

Regulation on requirements to multi-dimensional measuring instruments (multi-dimensional instruments)

Established by the Norwegian Metrology Service dd.dd.yyyy in accordance with the Units of measurement, measurement and standard time Act of 26 January 2007 no 4 § 35, cf. § 7 and § 10, and § 8, § 19 and § 30 and regulation December 20th 2007 no. 1723 on measuring units and measurements § 5-2 second subsection.

Chapter 1 – Introductory provisions

§ 1. Scope

The regulation prescribes the requirements which applies to multi-dimensional measuring instruments, hereafter called “multi-dimensional instruments”, cf. regulation December 20th 2007 no. 1723 on measuring units and measurements chapter 3 and supplementary provisions on control and approval in service.

The requirements of this regulation applies when

- a) such multi-dimensional instruments are sold or offered for sale, cf. regulation on measuring units and measurements § 3-1 and when
- b) the measurement result of such multi-dimensional instruments will be used in economic transactions , cf. regulation on measuring units and measurements § 3-4.

This regulation does not prescribe requirements to electromagnetic disturbance. Electromagnetic disturbance is regulated by regulation August 10th 1995 no. 713 on electric equipment.

§ 2. Definitions

In this regulation, the following definitions apply:

- a) *Multi-dimensional measuring instrument*: an instrument that serves for the determination of the edge length (length, height, width) of the smallest enclosing rectangular parallelepiped of a product.
- b) *Measurand*: the particular quantity subject to measurement
- c) *Influence quantity*: A quantity that is not the measurand but that affects the result of measurement
- d) *Rated operating conditions*: The values for the measurand and influence quantities making up the normal working conditions of an instrument
- e) *Disturbance*: An influence quantity having a value within the limits specified in the appropriate requirement but outside the specified rated operating conditions of the measuring instrument. An influence quantity is a disturbance if for that influence quantity the rated operating conditions are not specified.

- f) *Critical change value*: The value at which the change in the measurement result is considered undesirable.
- g) Direct sales: A trading transaction is direct sales if:
 - 1. The measurement result serves as the basis for the price to pay
 - 2. At least one of the parties involved in the transaction related to measurement is a consumer or any other party requiring a similar level of protection, and
 - 3. All the parties in the transaction accept the measurement result at that time and place.
- h) *Climatic environments*: The conditions in which measuring instruments may be used. To cope with climatic differences between the Member States of the EEC, a range of temperature limits has been defined.

§ 3. Requirements to multi-dimensional instruments

Multi-dimensional instruments shall as a minimum fulfill the essential requirements established in chapter 2. Maximal permissible errors for multi-dimensional instruments is established in § 29.

Multi-dimensional instruments which have been national type examined during a former legislation, shall in service fulfill the requirements which applied when the multi-dimensional instrument was national type examined, including the requirements for measurement accuracy in service.

Multi-dimensional instruments which are not lawfully conformity marked or has a valid national type examination and national verification, is not allowed in service.

§ 4. Surveillance and approval of sale of multi-dimensional instruments

Multi-dimensional instruments which are sold or offered for sale shall have a valid conformity assessment according to the provisions in regulation on measuring units and measurements chapter 4.

§ 5. Surveillance of a multi-dimensional instrument in service

A multi-dimensional instrument is subject to periodic surveillance. The surveillance period for a multi-dimensional instrument is three years.

Testing of multi-dimensional instruments in conjunction with the surveillance shall be carried out according to relevant parts of the applicable OIML R129 and the procedures of the Norwegian metrology service, unless the Norwegian metrology service considers that the testing should be carried out in a more appropriate and metrologically justifiable manner.

Chapter 2 Requirements to multi-dimensional instruments

Section I- General requirements

§ 6. Metrological protection and level of quality

A multi-dimensional instrument shall provide a high level of metrological protection in order that any party affected can have confidence in the result of measurement, and shall be designed and manufactured to a high level of quality in respect of the measurement technology and security of the measurement data.

§ 7. Intended use and foreseeable misuse

The solutions adopted in the pursuit of the requirements shall take account of the intended use of the multi-dimensional measuring instrument and any foreseeable misuse thereof.

§ 8. Allowable errors

Under rated operating conditions and in the absence of a disturbance, the error of measurement shall not exceed the maximum permissible error value as laid down in § 29.

Unless stated otherwise in section II, the maximum permissible error is expressed as a bilateral value of the deviation from the true measurement value.

Under rated operating conditions and in the presence of a disturbance, the performance requirement shall be as laid down in section II.

Where the multi-dimensional instrument is intended to be used in a specified permanent continuous electromagnetic field the permitted performance during the radiated electromagnetic field-amplitude modulated test shall be within the maximum permissible error.

§ 9. Influence quantities

The manufacturer shall specify the climatic, mechanical and electromagnetic environments in which the multi-dimensional instrument is intended to be used, power supply and other influence quantities likely to affect its accuracy, taking account of the requirements laid down in section II.

§ 10. Climatic environments

The manufacturer shall specify the upper temperature limit and the lower temperature limit from any of the values in table 1, and indicate whether the multi-dimensional instrument is designed for condensing or non-condensing humidity as well as the intended location for the instrument is open or closed.

Table 1

Upper temperature limit	30 °C	40 °C	55 °C	70 °C
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Lower temperature limit	5 °C	-10 °C	-25 °C	-40 °C
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§ 11. Mechanical environments

Mechanical environments are classified into the following classes:

Table 2

M1	This class applies to instruments used in locations with vibration and shocks of low significance, e.g. for instruments fastened to light supporting structures subject to negligible vibrations and shocks transmitted from local blasting or pile-driving activities, slamming doors, etc.
M2	This class applies to instruments used in locations with significant or high levels of vibration and shock, e.g. transmitted from machines and passing vehicles in the vicinity or adjacent to heavy machines, conveyor belts, etc.
M3	This class applies to instruments used in locations where the level of vibration and shock is high and very high, e.g. for instruments mounted directly on machines, conveyor belts, etc.

The following influence quantities shall be considered in relation with mechanical environments:

- a) Vibration
- b) Mechanical shock.

§ 12. Electromagnetic environments

Unless otherwise laid down in section II, electromagnetic environments are classified into the following classes:

Table 3

E1	This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in residential, commercial and light industrial buildings.
E2	This class applies to instruments used in locations with electromagnetic disturbances corresponding to those likely to be found in other industrial buildings.
E3	<p>This class applies to instruments supplied by the battery of a vehicle. Such instruments shall comply with the requirements of E2 and the following additional requirements:</p> <p>voltage reductions caused by energising the starter-motor circuits of internal combustion engines, and load dump transients occurring in the event of a discharged battery being disconnected while the engine is running.</p>

The following influence quantities shall be considered in relation with electromagnetic environments:

- a) Voltage interruptions
- b) Short voltage reductions
- c) Voltage transients on supply lines and/or signal lines, electrostatic discharges,
- d) Radio frequency electromagnetic fields
- e) Conducted radio frequency electromagnetic fields on supply lines and/or signal lines
- f) Surges on supply lines and/or signal lines.

Other influence quantities to be considered, where appropriate, are:

- a) Voltage variation
- b) Mains frequency variation
- c) Power frequency magnetic fields
- d) Any other quantity likely to influence in a significant way the accuracy of the instrument.

§ 13. Basic rules for testing and the determination of errors

Essential requirements specified in § 8 shall be verified for each relevant influence quantity. Unless otherwise specified in section II, these essential requirements apply when each influence quantity is applied and its effect evaluated separately, all other influence quantities being kept relatively constant at their reference value.

Metrological tests shall be carried out during or after the application of the influence quantity, whichever condition corresponds to the normal operational

status of the multi-dimensional instrument when that influence quantity is likely to occur.

§ 14. *Ambient humidity*

According to the climatic operating environment in which the multi-dimensional instrument is intended to be used either the damp heat-steady state (non-condensing) or damp heat cyclic (condensing) test may be appropriate.

The damp heat cyclic test is appropriate where condensation is important or when penetration of vapour will be accelerated by the effect of breathing. In conditions where non-condensing humidity is a factor the damp-heat steady state is appropriate.

§ 15. *Reproducibility*

The application of the same measurand in a different location or by a different user, all other conditions being the same, shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the maximum permissible error.

§16. *Repeatability*

The application of the same measurand under the same conditions of measurement shall result in the close agreement of successive measurements. The difference between the measurement results shall be small when compared with the maximum permissible error.

§ 17. *Discrimination and sensitivity*

A multi-dimensional instrument shall be sufficiently sensitive and the discrimination threshold shall be sufficiently low for the intended measurement task.

§ 18. *Durability*

A multi-dimensional instrument shall be designed to maintain an adequate stability of its metrological characteristics over a period of time estimated by the manufacturer, provided that it is properly installed, maintained and used according to the manufacturer's instruction when in the environmental conditions for which it is intended.

§ 19. *Reliability*

A multi-dimensional instrument shall be designed to reduce as far as possible the effect of a defect that would lead to an inaccurate measurement result, unless the presence of such a defect is obvious.

§ 20. Suitability

A multi-dimensional instrument shall be:

- a) Suitable for its intended use taking account of the practical working conditions and shall not require unreasonable demands of the user in order to obtain a correct measurement result.
- b) Robust and its materials of construction shall be suitable for the conditions in which it is intended to be used.
- c) Designed so as to allow the control of the measuring tasks after the instrument has been placed on the market and put into use. If necessary, special equipment or software for this control shall be part of the measuring instrument. The test procedure shall be described in the operation manual.
- d) Insensitive to small fluctuations of the value of the measurand, or it shall take appropriate action, when the measuring instrument is designed for measurement of values of measurand that are constant over time

A multi-dimensional instrument shall have no feature likely to facilitate fraudulent use, whereas possibilities for unintentional misuse shall be minimal.

When a multi-dimensional instrument has associated software which provides other functions besides the measuring function, the software that is critical for the metrological characteristics shall be identifiable and shall not be inadmissibly influenced by the associated software.

§ 21. Protection against corruption

If the multi-dimensional instrument gets connected to another device, direct or by any remote device that communicates with it, shall its metrological characteristics not be influenced in any inadmissible way.

The hardware components that are critical for metrological characteristics shall be designed so that they can be secured. Security measures foreseen shall provide for evidence of an intervention.

Software that is critical for metrological characteristics shall be identified as such and shall be secured. Software identification shall be easily provided by the measuring instrument. Evidence of an intervention shall be available for a reasonable period of time.

Measurement data, software that is critical for measurement characteristics and metrologically important parameters stored or transmitted shall be adequately protected against accidental or intentional corruption.

§ 22. *Information to be borne by and to accompany the multi-dimensional instrument*

A multi-dimensional instrument shall bear the manufacturer's mark or name and information in respect of its accuracy. When applicable the measuring instrument shall also bear the following information:

- a) Relevant information in respect of the conditions of use
- b) Measuring capacity
- c) Measuring range
- d) Identity marking
- e) Number of the EC-type examination certificate or the EC design examination certificate
- f) Information whether or not additional devices providing metrological results comply with the regulations on legal metrological control.

Information on its operation shall accompanied the multi-dimensional instrument, unless the simplicity of the instrument makes this unnecessary. Information shall be easily understandable and shall include where relevant:

- a) Rated operating conditions
- b) Electromagnetic environment
- c) The upper and lower temperature limit, if condensation is possible or not, open or closed location
- d) Instructions for installation, maintenance, repairs, permissible adjustments
- e) Instructions for correct operation and any special conditions of use;
- f) Conditions for compatibility with interfaces, sub-assemblies or measuring instruments.

All marks and inscriptions required shall be clear, unambiguous, non-erasable and non-transferable. Groups of identical multi-dimensional measuring instruments do not require individual instruction manuals.

§ 23. *Specification of measured value*

Unless specified in section II, the scale interval for a measured value shall be in the form 1×10^n , 2×10^n , or 5×10^n , where n is any integer or zero. The unit of measurement or its symbol shall be shown close to the numerical value.

The units of measurement and symbols used shall be in accordance with regulations on measuring units and measurements.

§ 24. *Indication of result*

Indication of the result shall be by means of a display or hard copy. In the case of hard copy the print or record shall also be easily legible and non-erasable.

The indication of any result shall be clear and unambiguous and accompanied by such marks and inscriptions necessary to inform the user of the significance of the result. Easy reading of the presented result shall be permitted under normal conditions of use. Additional indications may be shown provided they cannot be confused with the metrologically controlled indications.

A multi-dimensional instrument for direct sales trading transactions shall be designed to present the measurement result to both parties in the transaction when installed as intended. When critical in case of direct sales, any ticket provided to the consumer by an ancillary device not complying with the appropriate requirements of this regulation shall bear an appropriate restrictive information.

§ 25. *Further processing of data to conclude the trading transaction*

The multi-dimensional instrument shall record by a durable means the measurement result accompanied by information to identify the particular transaction, when the measurement is non-repeatable and the measuring instrument is normally intended for use in the absence of one of the trading parties.

Additionally, a durable proof of the measurement result and the information to identify the transaction shall be available on request at the time the measurement is concluded.

§ 26. *Conformity evaluation*

A multi-dimensional instrument shall be designed so as to allow ready evaluation of its conformity with the appropriate requirements of this regulation.

Section II - Specific requirements

§ 27. Electromagnetic immunity

The effect of an electromagnetic disturbance on a dimensional instrument shall be such that

- a) the change in measurement result is no greater than the critical change value as defined in second subsection,
- b) it is impossible to perform any measurement,
- c) there are momentary variations in the measurement result that cannot be interpreted, memorised or transmitted as a measuring result,

d) there are variations in the measurement result severe enough to be noticed by all those interested in the measurement result.

The critical change value is equal to one scale interval (d).

§ 28. Operating conditions

Relevant dimensions shall be within the range specified by the manufacturer for the instrument.

The lower limit of the minimum dimension for all values of the scale interval is given in table 4.

Table 4

Scale interval (d)	Minimum dimension (min) (lower limit)
$d \leq 2 \text{ cm}$	10 d
$2 \text{ cm} < d \leq 10 \text{ cm}$	20 d
$10 \text{ cm} < d$	50 d

The speed must be within the range specified by the manufacturer for the multi-dimensional instrument.

§ 29. Maximum permissible error

The maximum permissible error is $\pm 1,0 d$.

Chapter 3 - Concluding provisions

§ 30. Infringement penalty

Violation of the provisions of this regulation may lead to order of infringement penalty, determined by the provisions of regulation on measuring units and measurements chapter 7.

§ 31. Entry into force

This regulation enters into force on xx.