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Foreword

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This document was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 6, *Geodetic and surveying instruments*.

This third edition cancels and replaces the second edition (ISO 9849:2000), which has been technically revised.

Introduction

This document forms one of a series concerning geodetic and surveying instruments. It gives definitions of terms which may be used in the drafting of other International Standards and national standards in this field.

Only terms relating to geodetic and surveying instruments for geodetic work and their essential parts are described in this document. It is intended for both the surveyor and the non-surveyor. Every reader is requested to use only these terms in the future so that, with time, a standard and acceptable terminology will come into common usage.

Optics and optical instruments — Geodetic and surveying instruments — Vocabulary

1 Scope

This document defines terms relating to geodetic field instruments only, e.g. distance meters, levels, theodolites and others, and their essential component parts which are normally used in terrestrial measuring operations of ordnance survey, topographic survey, plane survey and engineering survey. Therefore, terms concerning fields such as the following are not mentioned, for example, photogrammetry, astronomy, hydrographic survey and industrial metrology.

Accessories which are not necessary for the functioning of the instruments are not dealt with. The terms are arranged in English alphabetical order.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Types of geodetic instruments and related terms

3.1.1
alignment instrument
device used to aim at intermediate points and to a reference target at the end of an alignment

Note 1 to entry: The device is usually equipped with a powerful magnifying *telescope* (3.2.38).

3.1.1.1
alignment laser
line laser
pipe laser
alignment instrument (3.1.1) using a laser beam as reference line instead of an optical line of sight

3.1.2
barometer
instrument for measuring atmospheric pressure

Note 1 to entry: Barometers can be used for the atmospheric reduction of electronically measured distances or as *barometric altimeters* (3.1.2.2).

3.1.2.1
aneroid barometer
barometer (3.1.2) in which atmospheric pressure is balanced by some elastic elements as a method that does not involve liquid

3.1.2.2
barometric altimeter
barometer (3.1.2) used for elevation measurement, in which case a read out is provided in meters

3.1.2.3
mercury barometer
barometer (3.1.2) in which atmospheric pressure is balanced by the mass of a column of mercury

3.1.2.4
electronic barometer
instrument for measuring atmospheric pressure by conversion of physical observation to electrical signals

3.1.3
electro-optical distance meter
electronic distance meter
EDM
instrument for measuring distances between the instrument and a reflective target, using various electro-optical techniques, visible light or infrared radiation as carrier waves

Note 1 to entry: The target can be a *reflector* (3.1.15) or any other surface.

Note 2 to entry: See also *total station* (3.1.20), *hand-held laser distance meter* (3.1.7), *terrestrial laser scanner* (3.1.8) and *laser tracker* (3.1.9).

3.1.3.1
phase shift distance meter
electronic distance meter which is based on the comparison of two modulation signals, one is the reference signal, the other the return signal from the reflective target

Note 1 to entry: The phase difference can be detected by various methods and is used to calculate the distance.

3.1.3.2
pulsed distance meter
time of flight distance meter
electro-optical distance meter which is based on measuring the time of flight between transmission and reception of the same pulse

3.1.4
field-controller
device that controls surveying instruments (total station, GNSS receiver, terrestrial laser scanner and digital level) by using on-board applications, recalls surveying data or other information and records and analyses measurement data of the instruments

3.1.5
Global Navigation Satellite System
GNSS
system consisting of several satellites in different orbital planes, which allow absolute navigation solutions as well as high precise (e.g. differential) positioning and broadcasting of time due to the global coverage

Note 1 to entry: GNSS includes all operating Global Navigation Systems by Satellite.

EXAMPLE 1 Global Positioning System (GPS) or Navigational Satellite Timing and Ranging – Global Positioning System (NAVSTAR-GPS) – US Department of Defence navigation system based on the constellation of usually more than 24 satellites at an altitude of 20 200 km above earth's surface.

EXAMPLE 2 GLObal'naya NAvigationnaya Sputnikovaya Sistema (GLONASS) – Russia's Global Navigation Satellite System based on the constellation of approximately 24 satellites at an altitude of 19 100 km above earth's surface.

EXAMPLE 3 Galileo – Global Navigation Satellite System organized by EU and European Space Agency. The system is planned to consist of 30 satellites at an altitude of 23 200 km above earth's surface.

EXAMPLE 4 Beidou – Satellite Navigation System operated by China. Satellites in medium earth orbit (22 000 km above earth's surface) as well as in geosynchronous orbit (35 790 km above earth's surface) are used, where the latter include satellites in both geostationary orbit and in inclined geosynchronous orbit.

EXAMPLE 5 Quasi-Zenith Satellite System (QZSS) – Satellite Navigation System operated by Japan. The System is compatible with GPS.

3.1.5.1
GNSS receiver
electronic device that receives and digitally processes the signals from GNSS satellites in order to provide position, velocity and time (of the receiver)

3.1.5.2
differential GNSS
DGNSS
processing application within mobile GNSS receivers, using difference techniques of GNSS observations and additional reference point or reference network GNSS observations

Note 1 to entry: In differential GNSS (DGNSS) applications, correction data and additional information from a known reference station are used by mobile rovers, enabling them to improve position accuracy from the 15 m nominal GNSS accuracy to about 10 cm and less.

3.1.5.3
differential GPS
DGPS
DGNSS application using only observations from the GPS (Navstar Satellite System) and additional reference point or reference network GPS observations

3.1.5.4
real-time kinematic
RTK
real-time processing algorithm technique of mobile GNSS receivers using the carrier phase of GNSS observations for a positioning of the mobile GNSS receiver within a reference network in a low cm-level

Note 1 to entry: In real-time kinematic (RTK) application, measurements of the phase of the signal's carrier wave are used to provide real-time corrections. By a data link from the reference station to the rover station, the corrections are transmitted to enhance the precision of the position up to cm-level.

3.1.6
gravimeter
gravity meter
gravity instrument
instrument for measuring the absolute gravity or the differences in the value of gravity

3.1.7
hand-held laser distance meter
electro-optical distance meter (3.1.3) which is used and held usually with the hands

Note 1 to entry: Usually, reflectorless EDM techniques are used.

3.1.8
terrestrial laser scanner
TLS
ground-based instrument using a scanning technology by a laser beam to produce detailed 3D data including intensity of complex structures and objects and geometries

3.1.9
laser tracker
portable coordinate measuring instrument based on laser interferometry techniques that enables to get high accuracy 3D data in real time by tracking a *reflector* (3.1.15) or *corner cube* (3.1.15.1)

3.1.10
level
instrument for measuring differences in height by establishing horizontal lines of sight, comprising as main components a *telescope* (3.2.38) which can be rotated on a *vertical axis* (3.2.44) and a facility for levelling the line of sight

Note 1 to entry: It can be additionally fitted with a horizontal *circle* (3.2.7) and/or a *parallel plate micrometer* (3.2.23). The reticule has sometimes stadia hairs for optical distance measurement.

Note 2 to entry: See also *spirit level* (3.2.16) and *tachymeter* (3.1.17).

3.1.10.1
automatic level
compensator level
self-levelling level
pendulum level
level which makes use of a *tilt compensator* (3.2.39) that ensures that the line of sight is horizontal once the operator has roughly levelled the instrument

3.1.10.2
digital level
level which electronically reads a sequence of code patterns on the *levelling staff* (3.1.11) by an image sensor

Note 1 to entry: These instruments usually include data recording capability. The automation removes the requirement for the operator to read a scale.

Note 2 to entry: The processing and the display of the results are taken by an integrated computer.

3.1.10.3
electronic level
inclinometer
tiltmeter
instrument which detects inclination or changes of inclination under the influence of gravity by the use of electronic sensors

3.1.10.4
tilting level
manual level
level which provides a tilting screw to establish a levelled line of sight

3.1.11
levelling staff
levelling rod
level rod
straight bar with a scale on a flat face

Note 1 to entry: The levelling staff can be made of, for example, metal, glass fibre or wood.

Note 2 to entry: The levelling staff is used to measure the vertical distance between a base point and the horizontal line of sight of a *level* (3.1.10).

3.1.11.1
digital levelling staff
bar code staff
levelling staff (3.1.11) for levelling with a *digital level* (3.1.10.2) having a specified code patterns on the flat face

3.1.11.2
invar levelling staff
precise levelling rod
invar rod
levelling staff (3.1.11) for precise levelling, having an invar strip with graduation lines or code patterns (bar code)

Note 1 to entry: Invar is a Fe-Ni alloy to ensure a low coefficient thermal expansion ($<10^{-6}$/°C).

3.1.12
optical plummet
instrument or device that realizes a visible line of sight in a vertical zenith or nadir direction

Note 1 to entry: The optical plummet can be levelled by liquid horizon, tubular levels or compensators.

Note 2 to entry: An optical plummet can also be a part of a geodetic instrument.

Note 3 to entry: It can be used for placing a mark on the ground or centring an instrument over a mark on the ground (nadir plummet) as well as for centring an instrument under a point (zenith plummet).

3.1.12.1
laser plummet
optical plummet (3.1.12) which uses a laser beam as a visual plumb line

3.1.12.2
optical precise plummet
optical plummet (3.1.12) comprising a telescope with high magnification and precise devices (e.g. bubbles, compensator) to precisely realize the vertical line of sight

3.1.13
optical square
pentaprism
device equipped with pentagonal prism for determination of orthogonal lines of sight

3.1.14
plane table
device used in surveying and related disciplines to provide a solid and level surface on which to make field drawings, charts and maps

Note 1 to entry: As a sighting instrument, usually, an alidade is used on the plane table.

Note 2 to entry: See also 3.2.27 for a description for a plane table as a part.

3.1.15
reflector
device at the target which reflects the light beam to an *electro-optical distance meter* (3.1.3) or to a tracker system

Note 1 to entry: These devices are, for example, glass prism reflectors, corner cube reflectors, acrylic reflectors, reflecting sheets.

Note 2 to entry: Reflectors are usually provided on a pole having a centring device. A 360° reflector device has multiple glass prisms which are measurable from any horizontal direction.

3.1.15.1
retroreflector
corner cube
device that reflects light back to the light source exactly along the same light direction

Note 1 to entry: These devices are, for example, glass prism reflectors, corner cube reflectors.

3.1.15.2
reflecting tape
reflecting sheet
reflector (3.1.15) of plane sheet or tape comprised of tiny prisms made of a flexible material

3.1.16
rotating laser
laser level
rotary laser
instrument generating a plane by means of a rotating laser beam

3.1.17
tachymeter
tacheometer
instrument for measuring horizontal directions, vertical angles and distances

3.1.18
target
target plate
symmetrical figure, structure or reflector defining a point on the target to which observations are taken

Note 1 to entry: It is usually provided with some form of a *forced-centring device* (3.2.13).

3.1.19
theodolite
transit
optical instrument for measuring horizontal directions and vertical angles, whose main components are the horizontal circle and the vertical circle inclusive reading systems, the *telescope* (3.2.38) and the *alidade* (3.2.1) inclusive the horizontal and vertical rotation axes

Note 1 to entry: The telescope can be rotated around the *horizontal axis* (3.2.15) and *vertical axis* (3.2.44).

Note 2 to entry: A theodolite can also be used for optical distance measurement.

Note 3 to entry: A theodolite used in astronomical work is usually termed an astronomical theodolite or a transit instrument.

3.1.19.1
compass theodolite
compass transit
theodolite (3.1.19) attached with a centrally mounted *compass* (3.2.6) for determining the magnetic azimuth

3.1.19.2
electronic theodolite
theodolite (3.1.19) with microprocessor(s), display and memory for automatic reading, processing, displaying and storing of measurement data

3.1.19.3
gyrotheodolite
gyro-azimuth theodolite
survey gyroscope
theodolite (3.1.19) with a north-seeking gyro attached for the determination of the geographic north direction

Note 1 to entry: In general, both theodolite and gyro form one unit. Different observation methods allow to determine the geodetic azimuth.

3.1.19.4
suspension theodolite
theodolite (3.1.19) in a hanging position to carry out measurements in the region of nadir, prior used for mining surveys

3.1.20
total station
electronic tachymeter
electronic tacheometer
tachymeter (3.1.17) with microprocessor(s), display and memory for opto-electronic distance measurement, angle reading, processing, displaying and storing of measurement data

3.1.20.1
multistation
combines the functionality of a *total station* (3.1.20), *terrestrial laser scanner* (3.1.8) and of imaging in one instrument

Note 1 to entry: A *multistation* (3.1.20.1) has often the possibility to attach or integrate a GNSS, wireless transmission techniques and other devices used for surveying.

3.1.20.2
non-prism total station
reflectorless total station
total station with capability to measure the distance to almost any object without the need of a specific reflector

3.1.20.3
gyro total station
total station with a north-seeking gyro attached for the determination of the geographic north direction

3.1.20.4
double-image tacheometer
tacheometer (3.1.17) with the optical wedge system included in the path of the rays in the *telescope* (3.2.38)

Note 1 to entry: It divides the image of a horizontal staff into two horizontally displaced images. The size of the displacement is the index of the distance reduced for the difference in height.

3.1.21
tripod
three-legged stand to which instruments or accessories can be attached and set up in a stable manner on the ground

Note 1 to entry: The tripod consists of a head and three legs made of wood or metal, with metal tips. The legs are either rigid or telescopic and connected with the tripod head by joints. The *tribrach* (3.2.41) is fixed on the head of the tripod.

3.2 Parts of geodetic instruments

3.2.1
alidade
turning board
DEPRECATED: alhidade, alhidad, alidad
device that allows one to sight a distant object and uses the line of sight to perform a task, consisting of an *upper part* (3.2.42) or turning part of a theodolite or total station with *telescope* (3.2.38) which can be rotated around the *standing axes* (3.2.44) with or without vertical circle and an opto-electronic distance-measuring device

Note 1 to entry: This task can be, for example, to draw a line on a *plane table* (3.1.14) in the direction of the object or to measure the angle to the object from some reference point.

3.2.2
base part
lower part
bottom part
centring flange
integrated group of parts of a *theodolite* (3.1.19) or the *total station* (3.1.20), supporting the *limb* (3.2.18) and the *upper part* (3.2.42), and are firmly attached to the *tribrach* (3.2.41) during the measurement

Note 1 to entry: The base part consists essentially of the bearings for the *vertical axis* (3.2.44) and connecting devices for the detachable tribrach.

3.2.3
base plate
lower part of the *tribrach* (3.2.41), connected by screws to the *spring plate* (3.2.36) and the *foot screws* (3.2.12), which rest on this metal plate

3.2.4
circle drive
device for turning the horizontal and vertical circle of a *theodolite* (3.1.19) or *total station* (3.1.20) [usually the *telescope* (3.2.38)] in relation of the fixed parts

3.2.5
clamp
device which enables rotating parts of the instrument to be clamped together when precisely sighting a target, usually with clamps on the horizontal and vertical axis circles

Note 1 to entry: There are different types of clamps: central clamp, coaxial clamp and friction clamp (also called friction brake).

Note 2 to entry: See also *fine-motion device* (3.2.10).

3.2.5.1
horizontal clamp
device for clamping the *upper part* (3.2.42) to the *base part* (3.2.2) of a *theodolite* (3.1.19) or *total station* (3.1.20)

Note 1 to entry: See also *horizontal fine-motion device* (3.2.10.1).

3.2.5.2
repetition clamp
device of a *theodolite* (3.1.19) or a *total station* (3.1.20) for clamping the horizontal circle to the *upper part* (3.2.42) in order to fix mechanically and temporarily a certain angle to the upper part

3.2.5.3
vertical clamp
device for clamping the *horizontal axes* (3.2.15) in order to fix mechanically and temporarily a certain angle to the *telescope* (3.2.38) in respect to the *vertical axis* (3.2.44)

Note 1 to entry: See also *vertical fine-motion device* (3.2.10.2).

3.2.6
compass
device which can be mounted on a *theodolite* (3.1.19) or *total station* (3.1.20) in order to orient the horizontal circle according to the direction of magnetic north

Note 1 to entry: Various types are full circle compass, line compass or case compass and tubular compass.

3.2.7
circle
graduated circle
disc with a circular scale graduated in degrees or other code patterns which may be subdivided

Note 1 to entry: The disc is usually made of glass.

Note 2 to entry: The disc is sometimes graduated in gons.

Note 3 to entry: *Electronic theodolites* (3.1.19.2) have coded circular scales on discs which are scanned electronically.

Note 4 to entry: The horizontal circle for measuring horizontal directions is mounted centrally on the *vertical axis* (3.2.44) and securely attached to the *base part* (3.2.2) during measurement.

Note 5 to entry: The vertical circle for measuring vertical angles is fixed at right angles to and centrally on the *horizontal axis* (3.2.15).

3.2.8
display
device which indicate the measured quantity or various information which is necessary for operation

Note 1 to entry: An electronic display is usually used in *electro-optical distance meters* (3.1.3), *electronic theodolites* (3.1.19.2) or *total station* (3.1.20), *digital level* (3.1.10.2) and others, e.g. to show the instrument status, current operations, results of measurements or calculations.

3.2.8.1
touch screen
finger-sensitive display to operate the instrument by finger or by pen in addition to or instead of keys

3.2.9
eyepiece
ocular
telescope (3.2.38) lens group which is nearest to the eye and with which the image formed by the preceding elements is viewed

Note 1 to entry: It can be focused so that it produces a sharp image of the *reticule* (3.2.30) adapted to the individual human eye of the observer.

3.2.9.1
prismatic diagonal eyepiece
prismatic eyepiece
eyepiece prisms
eyepiece (3.2.9) used in connection with a *telescope* (3.2.38) in order to make possible or facilitate steep sights

3.2.10
fine-motion device
slow-motion device
device for rotating the clamped axis by controlled small smooth movements

Note 1 to entry: There are two special (combined) types of fine-motion: rough-fine-motion and endless fine-motion.

Note 2 to entry: See also *clamp* (3.2.5).

3.2.10.1
horizontal fine-motion device
device for fine motion of the *upper part* (3.2.42)

Note 1 to entry: See also *horizontal clamp* (3.2.5.1).

3.2.10.2
vertical fine-motion device
device for the fine motion of the *telescope* (3.2.38) on the *horizontal axis* (3.2.15)

Note 1 to entry: See also *vertical clamp* (3.2.5.3).

3.2.11
focusing drive
focusing knob
focusing ring
device for focusing the image in the *telescope* (3.2.38), by means of which the focusing lens can be moved in order to shift the image generated by the objective lens into the plane of the *reticule* (3.2.30)

Note 1 to entry: At image total stations, it is also used to get a sharp live video stream from the telescope camera.

3.2.12
foot screw
component part of the *tribrach* (3.2.41)

Note 1 to entry: Usually, 3 foot screws are used for levelling the tribrach.

3.2.13
forced-centring device
constrained-centring device
centring
device whereby instruments and accessories are interchangeable by means of simple manual operation on *tripods* (3.1.21), *tribrachs* (3.2.41) or pillars without the centring being lost at a certain position

Note 1 to entry: Usually, the tribrach has the function of a forced centring device.

3.2.14
gyroscope
gyro
device for measuring and maintaining orientation in space

Note 1 to entry: Gyroscopes are based on various principles: mechanical or microelectromechanical systems (MEMS) gyroscopes, laser or fibre optic gyroscopes or quantum gyroscope.

Note 2 to entry: A mechanical gyroscope contains a rotating body on an axis that can turn freely in any direction, so that the body resists the action of an applied force and maintains the same orientation in space irrespective of the movement of the surrounding structure.

3.2.14.1
gyrocompass
device to determine astronomic north (true north) by means of *gyroscope* (3.2.14)

Note 1 to entry: See also *gyrotheodolite* (3.1.19.3) and *gyro total station* (3.1.20.3).

3.2.15
horizontal axis
tilting axis
elevation axis
axis on which the *telescope* (3.2.38) rotates up and down when moved vertically

Note 1 to entry: The horizontal axis is arranged normal to the optical axes of the telescope.

3.2.16
spirit level
level
bubble level
closed hollow vial which is partially filled with liquid, the remaining space containing air which finds its way to the highest point in the vial

Note 1 to entry: It is designed to indicate whether a surface is horizontal (levelled) or to measure the tilt of the surface against the horizon.

Note 2 to entry: Electronic level sensors measure the tilt automatically.

Note 3 to entry: The level is used for levelling instruments, instrument parts and/or accessories. The main types are the *circular level* (3.2.16.1) and the *tubular level* (3.2.16.2).

Note 4 to entry: See also *level* (3.1.10).

3.2.16.1
circular level
bull's eye level
box bubble
circular bubble
circular, flat-bottomed device with the liquid under a slightly convex glass face with a circle mark at the centre

Note 1 to entry: It serves to level a surface in all directions across a plane.

Note 2 to entry: The graduation is normally a circle of approximately the same diameter as the bubble. In special cases, the graduation consists of a number of concentric circles. Circular levels are normally used when a high degree of precision is not required.

3.2.16.2
tubular level
spirit level (3.2.16) with a tubular glass vial which is barrel-shaped internally and graduated on its upper surface (level graduation), fixed into a metal holder and fitted with adjusting screws

Note 1 to entry: Tubular level is often built and used for high precision levelling in the direction of the tube.

3.2.16.2.1
coincidence level
coincidence bubble
split bubble-level
tubular level (3.2.16.2) which is observed through a coincidence prism and levelled when the semi-images of both bubble ends coincide

3.2.16.2.2
index level
tubular level (3.2.16.2) which is used to ensure that the *vertical index* (3.2.45) of a vertical angle reading is correctly positioned in relation to the plumb line

Note 1 to entry: Normally, a *coincidence level* (3.2.16.2.1) is used.

3.2.16.2.3
telescope level
tubular level (3.2.16.2) which is securely fixed to the *telescope* (3.2.38) parallel to the collimation axis of the latter to align the telescope to the horizon

Note 1 to entry: Normally, a *coincidence level* (3.2.16.2.1) is used.

3.2.16.3
electronic level
level which senses the inclination in sighting- and/or cross-direction

Note 1 to entry: Opto-electronic devices with a light source and code pattern to measure the inclination supersede other principles such as the measurement of the electrical resistance or of the static electrical capacity.

3.2.17
light source
essential element of the *electro-optical distance meter* (3.1.3), which produces and emits the energy for the measuring signal

Note 1 to entry: The light source emits the energy as an electromagnetic wave. It carries the measuring signal which is normally obtained by modulation of the emitted wave. The light sources mainly used are the solid laser or collimated LED.

3.2.18
limb
center part
central part
limbus
middle part
integrated group of parts of the *theodolite* (3.1.19), or *total station* (3.1.20), comprising the horizontal circle and other elements, permitting the limb to rotate on the *vertical axis* (3.2.44)

Note 1 to entry: See also *base part* (3.2.2) and *upper part* (3.2.42).

Note 2 to entry: The limb of *electronic theodolites* (3.1.19.2) or *total stations* (3.1.20) does not usually rotate around the *vertical axes* (3.2.44) since any angle can be set electronically to a certain direction.

3.2.19
modulator
electronic device of the *electro-optical distance meter* (3.1.3) which modulates the carrier wave

3.2.20
objective
objective lens
combination of several lenses in a common mounting which, together with the focusing lens, projects a real reversed image of the object in the image plane

Note 1 to entry: The image can be brought into an upright position by means of an inverting prism system.

3.2.21
objective prism
wedge prism
thin prism in front of the *objective* (3.2.20) to deviate the line of sight perpendicular to the optical axis of the telescope

3.2.22
oscillator
electronic device of *electro-optical distance meters* (3.1.3) or geodetic *GNSS receivers* (3.1.5.1) which produces the modulation or reference frequency

3.2.23
parallel plate micrometer
device for producing a known parallel displacement of the line of sight

Note 1 to entry: The main component is a thick plate of optical glass with plane parallel surfaces.

3.2.24
photo detector
electronic device of the *electro-optical distance meter* (3.1.3) used for receiving the return signal

Note 1 to entry: Photo detector for the receiver of *rotating laser* (3.1.16) detects the emitted beam from *rotating laser* (3.1.16).

3.2.25
waveform-digitizer
method or technique which uses the advantages of time of flight and phase shift electronic distance measurements, by digitizing the start- and stop-pulses out of the received continuous signal-wave

3.2.26
pivot
plug
centre spigot
cylindrical part of the *base part* (3.2.2), which is placed in the *socket* (3.2.33) for forced centring

Note 1 to entry: See also *forced-centring device* (3.2.13).

3.2.27
plane table board
drawing board for the *alidade* (3.2.1) of the *plane table* (3.1.14) equipment, consisting essentially of the plane table board as a base for drawing and the plane table head which contains devices for levelling and orientating the plane table board

Note 1 to entry: The plane table head often consists of a *tribrach* (3.2.41) which rests with its *foot screws* (3.2.12) on the plate of the *tripod* (3.1.21).

Note 2 to entry: Plane table plotting device is a part of the *alidade* (3.2.1) of the *plane table* (3.1.14) equipment, consisting of a parallel sliding ruler with interchangeable scales and a pricking device.

3.2.28
plummet
optical plummet
laser plummet
plumbing device fitted in or attached to an instrument or a *tribrach* (3.2.41) in order to plumb (to centre) downwards

Note 1 to entry: Optical plummet uses a telescope to provide optical plumbing. Line laser plummet uses a laser beam as visual plumb line.

Note 2 to entry: Instead of an optical plummet or laser plummet, a plumb bob or a rigid plummet, also called centring rod, may be used. Plumb bobs are only suitable for simple, less accurate centring of measuring instruments or *target* (3.1.18) above a point.

Note 3 to entry: See also *optical plummet* (3.1.12), *laser plummet* (3.1.12.1).

3.2.29
reading device
circle or scale reading device
device to facilitate the reading of a disc with *graduated circles* (3.2.7), which comprises optical and/or mechanical parts

Note 1 to entry: The reading is taken either on a simple index line or by means of a *vernier* (3.2.43), a scale or a micrometer.

Note 2 to entry: In *electronic theodolites* (3.1.19.2), the scanning of coded circular scales on discs supersedes the optical reading of a disc [*graduated circle* (3.2.7)].

3.2.29.1
line microscope
reading device (3.2.29) which projects an image of the graduation that is read using a *reticule* (3.2.30) with an index

3.2.29.2
scale microscope
reading device (3.2.29) which projects an image of the graduation that is read using a *reticule* (3.2.30) with a scale

3.2.29.3
optical micrometer
reading device (3.2.29) which facilitates the improvement of the reading accuracy

Note 1 to entry: A major application is the *coincidence micrometer* (3.2.29.4) to optically read angles, distances or other scales with a high accuracy.

3.2.29.4
coincidence micrometer
reading device with a parallel plane micrometer moving a graduation line until it is covered by a scale line of the micrometer

Note 1 to entry: A specialized reading device of this kind is used for the optical combination of diametral circle reading.

3.2.30
reticule
cross-hair plate
glass plate in the image plane of *telescopes* (3.2.38) [or of microscopes or *reading devices* (3.2.29)], on which various kinds of sight marks or reading indices are marked

3.2.31
rotating wedge
refracting prism which is turned on an axis parallel to the collimation axis

Note 1 to entry: A pair of rotating wedge could be used, for example, on a double image tacheometer to correct the measured distance in function of the rotation of the wedge.

3.2.32
sighting device
diopter
viewfinder
finder
optical or mechanical device for approximately aligning the *telescope* (3.2.38) on the *target* (3.1.18)

3.2.33
socket
tubular part of the *tribrach* (3.2.41) into which the *pivot* (3.2.26) is placed

Note 1 to entry: See also *forced-centring device* (3.2.13).

3.2.34
solar filter
optical device for solar observation by attaching to the objective of a *theodolite* (3.1.19) or a *total station* (3.1.20), in order to protect the operator's eyes and sensitive electronic parts inside the instrument

3.2.35
solar reticule
reticule (3.2.30) for solar observation by attaching it to the telescope of a *theodolite* (3.1.19) or a *total station* (3.1.20), in order to protect the operator's eyes from the collimated sunlight

3.2.36
spring plate
part of the *tribrach* (3.2.41) which holds the *foot screws* (3.2.12) and presses them to the *base plate* (3.2.3)

3.2.37
subtense bar
horizontal stadia
bar with two *targets* (3.1.18) at either end, which is set up horizontally on a *tripod* (3.1.21) at the target point and perpendicular to the sighting direction

Note 1 to entry: The targets are usually 1 m or 2 m apart.

Note 2 to entry: Subtense bars are used for distance measurement by observing the parallactic angle.

3.2.38
telescope
measuring telescope
magnifying optical device in which a line through the optical centre of the *objective lens* (3.2.20) and the cross hairs define the line of sight

Note 1 to entry: It comprises essentially an *objective* (3.2.20), a focusing lens with *focusing drive* (3.2.11), a *reticule* (3.2.30) and an adjustable *eyepiece* (3.2.9).

Note 2 to entry: On total stations, often, the electronics and other parts of an electronic distance measurement device (EDM) or other devices are placed in the *telescope* (3.2.38).

Note 3 to entry: The collimation axis is the connecting line between the *reticule* (3.2.30) and the centre of the *objective* (3.2.20), running perpendicular to the *horizontal axis* (3.2.15).

3.2.38.1
anallatic telescope
telescope (3.2.38) in which the anallatic point coincide with the intersection of the line of sight and the *vertical axis* (3.2.44) of the *tacheometer* (3.1.17), e.g. to eliminate the addition constant for optical distance measurements

3.2.38.2
erecting telescope
terrestrial telescope
telescope (3.2.38) with an upright image

3.2.38.3
inverting telescope
astronomical telescope
telescope (3.2.38) with a reversed image

3.2.38.4
mirror telescope
telescope (3.2.38) comprising a lens system and one or more mirrors

Note 1 to entry: This allows greater focal length in a shorter telescope construction.

3.2.39
tilt compensator
device which automatically eliminates the influence of any levelling errors of a measuring instrument on the measured values

Note 1 to entry: Inclination is a common term for tilt or levelling errors.

Note 2 to entry: The inclination compensator replaces the *telescope level* (3.2.16.2.3).

Note 3 to entry: Single axis compensator corrects vertical angle reading. Double axis (dual axis) compensator corrects deviation from the standing axis in two perpendicular axes, which means in all directions of a horizontal plane.

3.2.40
tilting screw
device on the *level* (3.1.10) for fine adjusting the inclination of an object, e.g. a *telescope* (3.2.38), so that the line of sight becomes horizontal

3.2.41
tribrach
part by means of which the instrument rests on the base

Note 1 to entry: The tribrach is used for setting up the *vertical axis* (3.2.44) of the instrument. It consists of the *base plate* (3.2.3), the *spring plate* (3.2.36), the *socket* (3.2.33) and the *foot screws* (3.2.12), usually three. The tribrach may normally be detachable from the instrument, in order to obtain forced centring between measuring instruments, *target* (3.1.18) and other accessories.

3.2.42
upper part
top part
upper motion
integrated group of parts of a *theodolite* (3.1.19), or *total station* (3.1.20), consisting of the rotatable part of the instrument above the *base part* (3.2.2) and the *limb* (3.2.18)

Note 1 to entry: The main parts are the housing, the telescope support, the *telescope* (3.2.38), the *reading devices* (3.2.29), the *spirit levels* (3.2.16) and the *tilt compensator* (3.2.39).

Note 2 to entry: See also *alidade* (3.2.1).

3.2.43
vernier
vernier acuity
device by means of a movable scale to improve the reading accuracy of optical distance and angle readings

Note 1 to entry: The reading device is usually an auxiliary scale movable along the scale to be read.

Note 2 to entry: The reading mark is the zero line on the auxiliary scale.

3.2.44
vertical axis
standing axis
mechanical device defining the axis on which the *alidade* (3.2.1) can be rotated

Note 1 to entry: In the correct measuring position, this axis is positioned vertically by means of *foot screws* (3.2.12). The procedure of setting the axis vertically is called levelling the instrument. The vertical axis passes through the centre of the horizontal circle and is perpendicular to its plane. It also defines the point of the instrument to be centred over the point on the ground.

Note 2 to entry: Since the vertical axes are connected to the horizontal circle, in some countries, it is unfortunately also called “horizontal axes” but this is not defined in ISO vocabulary.

3.2.45
vertical index
reading mark for the vertical circle

Note 1 to entry: The *index level* (3.2.16.2.2) is fixed to the vertical index.

