

CLASS

Consultative Committee for Length – CCL

Working Group on the MRA – WG-MRA

## CCL Length Services Classification (DimVIM)

### English Language Approved Terms

| CCL Service Category | Instrument or Artifact | Measurand(s) |
|----------------------|------------------------|--------------|
|----------------------|------------------------|--------------|

### 1 Radiations of the Mise en Pratique

#### 1.1 Laser Radiations

|       |                             |                                       |
|-------|-----------------------------|---------------------------------------|
| 1.1.1 | frequency stabilized laser. | vacuum wavelength; optical frequency. |
|-------|-----------------------------|---------------------------------------|

#### 1.2 Lamp Radiations

|       |                |                    |
|-------|----------------|--------------------|
| 1.2.1 | spectral lamp. | vacuum wavelength. |
|-------|----------------|--------------------|

### 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 | EDM instrument.   | error of indicated distance.                              |
| 2.1.3 | 1-D measuring machine.  | error of indicated [size; displacement].                  |
| 2.1.4 | height measuring instrument.                                    | error of indicated [vertical size; displacement].         |
| 2.1.5 | 1-D displacement [transducer, actuator] (LVDT, PZT,...)         | 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; length difference of gauge block pairs. |
| 2.2.2 | length bar (long gauge block).          | central length; variation in length; thermal expansivity.   |
| 2.2.3 | [plane, 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 | 1-D grating.                                    | pitch.                        |
| 2.3.5 | 2-D 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 leveling 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. |

#### 2.5 Standards of 1D Dimensions

|       |  |                   |
|-------|--|-------------------|
| 2.5.1 | Standard of 1D point-to-point dimensions | sizes, distances. |
|-------|--|-------------------|

### 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.                              |
| 3.1.3 | rotary table, rotary encoder scale. | position angle.                           |

#### 3.2 Small-Angle Generators

|       |                    |                          |
|-------|--------------------|--------------------------|
| 3.2.1 | sine (bar, table). | cylinder spacing; angle. |
|-------|--------------------|--------------------------|

#### 3.3 Angle Instruments

|       |                         |  |
|-------|-------------------------|--|
| 3.3.1 | autocollimator.         | error of indicated angle; axes orthogonality; error of indicated angle (x-and y-components of spatial angles). |
| 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; straightness].   |
| 3.3.8 | angular interferometer. | error of indicated angle; [effective] retro-reflector spacing; [effective] beam spacing                        |

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| <b>3.4 Angle Artifacts</b>           |   |   |
| 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.   |
| <b>3.5 Angle Prisms</b>              |   |   |
| 3.5.1                                | optical square (pentaprism).                                    | deviation angle.  |
| 3.5.2                                | retroreflection (cube-corner, cat-eye) prism.                   | deviation angle.  |
| <b>4 Form</b>                        |   |   |
| <b>4.1 Flatness Standards</b>        |   |   |
| 4.1.1                                | optical flat.   | flatness.   |
| 4.1.2                                | optical (parallel, wedge).                                      | parallelism; wedge angle.   |
| 4.1.3                                | surface plate.  | flatness.   |
| <b>4.2 Roundness Standards</b>       |   |   |
| 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 & phase harmonic content.  |
| <b>4.3 Straightness Standards</b>    |   |   |
| 4.3.1                                | straight edge.  | straightness.   |
| 4.3.2                                | cylindrical straightness standard.                              | straightness.   |
| 4.3.3                                | straightness of guideway.                                       | straightness.   |
| <b>4.4 Cylindricity Standards</b>    |   |   |
| 4.4.1                                | external cylinder.  | cylindricity.   |
| 4.4.2                                | internal cylinder.  | cylindricity.   |
| <b>4.5 Optical Standards</b>         |   |   |
| 4.5.1                                | lens, radius standards.   | focal length, radius of curvature.  |
| <b>5 Complex Geometry</b>            |   |   |
| <b>5.1 Surface Texture Standards</b> |   |   |
| 5.1.1                                | (groove) depth (step height) standard (eg. ISO 5436-1 Type A).  | step height; (groove) depth.  |
| 5.1.2                                | tip-condition standard (eg. ISO 5436-1 Type B).                 | radii, angle.   |
| 5.1.3                                | spacing standard (eg. ISO 5436-1 Type C).                       | [amplitude; wavelength] parameters.   |
| 5.1.4                                | roughness standard (eg. ISO 5436-1 Type D).                     | ISO roughness parameters.   |
| 5.1.5                                | profile coordinate standard (eg. ISO 5436-1 Type E).            | profile coordinates.  |
| 5.1.6                                | softgauge (reference software data set, eg. ISO 5436-2 Type F1) | error in calculated [dimensions; parameters].   |
| <b>5.2 Screw Standards</b>           |   |   |
| 5.2.1                                | thread plug, plain.   | [simple] pitch diameter; pitch; flank angle.  |
| 5.2.2                                | thread plug, tapered.   | [simple] pitch diameter; pitch; flank angle; taper angle.   |
| 5.2.3                                | thread ring, plain.   | [simple] pitch diameter; pitch; flank angle.  |
| 5.2.4                                | thread ring, tapered.   | [simple] pitch diameter; pitch; flank angle; taper angle.   |
| 5.2.5                                | internal API screw thread gauge.                                | API thread parameters.  |
| 5.2.6                                | external API screw thread gauge.                                | API thread parameters.  |
| <b>5.3 Gear Standards</b>            |   |   |
| 5.3.1                                | Involute gear.  | profile slope [form, total] deviation, helix slope [form, total] deviation, single [cumulative] pitch deviation |
| 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, single] pitch deviation.   |
| 5.3.5                                | gear involute master  | involute profile [slope, form] deviation.   |
| <b>5.4 CMM Artifacts</b>             |   |   |
| 5.4.1                                | ball (hole, bore) plate.  | [ball; hole] center coordinates.  |
| 5.4.2                                | ball bar.   | ball spacing.   |
| 5.4.3                                | large CMM artifact.   | interval distances.   |
| 5.4.4                                | reference software.   | error in calculated [dimensions; parameters; features].   |
| 5.4.5                                | test circle for imaging probing systems.                        | diameter; roundness.  |
| <b>5.5 2-D, 3-D Instruments</b>      |   |   |
| 5.5.1                                | measuring projector.  | error of indicated [size; location; shape].   |
| 5.5.2                                | measuring microscope.   | error of indicated [size; location; shape].   |
| 5.5.3                                | CMM.  | error of indicated [size; location; shape].   |
| 5.5.4                                | laser tracking measuring system.                                | error of indicated [size; location; shape].   |
| 5.5.5                                | motion (translation, angle) stage.                              | error in prescribed [translation; angular] motion.  |
| 5.5.6                                | profile instruments.  | error of indicated [form, shape, size, surface texture parameters].   |
| 5.5.7                                | (flatness, wavefront) interferometer.                           | error of indicated [flatness; wavefront] deviation.   |
| 5.5.8                                | form-measuring machine.   | error of indicated form [roundness, straightness,...] deviation.  |
| <b>5.6 Hardness</b>                  |   |   |
| 5.6.1                                | hardness indenter [Rockwell, Vickers].                          | tip [size, shape]   |

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**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 Artifacts**

|       |                           |                  |
|-------|---------------------------|------------------|
| 6.2.1 | piston/cylinder assembly. | 3-D size, shape. |
|-------|---------------------------|------------------|

**6.3 Thermal Expansivity**

|       |                             |                                |
|-------|-----------------------------|--------------------------------|
| 6.3.1 | thermal expansion artifact. | 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; shape.  |
| 6.5.2 | [sieve, mesh] opening. | aperture [size, shape] |

**6.6 Layer thickness**

|       |                           |                 |
|-------|---------------------------|-----------------|
| 6.6.1 | layer thickness standard. | layer thickness |
|-------|---------------------------|-----------------|