

# CLASSIFICATION OF SERVICES IN LENGTH

Version dated 12 September 2005

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## METROLOGY AREA: LENGTH

### BRANCH: LASER

#### 1. Radiations of the mise en pratique

##### 1.1 Laser radiations

1.1.1 Stabilized laser of the mise en pratique<sup>1</sup>: *vacuum wavelength, optical frequency*

1.1.2 Other stabilized lasers: *vacuum wavelength, optical frequency*

##### 1.2 Lamp radiations

1.2.1 Spectral lamp: *vacuum wavelength, optical frequency*

### BRANCH: DIMENSIONAL METROLOGY

#### 2. Linear dimensions

##### 2.1 Length instruments

2.1.1 (Laser, length) interferometer (system, optics, refractometer): *error of indicated displacement, wavelength compensation*

2.1.2 Electronic Distance Measurement (EDM) instrument: *error of indicated distance*

2.1.3 One-dimension measuring machine: *error of indicated size or displacement*

2.1.4 Height measuring instrument: *error of indicated vertical size or displacement*

2.1.5 One-dimension displacement transducer or actuator (LVDT, PZT, etc.): *error of indicated displacement*

2.1.6 Gauge block comparators: *error of indicated displacement*

2.1.7 Dial-indicator tester: *error of indicated displacement*

##### 2.2 End standards

2.2.1 Gauge block: *central length, variation in length, thermal expansivity*

2.2.2 Length bar (long gauge block): *central length, variation in length, thermal expansivity*

2.2.3 Plane or thread micrometer setting rod: *length*

2.2.4 Step gauge: *face spacing*

2.2.5 Gap gauge: *face spacing*

2.2.6 Feeler (thickness) gauge: *thickness*

##### 2.3 Line standards

2.3.1 Precision line scale: *line spacing*

2.3.2 Stage micrometer: *line spacing*

2.3.3 Grid plate: *grid point coordinates*

2.3.4 One-dimension grating: *pitch*

2.3.5 Two-dimension grating: *pitch, orthogonality*

2.3.6 Linewidth standard: *linewidth, spacewidth, pitch*

2.3.7 (Surveyor, engineer, pi) tape, (geodetic) wire: *line spacing*

2.3.8 Surveyor levelling rod: *line spacing*

2.3.9 Engineer or machinist scale, steel: *line spacing*

##### 2.4 Diameter standards

2.4.1 External cylinder (plug, piston, pin, wire): *diameter*

2.4.2 Internal cylinder (ring): *diameter*

2.4.3 Sphere (ball): *diameter*

#### 3. Angle

##### 3.1 Angle by circle dividers

3.1.1 Optical polygon: *face angle, pyramid error, face flatness*

3.1.2 Index table: *index angle*

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<sup>1</sup> For each service, the instrument or artefact is indicated in roman characters, and the measurand(s) in italic characters.

- 3.1.3 Rotary table, rotary encoder scale: *position angle*
  - 3.2 Small-angle generators**
    - 3.2.1 Sine bar or table: *cylinder spacing, angle*
  - 3.3 Angle instruments**
    - 3.3.1 Autocollimator: *error of indicated angle, axes orthogonality*
    - 3.3.2 Electronic level: *error of indicated inclination angle*
    - 3.3.3 Clinometer: *error of indicated inclination angle*
    - 3.3.4 Spirit (bubble) level: *error of indicated inclination angle*
    - 3.3.5 Theodolite: *error of indicated angle, axes orthogonality*
    - 3.3.6 (Bevel) protractor: *error of indicated angle*
    - 3.3.7 Squareness tester: *error of indicated squareness or straightness*
  - 3.4 Angle artefacts**
    - 3.4.1 Angle block: *included angle, pyramid error, face flatness*
    - 3.4.2 90° (steel, granite, try) square: *squareness*
    - 3.4.3 90° cylinder square: *squareness*
    - 3.4.4 Cone (taper) gauge: *cone angle, diameter*
  - 3.5 Angle prisms**
    - 3.5.1 Optical square (pentaprism): *deviation angle*
    - 3.5.2 Retroreflection (cube-corner, cat-eye) prism: *deviation angle*
- 4. Form**
- 4.1 Flatness standards**
    - 4.1.1 Optical flat: *flatness*
    - 4.1.2 Optical parallel or wedge: *parallelism, wedge angle*
    - 4.1.3 Surface plate: *flatness*
  - 4.2 Roundness standards**
    - 4.2.1 External cylinder: *roundness*
    - 4.2.2 Internal cylinder: *roundness*
    - 4.2.3 Sphere (hemisphere): *roundness*
    - 4.2.4 Magnification standard (e.g. flick standard): *roundness, amplitude and phase harmonic content*
  - 4.3 Straightness standards**
    - 4.3.1 Straight edge: *straightness*
    - 4.3.2 Cylindrical straightness standard: *straightness*
    - 4.3.3 Straightness of guideway: *straightness*
  - 4.4 Cylindricity standards**
    - 4.4.1 External cylinder: *cylindricity*
    - 4.4.2 Internal cylinder: *cylindricity*
  - 4.5 Optical standards**
    - 4.5.1 Lens, radius standards: *focal length, radius of curvature*
- 5. Complex geometry**
- 5.1 Surface texture standards**
    - 5.1.1 (Groove) depth (step height) standard (e.g. ISO 5436-1 Type A): *step height, (groove) depth,*
    - 5.1.2 Tip-condition standard (e.g. ISO 5436-1 Type B): *radii, angle*
    - 5.1.3 Spacing standard (e.g. ISO 5436-1 Type C): *amplitude or wavelength parameters*
    - 5.1.4 Roughness standard (e.g. ISO 5436-1 Type D): *ISO roughness parameters*
    - 5.1.5 Profile coordinate standard (e.g. ISO 5436-1 Type E): *profile coordinates*
    - 5.1.6 Soft gauge standard (reference software data set): *error in calculated dimensions or parameters*
  - 5.2 Screw standards**
    - 5.2.1 Thread plug, plain: *pitch diameter, pitch, flank angle*
    - 5.2.2 Thread plug, tapered: *pitch diameter, pitch, flank angle, taper angle*
    - 5.2.3 Thread ring, plain: *pitch diameter, pitch, flank angle*
    - 5.2.4 Thread ring, tapered: *pitch diameter, pitch, flank angle, taper angle*
    - 5.2.5 Internal API (American Petroleum Institute) screw thread gauge: *API thread parameters*
    - 5.2.6 External API (American Petroleum Institute) screw thread gauge: *API thread parameters*
  - 5.3 Gear standards**
    - 5.3.1 Spur gear: *pitch, involute*

- 5.3.2 Bevel gear: *pitch, involute, bevel angle*
- 5.3.3 Gear pitch master: *total cumulative pitch deviation*
- 5.3.4 Gear lead master: *total cumulative or single pitch deviation*
- 5.3.5 Gear involute master: *involute profile (slope or form) deviation*
- 5.4 Coordinate Measuring Machine (CMM) artefacts**
  - 5.4.1 Ball (hole, bore) plate: *ball or hole center coordinates*
  - 5.4.2 Ball bar: *ball spacing*
  - 5.4.3 Large CMM artefact: *interval distances*
  - 5.4.4 Reference software: *error in calculated dimensions, parameters or features*
- 5.5 Two-dimension and three-dimension instruments**
  - 5.5.1 Measuring projector: *error of indicated size, location or shape*
  - 5.5.2 Measuring microscope: *error of indicated size, location or shape*
  - 5.5.3 Coordinate Measuring Machine (CMM): *error of indicated size, location or shape*
  - 5.5.4 Laser tracking measuring system: *error of indicated size, location or shape*
  - 5.5.5 Motion (translation, angle) stage: *error in prescribed translation or angular motion*
  - 5.5.6 Profile instruments: *error of indicated form, shape, size or surface texture*
  - 5.5.7 (Flatness, wavefront) interferometer: *error of indicated flatness or wavefront deviation*
  - 5.5.8 Form measuring machine: *error of indicated form (roundness, straightness, ...) deviation*
- 5.6 Hardness**
  - 5.6.1 Hardness indenter (Rockwell, Vickers): *tip (size or shape)*
- 6. Various dimensional**
  - 6.1 Hand instruments**
    - 6.1.1 External micrometer: *error of indicated size*
    - 6.1.2 Micrometer head: *error of indicated displacement*
    - 6.1.3 Depth micrometer: *error of indicated depth*
    - 6.1.4 Caliper: *error of indicated size*
    - 6.1.5 Depth gauge: *error of indicated depth*
    - 6.1.6 Internal two-point (bore) micrometer: *error of indicated diameter*
    - 6.1.7 Internal three-point (bore) micrometer: *error of indicated diameter*
    - 6.1.8 Dial gauge: *error of indicated displacement*
    - 6.1.9 Snap gauge (internal, external): *error of indicated size*
  - 6.2 Pressure artefacts**
    - 6.2.1 Piston/cylinder assembly: *three-dimension size, shape*
  - 6.3 Thermal expansivity**
    - 6.3.1 Thermal expansion artefact: *thermal expansion coefficient*
  - 6.4 Long distance**
    - 6.4.1 Geodetic baseline: *interval distances*
  - 6.5 Reference materials**
    - 6.5.1 Standard particle: *particle size, particle shape*
    - 6.5.2 Sieve or mesh opening: *size or shape of aperture*
  - 6.6 Layer thickness**
    - 6.6.1 Layer thickness standard: *layer thickness*
  - 6.7 Index of refraction**
    - 6.7.1 Refractometer for optical materials: *refractive index,  $n$*