90.31 - Measuring or checking instruments, appliances and machines, not specified or included elsewhere in this Chapter; profile projectors (+).

9031.10 - Machines for balancing mechanical parts

9031.20 - Test benches

- Other optical instruments and appliances :

9031.41 - - For inspecting semiconductor wafers or devices or for inspecting photomasks or reticles used in manufacturing semiconductor devices

9031.49 - - Other

9031.80 - Other instruments, appliances and machines

9031.90 - Parts and accessories

In addition to **profile projectors**, this heading covers **measuring or checking instruments, appliances and machines, whether or not optical**. It should, however, be noted that this group **does not include** any instruments, apparatus, etc., falling in headings 90.01 to 90.12 or 90.15 to 90.30; in particular, the following are therefore **excluded** :

(a) Astronomical instruments of **heading 90.05**.

(b) Microscopes (**heading 90.11** or **90.12**).

(c) Surveying, etc., instruments and appliances of **heading 90.15**.

(d) Instruments for measuring length, for use in the hand (**heading 90.17**).

(e) Medical, surgical, etc., instruments and appliances of **heading 90.18**.

(f) Machines or appliances for testing the mechanical properties of materials (**heading 90.24**).

(g) Flowmeters, etc., of **heading 90.26**.

(h) Instruments and apparatus for measuring and checking electrical quantities and instruments and apparatus for measuring or detecting ionising radiations of **heading 90.30**.

(ij) Automatic regulating or controlling instruments and apparatus (**heading 90.32**).

(I) MEASURING OR CHECKING INSTRUMENTS, APPLIANCES AND MACHINES
(A)

These include :

(1) **Machines for balancing mechanical parts (dynamic, static or with an electronic balancing device)** e.g., armatures, rotors, crank shafts, connecting rods, propeller shafts, wheels, flywheels.

In dynamic machines, the parts are rotated on two bearing blocks or between centres, the out-of-balance being measured mechanically (tracing of diagrams on a recording plate, spring balance principle, etc.).

Static balancing machines operate on the tilting principle, the out-of-balance being measured on scales or dials. They differ from dynamic machines in that the part to be balanced does not rotate.

Out-of-balances are compensated either by counterweights or removal of material.

On machines fitted with an electronic balancing device, the vibrations due to unbalance are detected by a special sensitive element and are then amplified.

This heading also covers balancing machines fitted with a machine-tool (drilling-machine, for example) and used exclusively for rectifying out-of-balances.

(2) **Test benches** for engines and motors, electrical generators, pumps, speed indicators or tachometers, etc., consisting of a frame and a measuring or calibrating instrument.

(3) **Laboratory appliances** of a kind used **for testing fuels** and in particular for measuring the octane index of petroleum or the cetane index of diesel engine oils. This apparatus usually consists of an internal combustion engine, a dynamo, an ignition generator, heating resistors, measuring instruments (thermometers, pressure gauges, voltmeters, ammeters, etc.).

(4) **Apparatus for testing and regulating vehicle motors**, for checking all parts of the ignition system (coils, sparking plugs, condensers, batteries, etc.), for ascertaining the best carburettor setting (by analysing exhaust gases), or for measuring the compression in the cylinders.

(5) **Planimeters**, for measuring plane areas (e.g., on plans, diagrams, skins or hides). A tracing point combined with a measuring device follows the outline of the area to be measured.

Integrators, harmonic analysers and other instruments are based on the planimetric principle and capable of measuring other factors (e.g., volume, moments of inertia).

(6) **Head contour measurers**, used by hatters, which operate by perforating a sheet of paper.

(7) Dial indicating **comparators**, micrometric devices, electronic, opto-electronic and pneumatic sensors, whether or not automatic, as well as all devices or instruments for measuring length, angles or other geometrical quantities using such sensors. The heading also includes recording comparators, and comparators fitted with a mechanical device which conveys mass produced parts to the comparator and eliminates defective parts.

However, this heading **does not include** the dial type comparators for use in the hand described in Item (4) of Part (D) of the Explanatory Note to heading 90.17 (see exclusion (d) above).

(8) **Column-type gauges** for checking precision set squares, for checking heights or for other checks during manufacturing processes.

(9) **Sine bars and adjustable table sine bars** for checking angles.

(10) **Bubble levels**, used in numerous trades, including **micrometric adjustable levels** (bubble level with built-in micrometer), **block levels** (metal frame with two levels) used in engineering, and **liquid levels** based on the communicating vessels principle.

It should be noted that the heading **excludes** levels specialised for surveying purposes (**heading 90.15**).

(11) **Clinometers** (pointer or graticule types, clinometer-rules, clinometer-protractors) to check a level as compared with a horizontal plane, or to measure surface inclination.

However, the instruments, also called clinometers, used in surveying to gauge the height of land, are **excluded (heading 90.15)**.

(12) **Plumb-lines**.

(13) **Spherometers** to measure the curvature of spherical surfaces (lenses, mirrors, spectacle lenses, etc.). These consist essentially of a base with three pins (at the angles of an equilateral triangle), a divided rule and a micrometric screw with feeler. Other types (opticians' lens measurers) may be fitted with a dial to indicate the curvature directly.

(14) **Checking standards**.

(15) **Multidimensional measuring equipment**, including **Co-ordinate Measuring Machines** (CMMs) used to perform dimensional checks, either manually or mechanically, on various components or parts of machines.

(16) **Opticians' centring machines** for determining and marking the axis and centre of a lens.

(17) **Micrometric standard measuring machines**, based on the micrometer principle. These consist of a fixed tailstock (with a contact indicator) and an adjustable headstock with micrometer screw.

(18) **Apparatus for measuring or detecting vibrations, expansion, shock or jarring**, used on machines, bridges, dams, etc.

(19) **Apparatus for checking textile materials**, for example, **yarn grading winding reels (warp reels)**, for obtaining a determined length of yarn or slivers, (with or without tension regulator, counter and bell); **torsiometers and torsiographs** for determining torsion of yarn; **tensiometers** for measuring tension of yarn on textile machines (warping, spool winding, spinning, etc.); **instruments for checking the regularity of yarn** by winding on a drum or board, usually comprising a device for checking the interval between windings.

(20) **Surface-finish testing instruments** and machines for gauging the condition of surface.

In mechanical or pneumatic types the gauging is done by means of a hard contact point or air jets.

In electrical types a sapphire or diamond pick-up moves across the surface to be tested and converts any irregularities of that surface into an electric potential. The vertical movements of the pick-up are converted into the electric potential by means of a piezo-electric crystal or, indirectly, by being made to vary the value of a capacitor or inductor. The electric potential is then amplified and measured. Comparison of the measurement with the readings obtained by use of selected surface roughness standards (small metal plates supplied for that purpose) give a measure of the state of the surface being tested.

(21) **Gear testing machines** using, for example, a lever amplifying system, for testing profile forms, pitch diameters, tooth spacing and rolling contact, etc. (on spur and bevel gears), lead, etc. (on helical and worm gears).

(22) **Instruments for measuring the contracting of a clay, etc., test piece** taken from a ceramic furnace during firing to determine the course of the firing (pyroscopes). These instruments are often similar to callipers but are calibrated in arbitrary units.

(23) **Instruments for measuring irregular surfaces** (such as skins and hides) by the photoelectric process. (The differences in the current from a photoelectric cell depend on how much of a uniformly lit glass sheet is covered by the opaque surface under measure.)

(24) **Instruments for measuring the diameter of yarns** by the photoelectric process as described in Item (23) above.

(25) **Instruments for continuous measurement and checking of the thickness** of metal sheets or strip in rolling mills, etc.

(26) **Ultrasonic thickness measuring instruments** which enable thickness to be ascertained by observations made from one side of the material only.

(27) **Instruments for detecting faults, fissures, cracks or other defects in materials** (bars, tubes, profiles, machined articles, such as screws, needles, etc.). These operate either by observing the cathode-ray screen diagram resulting from magnetic variations, or by direct reading of variations in magnetic permeability as indicated on a graduated scale or by the use of ultrasonic waves. The latter group includes **ultrasonic instruments for checking soldered or welded joints**, which operate on the principle that any lack of continuity in the medium through which the ultrasonic waves pass deflects the beam. Defects may be measured by either observing the attenuation of the beam or by echo methods. The observation may be made on a cathode-ray tube screen.

(28) **Special instruments for checking watches or watch parts**. These include :

(i) **Instruments for checking hairsprings**.

(ii) **Amplitude meters** for checking the amplitude of the oscillations of the balance wheel. A light beam, which is interrupted by the movement of the balance wheel, is projected on to a photoelectric cell which thus gives a measure of the amplitude.

(iii) **Oscillometers** for testing and checking complete watch movements. The watch movement is placed on a microphone, and each tick of the watch produces a potential which is amplified and applied to two electrodes. One of the electrodes is fitted with points which thus perforate a record on a paper strip.

(iv) **Instruments for the final check of the watch**. These operate on the same principle as oscillometers (recording the ticking of the watch placed on a microphone) but may also be fitted with a cathode-ray oscilloscope.

(29) **Special electrical instruments for measuring stress and strain**. They are based, for example, on the following principles :

(i) Variations in the resistance of a wire when subjected to stress (strain gauges). However, electrical resistors known as "strain gauges" fall in **heading 85.33**.

(ii) Variations of capacity between specially constructed electrodes.

(iii)Electric potentials produced by quartz or similar crystals when subjected to pressure.

This group also includes **dynamometers**, used to measure the compression or tractive force of hydraulic presses, rolling mills, material testing machines, etc., and also for load tests (aircraft). They usually consist of a metal body (cylinder, ring, etc.) to which stress is applied, and of a measuring apparatus, graduated in units of weight, which records any change in the shape of the metal body.

However, dynamometers for testing the properties of materials are **excluded** (**heading 90.24**).

(30) **Load cells** which convert changes in applied force (including weight) into proportional changes in voltage. These changes in voltage are generally detected by instruments for measuring, controlling, weighing, etc., and are expressed in the desired units.

(31) **Electronic chronographs and chronoscopes** for measuring the duration of an electric contact. These consist of a capacitor which is charged through a high resistance whilst the contact is closed; the measurement is made on a valve voltmeter calibrated in time units.

(B)

This heading also covers **optical** type measuring and checking appliances and instruments, such as :

(1) **Optical or graduated scale comparators**, for checking the dimensions of a part being manufactured against a standard piece; the movement of the feeler is magnified by an optical device (revolving mirror principle).

(2) **Comparator benches** for checking elongation, lengths, surfaces, etc. These incorporate table and frame, sliding carriage and two mounted micrometric microscopes.

(3) **Measuring benches** for large parts, thread gauges, gear cutters, threaded shafts for lathes, cross members, etc. These incorporate frame and table, viewing microscope, two micrometric microscopes and projection apparatus.

(4) **Interferometers**, for checking plane surfaces. These are based on the principle of light interference, and comprise a standard optical flat and lenses with micrometric cross wires for measuring the interference bands. But the heading **excludes** standard optical flats (**heading 90.01**), and interferometers for measuring refractive indices (**heading 90.27**).

(5) **Optical surface testers**, for gauging the condition of surfaces by means of a combination of a prism and a lens.

(6) **Apparatus equipped with rapid impulse differential feeler and optical viewer**, for photographically recording and measuring profiles and conditions of surfaces.

(7) **Alignment telescopes**, for checking straightness of benches or machine slides and measuring metallic constructions. They are operated by collimation or auto-collimation and comprise a telescope and a collimator or mirror.

(8) **Optical rules**, for measuring deviations from the plane; they incorporate a hollow rule with a prism and lens at each end, and an eyepiece micrometer incorporating a feeler.

(9) **Micrometric reading apparatus** for checking movement of tables of machine-tools; they incorporate a micrometric device for reading off millimetre graduations on individual scales.

(10) **Optical goniometers or angle gauges**, for checking sharpening angles of teeth or blades (front rake) during sharpening. They incorporate either an optical device with lens and mirrors and a dial for reading off the angle of incidence, or a shutter system forming a mirror and an adjustable eyepiece.

(11) **Focimeters**, for taking measurements of spectacle lenses.

The apparatus and instruments mentioned above remain classified in this heading whether or not they are suitable for mounting on machines.

It should, however, be noted that **heading 84.66** covers fittings for adjusting the work or tools on machine-tools or water-jet cutting machines, including "optical" fittings (e.g., "optical" dividing heads and "optical" circular tables) incorporating optical devices to assist in reading scales, in carrying out adjustments, etc.

(II) PROFILE PROJECTORS

Profile projectors, used for checking the shape and dimensions of a wide variety of objects (pieces cut to shape, gears and pinions for small-sized mechanisms, screws, screw-taps, chasers, etc.), or for examining surfaces. In the majority of these projectors, light from a lamp is concentrated into a beam by a condenser before being directed on to the specimen, which is placed on a stage. The specimen is silhouetted in the beam which, after being reflected several times, is finally projected, by a set of prisms, on to a screw which is generally built in to the projector. Some of these projectors are fitted with an intermediate stage on which a standard part is placed.

PARTS AND ACCESSORIES

Subject to the provisions of Notes 1 and 2 to this Chapter (see the General Explanatory Note), the heading also covers parts and accessories identifiable as being suitable for use solely or principally with the machines, apparatus and instruments described above, e.g., planimeter arms, stands and checking tables for dial comparators.

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Subheading Explanatory Note.

Subheading 9031.49

This subheading covers not only instruments and appliances which provide a direct aid or enhancement to human vision, but also other instruments and apparatus which function through the use of optical elements or processes.