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Fields of use of measuring instruments subject to
verification

Domaines d'utilisation des instruments de mesure assujettis à la vérification

OIML D 12 Edition 1986 (E)



ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION
OF LEGAL METROLOGY

Foreword

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

- **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D)**, which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by technical committees or subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users of measuring instruments, test laboratories, etc. may apply simultaneously OIML publications and those of other institutions.

International Recommendations and International Documents are published in French (F) and English (E) and are subject to periodic revision.

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FIELDS of USE

of MEASURING INSTRUMENTS

SUBJECT to VERIFICATION

1. Introduction

1.1. This International Document defines the fields of application for which the use of verified ^(*) measuring instruments is recommended. Under the heading «Commentary», the Document gives explanations, reasons, and examples intended to facilitate understanding of the text. In addition, under the heading «Examples», it indicates a number of measuring instruments which could be considered suitable subjects for verification.

1.2. This Document, in conjunction with other OIML International Documents, concerning «metrological law», «legal units of measurement», etc., can serve as a starting point for developing legislation by the appropriate bodies. Even jurisdictions which already have a well developed system of legal metrology may consider some aspects of this Document if they want to extend their system of legal metrology into additional fields (for example, official activities, medicine, or environmental protection). The Document stresses the need to utilize instruments that have been verified. The measurement assurance techniques that verify the accuracy of the entire measurement by assessing the results of the measurement process, such as those described in Documents developed by the Reporting Secretariat SP 22-Sr 6, are also consistent with the intent of this Document.

1.3. In the light of this Document, each OIML Member should examine, in accordance with his needs and capabilities, to what extent the text can be applied. The effort necessary should be in reasonable proportion to the attainable benefit. In addition to the verification of each instrument in the classical sense, there are other strategies which ensure that «correct» measuring instruments are used (for example, verification by sampling and inter-laboratory comparisons).

While legal metrology agencies are responsible for metrological examinations, it is possible to ask other official, semi-official, or authorized private bodies to perform these tasks. A condition in such cases is that these organizations operate impartially and at an acceptable level of accuracy and competence.

1.4. Measuring instruments should only be used in the fields of application mentioned in the text if they are provided with valid verification marks and are correct. Verification certificates may also be issued. Other possibilities for the registration of verified measuring instruments are also conceivable. Verified instruments may, for instance, be registered by their serial numbers without marking every individual measuring instrument. In such a case, the fact that the instrument is verified is less evident to the user and therefore such registration should only be used in special cases.

^(*) Verification: all the operations carried out by an organ of the national service of legal metrology (or other legally authorized organization) having the object of ascertaining and confirming that the measuring instrument entirely satisfies the requirements of the regulations for verification.

Verification includes both examination and stamping.

(Vocabulary of legal metrology, 1978 edition, point 2.4).

1.5. Auxiliary devices for measuring instruments used in the fields of application under point 2 or 6 should also be verified if their mode of operation directly influences the associated measuring instruments or if they have or may have an effect on measurement results.

1.6. Legislation must specify the fields and quantities to be covered by verification. Measuring instruments in the fields of trade, health and safety, environment, traffic, etc., should be included. It should be recognized that, even in these fields, not all measurements need be controlled - only those measurements of which the errors could have an adverse impact.

2. Verification for use in trade

2.1. Measuring instruments should be verified when used in trade, that is to say in connection with commercial activities, whenever it is clear that measurement errors could have a significant adverse economic impact on the buyer or seller. It might be argued that, to completely protect the public, all instruments used in trade should be subject to legal controls and verified. However, because effective controls are often expensive, judgment must be exercised in determining which measurements to control. From the examples given just below, those instruments considered to have the highest priority may be selected.

2.1.1. Instruments to measure the following quantities:

Length, area, volume, mass, time, temperature, pressure, thermal or electric energy, thermal or electric power, volume, flowrate and caloric value of liquids or gases, density or specific gravity calculated from density measurements, water content of fats, fat content of milk and of other dairy products, moisture content of cereals or of foods containing oil, and sucrose content.

2.1.2. Instruments to determine the cost of transport in passenger-carrying vehicles (taxis).

2.2. Auxiliary devices for determining price, that are associated with measuring instruments should also be verified.

Commentary

« Commercial activities » include activities of a commercial nature related to merchandise the price of which is determined on the basis of measurement.

Frequently it is necessary to measure several physical quantities to determine price. For example, it is generally not sufficient to determine merely the gross volume of a load of oil. In such a case, it is also important to measure temperature and density in order to calculate the mass to be invoiced. For this reason, not only the instrument used to measure volume, but also those to determine temperature and density, should be subject to metrological control. The situation is the same in the case of food fats, the price of which is influenced by water content. In such cases the instruments used to determine the water content should also be verified. When the quantity to be measured may be nonhomogeneous, proper sampling must be considered. The sale of electric, gas, or heat energy also represents a commercial activity in which price is generally determined with measuring instruments connected to the distribution lines. Likewise, the transportation of persons or freight is a commercial activity based largely on distance travelled and time.

Examples of measuring instruments, used to determine certain quantities, which should be considered for verification are:

— Length

Rigid and flexible rules, measuring tapes, including those in bolts of cloth, calipers, micrometers, dial gauges, and odometers.

— Area

Planimeters and machines for measuring surface area (for example, leather or similar materials).

— Volume

- a) Instruments for measuring the volume of liquids or gases at rest: drinking glasses, flasks, graduated containers, piston metering pumps, automatic units for volume measurement, proving tanks, prover loops, road tankers used as measuring containers, transportable measuring containers, brewing and fermentation tanks, and bottles and barrels with indications of nominal volume,
- b) instruments for determining the volume of liquids in motion: flowmeters, including measuring units equipped with counters,
- c) volume measures used in laboratories: graduated flasks and test tubes, burettes for liquids or gases, measuring cylinders, and pipettes.

— Mass

Weights and weighing instruments of all types: equal and unequal arm balances, sliding weight steelyards, tipper or spring balances, electromechanical weighing machines, automatic machines for weighing products at rest or in motion, automatic machines for continuous or discontinuous weighing of bulk products, and automatic check weighers or weight graders.

— Electric energy and power; volume and flowrate of liquids and gases

Electricity meters for d.c. or single or multi-phase a.c., maximum demand indicators, flowmeters for liquids or gases, and heat meters.

— Density

Hydrometers, pycnometers, and hydrostatic balances.

3. Verification in the field of official activities

Measuring instruments under point 2.1 should be verified when used in connection with the following official activities.

- 3.1. Measurements in connection with, for example, customs, and tax or toll legislation.
- 3.2. Determination of transport charges for official bodies (postal service).
- 3.3. Measurement and gauging of quantities that characterize ships and barges.
- 3.4. Surveillance in the public interest.
- 3.5. Preparation of expert reports in connection with proceedings initiated by legal authorities or with legal proceedings or for other official purposes.
- 3.6. Geodetic measurements.

Commentary

In order to provide necessary legal assurance, measurements for official purposes should be made exclusively with verified measuring instruments.

Surveillance tasks in the interest of the public are control functions which contribute to the protection and safety of the public and are required by law of government agencies or of private bodies in such fields as food, health, and drug enforcement.

Point 3.4 is partly identical with point 6 since it includes official road traffic surveillance (point 6) which is also surveillance in the interest of the public.

4. Verification in the field of medicine and of the manufacture and testing of pharmaceuticals

Instruments, substances, and devices used in the diagnosis and treatment of humans and animals, in the manufacture of medicines, and in the monitoring of the medical environment (patient and hospital) should be considered for verification. Examples of such instruments, substances, and devices include, but are not limited to, the following.

- 4.1. Instruments and devices used to measure the physical aspects of man and animals, including height, weight, temperature, blood and pulmonary pressure, respiratory volume, and parameters of speech, hearing, and vision.
- 4.2. Instruments, substances, and devices used in chemical, biological, and biochemical analyses (including counting) to identify biological and chemical substances and species and to determine content, concentration, proportions, and counts.
- 4.3. Reference materials and certain chemical, biological, and radiological reagents (substances) used in clinical laboratories for calibrating the instruments under point 4.2 or for biochemical analyses.
- 4.4. Reference standards for physical quantities used for calibrating the instruments under point 4.1.

Commentary

Verification in the medical field and in connection with the manufacture and testing of pharmaceuticals serves to protect human and animal health. It contributes to the correct functioning of measuring instruments used in human medicine, dentistry, and veterinary medicine, provided that they are used in conformity with regulations and that the instruments remain stable during the period of validity of the verification.

The types of measuring instruments under point 4 include highly complex instruments which require much experience on the part of the user. For this reason, pattern evaluation and subsequent verification of instruments are not always sufficient to assure correct measurement results. Practice has shown that proficiency tests with samples of clearly defined composition, which are left unmarked and are then analyzed by the laboratory personnel, are effective in identifying problems related to measurement methods, measuring instruments, ambient conditions, and measurement techniques. Appropriate inter-laboratory tests carried out with samples of undisclosed values are also useful for determining measurement capabilities. The critical parameters of reference materials and standards used in inter-laboratory tests should be officially certified.

Examples of measuring instruments under point 4.1

Tonometers, instruments for measuring blood pressure, clinical thermometers, ophthalmodynamometers, weighing instruments such as baby scales and bed scales, audiometers, focimeters, and dosimeters related to instruments emitting radiation.

Examples of measuring instruments under point 4.2

Chemical balances, graduated flasks and test tubes, burettes, syringes, pipettes for mixing blood and for measuring blood sedimentation rate, piston-type pipettes, dilutors, dispensers, pycnometers, hydrostatic balances, cell counting chambers and cell counting instruments, glucose analyzers, spectrophotometers, microazotometers, and coagulometers.

5. Verification in the fields of environmental protection, occupational safety, and accident prevention

- 5.1. Instruments for measuring sound (noise), vibration, ionizing and nonionizing radiation, and pollution of air, water, soil, and food products should be verified.
- 5.2. Instruments for determining the values of quantities and for checking the observance of permissible limits in occupational safety and accident prevention should be verified.
- 5.3. For applications referred to in points 5.1 and 5.2, measuring instruments other than those indicated in those points are also frequently used (sometimes as auxiliary measuring devices) and should be verified. These include instruments for determining mass, length, area, volume, pressure, temperature, time, frequency, density, volume or mass concentration, voltage, and current.
- 5.4. Reference materials and standards used in testing and calibrating instruments under points 5.1 to 5.3 should be officially certified.

Commentary

Verification of measuring instruments in the fields of environmental protection, occupational safety, and accident prevention at work and elsewhere should provide assurance of correct measurement results and improve the accuracy of these instruments. The verification of measuring instruments in the field of environmental protection can also be of importance in connection with any legal consequences of unacceptable environmental pollution.

For the measurement of pollution, for example air pollution, it is generally necessary to take account of environmental influences. For this reason, all measuring instruments involved in the measurement process, and alluded to in point 5.1 (for example, thermometers, barometers, and balances for measuring dust samples) should be verified. Measuring instruments used for official purposes should meet particularly severe requirements because measurement results obtained with them may be used, where appropriate, as the basis for decisions which may involve major economic consequences for those causing the pollution.

Examples of measuring instruments used in the field of environmental protection, occupational safety, and accident prevention:

- dosimeters, and dose-rate meters for use in radiation protection,
- sound level meters,
- equipment for measuring smoke density in connection with heating installations,
- instruments for measuring carbon monoxide in motor vehicle exhaust gases,
- gas detecting devices,
- instruments for measuring SO₂ which are used in anti-pollution protection,
- electrical safety relays (circuit breakers),
- automobile tire pressure gauges,
- pressure gauges on boilers and pressure vessels.

6. Measuring instruments used for road traffic surveillance

Measuring instruments used for official surveillance of road traffic should be verified.

Commentary

Measuring instruments used for official surveillance of road traffic contribute to road user safety. The observance of statutory speed limits by road users is monitored. Because users caught exceeding these limits may be penalized, both users and traffic police should be certain that speed is checked with measuring instruments giving correct indications.

In certain types of vehicles, chronotachographs should be installed in the interest of road safety and to monitor compliance with regulations concerning admissible speeds and driving rest periods. Information recorded on chronotachographs may also be used as evidence in legal proceedings. In such cases, verification is a precondition to acceptance of the accuracy of the measurement results and of the stability of the instruments used.

Checks of maximum permissible axle load, headlamp adjustment, tire pressure and depth of tire tread, and checks of instruments for measuring breath alcohol also contribute to road safety.

Examples of measuring instruments used for official surveillance of road traffic:

Speedometers, chronotachographs, decelerometers, tire pressure gauges, traffic control radars, instruments for measuring axle load, stop/start chronometers, distance measuring instruments, breath testers.

7. Other fields of metrological control

In addition to the fields of application mentioned above, there are occasions when verified measuring instruments should also be used in various other applications, for example:

- structures (buildings, dams and bridges),
- transportation (roads, automobiles, waterways, railways, and airplanes),
- hazardous materials (storage, transportation, and disposal of toxic, flammable, explosive, and radioactive materials),
- public utilities (water, energy, sewage, garbage, and trash),
- entertainment (slot machines and other gambling devices).

In certain countries, measuring instruments employed by industry are also subject to metrological control, for example to assure a uniform quality of manufactured products and conformity of actual product characteristics with those specified.

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