90.30 - Oscilloscopes, spectrum analysers and other instruments and apparatus for measuring or checking electrical quantities, excluding meters of heading 90.28; instruments and apparatus for measuring or detecting alpha, beta, gamma, X-ray, cosmic or other ionising radiations.

9030.10 - Instruments and apparatus for measuring or detecting ionising radiations

9030.20 - Oscilloscopes and oscillographs

- Other instruments and apparatus, for measuring or checking voltage, current, resistance or power :

9030.31 - - Multimeters without a recording device

9030.32 - - Multimeters with a recording device

9030.33 - - Other, without a recording device

9030.39 - - Other, with a recording device

9030.40 - Other instruments and apparatus, specially designed for telecommunications (for example, cross-talk meters, gain measuring instruments, distortion factor meters, psophometers)

- Other instruments and apparatus :

9030.82 - - For measuring or checking semiconductor wafers or devices

9030.84 - - Other, with a recording device

9030.89 - - Other

9030.90 - Parts and accessories

(A) INSTRUMENTS AND APPARATUS FOR MEASURING OR DETECTING ALPHA, BETA, GAMMA, X-RAY, COSMIC OR OTHER IONISING RADIATIONS

These instruments and apparatus are used in scientific research, for industrial purposes (metallurgy, petroleum prospecting, etc.), or for biological or medical purposes (in conjunction with radioactive tracers). They include :

(1) **Detection instruments incorporating ionisation chambers**. A potential difference is set up between two electrodes contained in the ionisation chamber. The ions formed when a radiation enters the chamber are attracted to the electrodes, and the resulting changes in the potential difference may be amplified and measured.

(2) **Geiger counters**. A large potential difference is maintained between the electrodes of the counter; the ions produced by an incoming radiation are greatly accelerated, and in turn ionise the gas contained in the tube. This sets up impulses which may be counted.

The ionisation chamber and Geiger counter apparatus of this heading normally consist of several units such as a chamber or counter, an amplifier, a voltage supply unit for the chamber or counter, and a counting circuit or indicating instrument. All these units are often incorporated in the same case. Sometimes all the units except the chamber or counter are in the same case, and apparatus of this type (which requires a chamber or counter before it is complete) remains classified in this heading (as an essentially complete instrument). When the individual units are presented separately they are classified in accordance with the provisions of the General Explanatory Note to this Chapter.

Certain ionisation chambers which are used to measure total quantities of radiation over an appreciable time (e.g., 24 hours) do not require any auxiliary amplifiers, etc., but incorporate a very light moving pointer which can be read under a microscope and then shows the total amount of radiation which has passed through the chamber. These chambers (which often resemble fountain pens) are complete measuring instruments in themselves and are classified in this heading.

The heading also covers **scintillation counters**. These consist of a device (photomultiplier) which is made up essentially of a photoelectric cell and an electron multiplier. They operate on the principle that radiation may be detected or measured by its effect in exciting the fluorescence of certain crystals (zinc sulphide, thallium activated sodium iodide, anthracene, plastics impregnated with tetraphenyl-butadiene, etc.). The crystals are placed between the source of radiation and one electrode of the counter.

This group also includes :

(1) **Dosimeters and similar apparatus used in radiology** for measuring and checking the intensity and penetrating power of X-rays.

(2) **Apparatus for measuring cosmic or similar radiations**.

(3) **"Thermopile" neutron detectors and measuring or detecting instruments** incorporating neutron detector tubes (boron, boron trifluoride or hydrogen types, or using radioactive fissionable elements).

(4) **Radiation measuring or detecting instruments** incorporating liquid or solid scintillators.

The heading **excludes** :

(a) Apparatus incorporating a scintillation counter whose data are converted into analogue signals for the purpose of making medical diagnoses (e.g., gamma camera, scintillation scanner) (**heading 90.18**).

(b) Measuring or checking apparatus designed to incorporate a radioactive source (in particular, artificial isotopes), for example, for measuring thickness of materials (sheets, linings or the like), for monitoring the contents of packages, for measuring low speed air currents (ionisation anemometers), etc. (**heading 90.22**).

(B) OSCILLOSCOPES, SPECTRUM ANALYSERS AND OTHER INSTRUMENTS AND APPARATUS FOR MEASURING OR CHECKING ELECTRICAL QUANTITIES

Oscilloscopes and oscillographs are used respectively for observing or recording rapid variations of an electrical quantity (voltage, current, etc.). The instruments may be divided into three main categories :

(a) **Duddell oscillographs**, in which a coil, usually consisting of a loop of taut wire with mirrors attached, moves in the field of an electro-magnet. The periodic phenomenon under study can be observed directly on a sheet of frosted glass, or recorded on a photographic tape.

(b) **Soft iron and graver type oscillographs**, with a coil acting on a strip of soft iron placed in a constant field. A lightweight rod, pointed at one end, is fixed to the strip and traces the phenomenon (e.g., by cutting a coated cellulose acetate tape).

(c) **Cathode-ray oscilloscopes and oscillographs**; these operate by recording how a cathode-ray beam is deflected by electrostatic or electro-magnetic forces. These instruments, which may be in one or more parts, consist essentially of the cathode-ray tube, feeding devices and transformers, amplifiers, a sweeping or scanning system and other auxiliary devices and, sometimes, an electronic switch. Oscilloscopes with a memory, used to examine isolated rapid transient phenomena, are equipped with either a cathode-ray memory tube or a numeric memory associated with a cathode-ray tube. In the first type, the image of the signal is captured and maintained on the cathode-ray tube. In the second type, the signal is recorded in the memory and can be retrieved at will to be viewed on the screen.

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Spectrum analysers are instruments which identify the different frequency components of an electrical input signal. They are mainly used to analyse electrical quantities. They can also analyse ionising radiations, sound waves or other non-electrical quantities when used in conjunction with radiation detectors or other devices which can detect non-electrical quantities and convert them into electrical signals.

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The heading covers transient phenomena recorders which are apparatus designed to capture a signal and to record it with a view to transmitting it later, in an appropriate form, onto a display apparatus (television monitor, for example). "Logic analysers", which are apparatus used to examine electrical circuits consisting for the most part of semiconductor devices, are also classified here.

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Instruments and apparatus for measuring or checking electrical quantities may be indicating or recording types.

They may be subdivided, according to their mode of operation, into a number of groups, such as :

(1) **Moving-coil instruments**, in which the current to be measured passes through a coil free to move in the magnetic field provided by a permanent magnet. The pointer is secured to the moving coil.

(2) **Moving-iron instruments**, in which the pointer is deflected by a solenoid acting upon a piece of soft iron fixed to the pointer shaft.

(3) **Electrodynamic instruments**, in which the current to be measured passes through fixed and moving coils, the moving coils operating in the magnetic field of the fixed coils. The pointer is secured to the moving coils.

(4) **Induction instruments**, consisting of a pointer shaft on which is mounted a flat disc or cylinder which operates in the air gap of an electro-magnet having one or more coils.

(5) **Thermocouple instruments**, in which the current to be measured is passed through a heater applied to the hot junction of a bi-metallic thermocouple whose electromotive force is then measured.

(6) **Electronically operated instruments** based on semiconductor technology with a pointer or an opto-electronic display for analogue or digital readout.

Apart from the above-mentioned types of instruments or apparatus which generally effect direct measurements, the heading also includes those which supply the operator with certain data from which the quantity to be measured can be calculated (comparative method). This group includes, in particular, **measuring bridges** and **potentiometers**. These are usually mounted in boxes or cases containing one or more galvanometers, standard resistors, standard capacitors, standard inductors, standard cells, transformers, converters, switches, etc. Measuring bridges are often named after their inventor (Wheatstone, Thomson, Anderson, Maxwell, Sauty, Schering, Kohlrausch, Wien, etc.); others have names indicating the grouping system of the units of comparison (decade pattern bridges, double bridges, T-type bridges, etc.), or the special purpose of the bridge (impedance, resistance, capacitance or connection bridges, universal bridges, etc.).

The following are, however, **excluded** (**Chapter 85**) when presented separately : transformers, standard resistors, standard capacitors, standard inductors, standard cells, etc.; also earphones (headsets) (used instead of the visual null indicator in some types of measuring bridge).

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The main types of electrical measurements are :

(I) **Measurement of electric currents**. This is carried out, in particular, by means of galvanometers or amperemeters (ammeters).

(II) **Voltage measurement**, by voltmeters, potentiometers, electrometers, etc. The electrometers used for measuring very high voltages are electrostatic; they differ from the usual type of voltmeter in that they are fitted with spheres or plates held on insulating pillars.

(III) **Measurement of resistance and conductivity**, by means of ohmmeters or measuring bridges, in particular.

(IV) **Measurement of power** by means of wattmeters.

(V) **Measurement of capacitance and inductance**, effected by means of measuring bridges, and expressed in farads or henrys.

(VI) **Measurement of frequencies**, by means of frequency meters graduated in hertz (cycles per second).

(VII) **Measurement of wavelengths or radio frequencies** by wavemeters, or slotted line or slotted waveguide instruments.

(VIII) **Measurement of phase angles or power factors**, carried out with phase meters, calibrated in power factors (cos phi).

(IX) **Measurement of the ratios of two electrical quantities** by ratiometers.

(X) **Measurement of magnetic fields or magnetic fluxes**, effected with galvanometers or fluxmeters.

(XI) **Measurement of the electrical or magnetic properties of materials**, carried out with hysteresis testers, permeameters or similar instruments.

(XII) **Testing of synchronism**, by means of synchroscopes, instruments for indicating the phase relation and difference in frequency between two periodic phenomena. Such instruments can be recognised by the fact that their dials bear the indications "Fast" and "Slow" (with corresponding arrows).

(XIII) **Measurement and recording of rapid variations of electrical quantities** by means of the oscilloscopes or oscillographs described above.

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Some electrical measuring instruments can be used for many purposes, for example, electrical or electronic instruments known as "universal testers" (e.g., multimeters) which serve for the rapid measurement of voltages (direct or alternating), currents (direct or alternating), resistances and capacitances.

The heading also includes a wide range of electrical or electronic instruments used in radio-communications or telecommunications. In addition to the voltmeters, potentiometers, measuring bridges, ammeters, wattmeters, phase meters and frequency meters already mentioned, this range includes :

(i) **Impedance testers and bridges**, for determining the impedance in a circuit, and also for measuring capacitances or inductances.

(ii) **Inductance bridges and similar instruments**, for measuring ring inductances on the Wheatstone bridge principle.

(iii) **Nepermeters and decibel meters**. These are used for measuring the attenuation over long distance telephone circuits. Instruments and apparatus for measuring quantities of sound fall in **heading 90.27**.

(iv) **Fading indicators**. Unlike nepermeters (which give measurements based on a compensatory system), these give a direct indication of the fading.

(v) **Cross-talk meters**, used on telephone circuits for measuring various quantities.

(vi) **Transmission level indicators**.

(vii) **Noise level meters**, for use on high frequency lines.

(viii) **Gain measuring instruments**, for measuring the gain through repeaters relaying long distance telephone circuits.

(ix) **Instruments for measuring interference**, e.g., noise voltage in long distance telephone installations or interference from neighbouring high tension circuits.

(x) **Psophometers**, instruments for calculating line-noise, i.e., the electromotive force of a source of current which would produce the same interference if substituted for the voltages induced in the telephone circuit.

(xi) **Peak indicators**, for recording short voltage peaks such as occur in transmission systems (e.g., long distance telephone cables, radio transmission circuits, shortwave links).

(xii) **Echo meters**, used in establishing line balance by direct readings of echo expressed in nepers or decibels.

(xiii) **Distortion factor meters**, for measuring the harmonic distortion introduced into complex transmissions.

Some of the above instruments, in particular those used for electro-acoustic measurements, are calibrated in nepers or decibels.

This heading also covers other instruments and apparatus which perform operations of a kind described in the heading, including **valve testing or measuring instruments, in particular those for testing radio valves**. These valve testing or measuring instruments are sometimes designed so as to produce the characteristic curve of the valve on the screen of an oscilloscope.

PARTS AND ACCESSORIES

Subject to the provisions of Notes 1 and 2 to this Chapter (see the General Explanatory Note), separately presented parts and accessories of instruments or appliances of this heading remain classified here. Examples of these are : **coincidence units**, electronic, for use with Geiger-Müller counters or proportional counters, **solid scintillators** in the form of crystals or of elements of plastics, mounted or metal-sheathed, designed solely for fitting to detection instruments, **neutron detector tubes** using boron, boron trifluoride, hydrogen or fissionable elements.