronic inclinometer shall be powered from the ship's main source of electrical energy and shall also be capable of operation from the ship's emergency source of electrical energy, in accordance with the applicable IMO performance standards.

If the inclinometer is part of an integrated system, failure of non-essential components must not prevent heel indication unless explicitly permitted by the Administration.

7. Zero Adjustment and Calibration

The system must allow for zero setting when the ship is upright in calm conditions. This adjustment must:

- Be protected against inadvertent or unauthorized alteration
- Be clearly indicated in the system documentation

Calibration stability is a key requirement, and drift must remain within acceptable limits defined during type testing.

8. Display Requirements

The display must be:

- Permanently installed
- Clearly visible from the required operating position (e.g. navigating bridge, cargo control room)
- Legible under all lighting conditions normally encountered on the bridge

If repeaters are installed, they must meet the same performance requirements as the primary display.

9. Testing and Type Approval

To be accepted for statutory use, an electronic inclinometer must:

- Be type approved by the flag Administration or a recognized organization
- Be tested in accordance with ISO 19697:2016, which specifies test methods , tolerances, and acceptance criteria
- Demonstrate compliance with MSC.363(92) during approval testing

Only instruments meeting these standards may be accepted as equivalents to traditional mechanical inclinometers under SOLAS.

10. Interfacing and Integration

The electronic inclinometer shall be provided with a digital interface for the transmission of actual heel angle data to other shipborne systems, including the Voyage Data Recorder (VDR). The interface shall comply with IEC 61162 standards and shall provide an update rate of not less than 5 Hz.

Owner Responsibilities

The ship owner is responsible for ensuring that any electronic inclinometer installed onboard complies with all applicable statutory, flag State, and classification requirements throughout the ship's operational life. The equipment shall be of an approved type, fully compliant with IMO Resolution MSC.363 (92), and properly certified in accordance with the relevant type approval procedures.

The ship owner shall ensure correct installation in an appropriate and representative location, maintain the equipment in an operable condition in accordance with the manufacturer's instructions, and ensure that relevant documentation is retained onboard and made available for survey or inspection.

Classification Responsibilities

The classification society is responsible for verifying that the electronic inclinometer complies with applicable statutory and class requirements.

This includes review of type approval and installation arrangements at the design and construction stage, and verification during initial and subsequent surveys that the equipment remains properly installed, functional, and consistent with the approved configuration. Where non-compliance is identified, appropriate corrective action shall be required.

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