90.25 - Hydrometers and similar floating instruments, thermometers, pyrometers, barometers, hygrometers and psychrometers, recording or not, and any combination of these instruments.

- Thermometers and pyrometers, not combined with other instruments :

9025.11 - - Liquid-filled, for direct reading

9025.19 - - Other

9025.80 - Other instruments

9025.90 - Parts and accessories

(A) HYDROMETERS AND SIMILAR FLOATING INSTRUMENTS

These instruments are used for determining, generally by direct reading on a graduated stem, the specific gravity of solids or liquids, or some arbitrary value related to specific gravity (e.g., strength of spirituous liquors). The reading is sometimes converted by a table into other units.

The instruments are usually made of glass (though some may be of metal, e.g., nickel-silver, silver, etc.), and weighted at one end with mercury or fine lead shot. These weights are generally fixed, but instruments for ascertaining the density of liquids of different specific gravities are sometimes designed so that the weights can be varied or additional weights added. Some hydrometers (e.g., those used to determine the strength of the acid in accumulators) are enclosed in a glass syringe. Other types are combined with a thermometer.

Most of these instruments are known according to the use for which they are designed, for example, alcoholometers; saccharometers (used in brewing or in sugar manufacture); salinometers; lactodensimeters or lactometers; acidimeters (for determining the specific gravity of accumulator or other acid); urinometers; etc. Others are named after the inventor (e.g., Baumé, Brix, Balling, Bates, Gay-Lussac, Richter, Tralle, Sikes, Stoppani, etc.). Nicholson's hydrometer is used for solids.

The heading **does not cover** :

(a) Instruments which determine specific gravity by other methods, for example, pyknometers (specific gravity bottles) (**heading 70.17**), specific gravity or hydrostatic balances (**heading 90.16**).

(b) Certain analysis apparatus which are not floating instruments, for example, butyrometers (for determining the fatty content of butter), ureometers (for testing urea content); these are classified in **heading 70.17**.

(B) THERMOMETERS, THERMOGRAPHS AND PYROMETERS

This group includes :

(1) **Glass thermometers, with a liquid-filled glass tube**. These include household thermometers (room, window thermometers, etc.), floating thermometers (bath thermometers, etc.), clinical thermometers, industrial thermometers (for boilers, furnaces, autoclaves, etc.), laboratory thermometers (used in calorimetry, etc.), special meteorological thermometers (e.g., for measuring solar or terrestrial radiations), thermometers used in hydrography (e.g., reversible thermometers used in taking deep-sea soundings). The heading also includes glass thermometers called minimum and maximum thermometers since they are designed to indicate the highest and lowest temperature they have recorded.

(2) **Metallic thermometers** (in particular bi-metallic thermometers which make use of the different coefficients of expansion of two metal strips welded together). They are mainly used in meteorology, for air conditioning and for other scientific or industrial purposes; thermometers for use with motor vehicles, to indicate the temperature of the radiator water, are usually of this type.

(3) **Expansion or pressure thermometers** with metallic systems. In these thermometers the expansible medium (liquids, vapours, gases) develops a pressure and actuates a Bourdon tube or similar pressure measuring device, which then operates a pointer over an indicator dial. Most of these thermometers are used for industrial purposes.

(4) **Liquid crystal thermometers**. These contain liquid crystals which change their physical properties (e.g., colour) according to variations in temperature.

(5) **Electrical thermometers and pyrometers**, such as :

(i) **Resistance thermometers and pyrometers** operating by changes in the electrical resistance of a metal (e.g., platinum) or of a semiconductor.

(ii) **Thermocouple thermometers and pyrometers** based on the principle that the heating of the junction of two different electric conductors generates an electro-motive force proportional to the temperature. The combinations of metals used are generally : platinum with rhodium-platinum; copper with copper-nickel; iron with copper-nickel; nickel-chromium with nickel-aluminium.

(iii) **Radiation (including optical) pyrometers**. These are of various types, e.g. :

(a) **Pyrometers** in which a concave mirror concentrates the radiations from an incandescent body, e.g., onto the hot junction of a thermocouple placed at the focal point of the mirror.

(b) **Disappearing filament pyrometers**. In these the temperature is measured by varying the brightness of a filament of an incandescent lamp, by means of a rheostat device, until it coincides with that of the image of the source to be controlled.

Electrical thermometers and pyrometers are sometimes combined with automatic regulating devices which control the operation of the furnace, oven, fermentation vats, etc. Such combinations are classified in **heading 90.32**.

(6) **Optical, photometric cube type pyrometers**. A prism provides a field of view in which the centre section is illuminated by a standard incandescent lamp and the surrounding field is illuminated by light from the hot body. A circular glass disc, coated with an emulsion of varying density, is rotated so as to vary the intensity of light from the hot body. The number of degrees of rotation of the disc necessary to match the brightness in the inner and outer parts of the field is a measure of the temperature.

(7) **Optical, disappearing filament type pyrometers**. The intensity of the image reflected from the furnace is equalised with that of the standard lamp by interposing a series of smoked glasses, or by the rotation of a graduated wedge of absorbing glass corresponding to given temperatures.

(8) **Pyrometric telescopes based on rotatory polarisation**. These consist of two Nicol prisms between which is placed a calibrated quartz crystal; the temperature may be calculated from the angle through which one of the Nicol prisms must be turned to obtain a particular colouring.

(9) **Pyrometers based on contraction of a solid substance** (clay, for instance). These consist of an oscillating lever, one arm of which moves before a dial, the other connecting with the rod which serves to estimate the temperature.

The heading also includes **" contact " thermometers** which indicate temperature but also incorporate an auxiliary device which can operate an electric signal light, alarm, relay or switch.

It further includes metallic or vapour pressure thermometers, sometimes called " pyrometers ", which enable maximum temperatures of up to 500 to 600 ºC to be measured.

Thermographs also fall in this heading. They consist of a thermometer combined with an indicator registering the variations in temperature on a drum; they are operated by a mechanical or electric clock movement, or a synchronous motor.

The heading **excludes** " pyroscopes ", calliper-type instruments used for measuring the contraction of a clay, etc., test-piece taken from a ceramic furnace during firing to determine the course of the firing (**heading 90.17** or **90.31**).

(C) BAROMETERS AND BAROGRAPHS

These are instruments for determining the atmospheric pressure; similar instruments (pressure gauges) for measuring the pressure of liquids or gases are **excluded** (**heading 90.26**).

There are two types of barometer in general use, the mercury barometer and the aneroid barometer.

The ordinary **mercury-barometer** consists of a mercury-filled glass tube sealed at the upper end. In one type the lower end stands in a cistern of mercury, while in another type the lower end of the tube is bent into a siphon, the atmospheric pressure then acting on the short open part of the tube. In both cases, the mercury column in the tube is balanced by the weight of the atmosphere, and its rise or fall (indicated on a scale or on a dial with a pointer) is a measure of the atmospheric pressure. Mercury barometers include the Fortin barometer (with adjustable cistern), the siphon barometer (with adjustable scale), the marine barometer (mounted in gimbals).

In the **aneroid barometer** the atmospheric pressure acts on one or more exhausted, corrugated metal capsules, or on a thin-walled, bent metal tube. The deformation of the capsules or of the tube is amplified and transmitted to a pointer indicating the atmospheric pressure on a scale or is converted into an electrical signal.

This heading also includes :

(1) **Barometric altimeters** which indicate not only atmospheric pressure but also altitude; it should, however, be noted that the heading **excludes** altimeters (especially for air navigation) which indicate altitude only (**heading 90.14**).

(2) **Sympiesometers**. In these the mercury is replaced by a liquid such as oil which compresses a gas contained in the tube.

Barographs are instruments for recording atmospheric pressure in a manner similar to that in which the thermographs record temperature (see Part (B) above).

(D) HYGROMETERS AND HYGROGRAPHS

These are used to determine the moisture content of the air or other gases. The main types are :

(1) **Chemical hygrometers**, based on absorption of moisture by chemical substances which are then weighed.

(2) **Condensation or dewpoint hygrometers**, using the " dewpoint " method (i.e., the temperature at which water vapour begins to condense).

(3) **Hair hygrometers**, based on the change in length of one or more hairs or strips of plastics, according to whether they are dry or humid. The hairs or strips of plastics are strung over a frame, weighted with a counterweight, and mounted on a pulley the axle of which is fitted with a needle moving across a dial. In some devices the movement is converted into an electrical signal.

(4) **Hygrometers consisting of a torus-shaped glass tube** partly filled with mercury, and closed at one end by a diaphragm semi-pervious to the water vapour in the atmosphere. The pressure of the water vapour acts on the mercury and thus displaces the tube round a shaft connected to a needle on the dial. In some devices the displacement of the tube is converted into an electrical signal.

(5) **Hygrometers with metallic strips** wound helicoidally and coated with a substance which reacts to humidity. The hygroscopic reaction varies the length of the metallic strips. This movement is transmitted to an axle fixed to the end of the metallic strips and fitted with a needle moving across a dial. In some devices the movement is converted into an electrical signal.

(6) **Electrical hygrometers**. The operation of electrical hygrometers is normally based on the variation of conductivity of special absorbent salts (e.g., lithium chloride) or on the variation of the capacity of an electrical element in relation to humidity. (These instruments are sometimes graduated to show the dewpoint of the element to be measured.)

Fancy hygroscopes consisting essentially of more or less decorative objects (chalets, towers, etc.) with figurines coming in or going out, according to whether the weather is likely to be good or bad, are also classified here. On the other hand, papers impregnated with chemical substances, the colour of which varies according to the moisture content of the atmosphere are **excluded** (**heading 38.22**).

Hygrographs, which also fall in this heading, are similar to hair hygrometers but record variations of relative humidity in a manner similar to that in which thermographs record temperature (see Part (B) above).

This heading **does not cover** instruments which determine the moisture content of solid matter (**heading 90.27**).

(E) PSYCHROMETERS

These are a special type of hygrometer. They determine the humidity content by reference to the difference in the temperatures indicated by (a) a dry thermometer which registers air temperature, and (b) a wet thermometer whose bulb is kept continually moist by a material impregnated with water which absorbs heat on evaporation.

Electrical psychrometers usually employ resistance thermometers or semiconductors in place of the non-electric thermometers of the normal psychrometer.

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Hygrometers and psychrometers are employed for a wide variety of purposes, e.g., in meteorology (in observatories, in the home, etc.), in laboratories, in refrigerating plants, in artificial incubation, in air conditioning (especially in textile mills).

COMBINATIONS OF INSTRUMENTS

This heading also includes **combinations of the instruments referred to above** (e.g., combinations of hydrometers, thermometers, barometers, hygrometers, psychrometers), except when the addition of one or more other devices gives the combination the character of equipment or appliances covered by more specific headings (e.g., **heading 90.15** as meteorological instruments). In particular, the following remain classified in this heading :

(1) **Thermo-hygrographs** and **baro-thermo-hygrographs; actinometers** (instruments consisting simply of two special thermometers combined).

(2) **Pagoscopes**, i.e., instruments giving warning of frost, and therefore used especially in horticulture. These also consist essentially of a combination of two thermometers.

On the other hand, the heading **excludes** radio-sondes for atmospheric soundings (see Explanatory Note to **heading 90.15**).

90.25

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 apparatus or appliances of this heading remain classified here (e.g., dials, pointers, cases, graduated scales).