Profile Projector
PJ/PV/PH Series

Catalog No. E14005(2)
Each Mitutoyo profile projector is a measuring machine that performs measurement, inspection and observation efficiently by projecting an image of a test workpiece on the stage onto a viewing screen under accurate magnification. The inherently non-contact measurement method of profile projectors makes this type of instrument highly suitable for measuring small parts that are unmeasurable with general-purpose contact instruments or easily deformed plastic parts, and can also be used to observe the surface profiles of workpieces or inspect minute assemblies with surface illumination. Additionally, a wide selection of accessories allows advanced measurement and inspection of various workpieces.
PJ Series

Screen diameter
300mm

- Applicable to a wide range of workpiece size
- Operations concentrated at the front of the instrument
- An extensive choice of workstages

PV Series

Screen diameter
500mm

- Optimal for measurement compared with an enlarged drawing or tracing of a projection image on the screen
- Clock components, electronic parts, precious metal parts, precision parts, etc.

PH Series

Screen diameter
350mm

- Observation/measurement of cutting tools (end mills, lathe tools, tipped saws, etc.)
- Cylindrical form (screws, springs, etc.)
- Horizontal-beam design means easy workpiece loading/unloading coupled with high weight-carrying capacity of glassless stage.

PJ-A3000
P4 - 5

PJ-H30
P6 - 7

PV-5110
P8 - 9

PH-3515F, PH-A14
P10 - 11

Stages
P12 - 13

Accessories
P14 - 18

Optical terms basic knowledge
P19
High cost performance and high degree of operability
Stage-size selectable standard model with a screen diameter of 300mm
Built-in digital counter in the large character display specification

**Technical Data**

- **Projected image:** Inverted
- **Protractor screen:**
  - Effective diameter: 315mm (12.4"
  - Screen material: Fine-ground glass
  - Screen rotation: ±360°, The counter displays up to ±370°
  - Angle reading: Digital counter (LED), Resolution: 1° or 0.01° (switchable)
  - Range: ±370°, ABS/INC mode switching, Zero Set
  - Cross hairs: 90° Solid lines
- **Projection lens:** 10X (Standard accessory) Optional: 50X, 100X
  - External half-reflecting mirror for surface illumination (only for 10x, 20x)
- **Lens mount:** Bayonet mount
- **Magnification accuracy:** ±0.1% or less
- **Surface illumination:** ±0.15% or less
- **Maximum workpiece height:** Refer to the projection lenses (H) right.
- **Contour illumination:**
  - Light source: Halogen bulb (24V, 150W)
  - Optical system: Telecentric
  - Functions: 2-step (High/Low) brightness switch, Heat-absorbing filter, Cooling fan
- **Surface illumination:**
  - Light source: Halogen bulb (24V, 150W)
  - Optical system: Vertical illumination with adjustable condenser lens
  - Functions: Heat-absorbing filter, Cooling fan
- **Resolution for X/Y counter:** 0.001mm or .0001 (0.0005"/0.001mm: digital head)
- **Power supply:** 100 - 240V AC, 50/60Hz, power cord (2m)
- **Mass:** 105kg - 140kg
- **Power consumption:** Approx. 400W
- **Slide mechanism for replacing the tungsten-halogen lamp**

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**Main unit side panel**

- [Image of the main unit side panel]

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**Dimensions**

- [Diagram showing the dimensions of the PJ-A3000]

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**Projection lenses (10X is a standard accessory)**

<table>
<thead>
<tr>
<th>Lens Type</th>
<th>10X Lens</th>
<th>20X Lens</th>
<th>50X Lens</th>
<th>100X Lens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnification</td>
<td>View Field Ø31.5</td>
<td>Ø15.7</td>
<td>Ø6.3</td>
<td>Ø3.1</td>
</tr>
<tr>
<td>[W]</td>
<td>66.2 (20)</td>
<td>32.5 (2)</td>
<td>12.6</td>
<td>5</td>
</tr>
<tr>
<td>[H]</td>
<td>123.5</td>
<td>123.5</td>
<td>123.5</td>
<td>123.5</td>
</tr>
<tr>
<td>-50 models*</td>
<td>91</td>
<td>91</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>-100 models</td>
<td>103.5</td>
<td>103.5</td>
<td>103.5</td>
<td>103.5</td>
</tr>
<tr>
<td>-150 models</td>
<td>92.5</td>
<td>92.5</td>
<td>92.5</td>
<td>92.5</td>
</tr>
<tr>
<td>200 models</td>
<td>124 (198°)</td>
<td>87 (61)</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>-50 models*</td>
<td>182</td>
<td>87 (61)</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>-100 models</td>
<td>207 (198°)</td>
<td>87 (61)</td>
<td>27</td>
<td>10</td>
</tr>
<tr>
<td>200 models</td>
<td>185</td>
<td>87 (61)</td>
<td>27</td>
<td>10</td>
</tr>
</tbody>
</table>

* *When using surface illumination*
System Diagram

- Standard scale 50mm / 2"
  No.172-116/No.172-117
- Reading scale 200mm / 8"
  No.172-118/No.172-119
- Reading scale 300mm / 12"
  No.172-161/No.172-162
- Green filter No.172-160-2
- Overlay chart set No.12AAM027 (12 pcs.)
- Oblique reflection mirror No.172-116
- Projection lens 10x Set (Standard accessory) No.172-202
- Projection lens 20x Set No.172-203
- Projection lens 50x No.172-204
- Projection lens 100x No.172-207
- Rotary table No.176-106
- Swivel center support No.176-105
- Holder with clamp No.176-107
- V-block with clamp No.172-378
- Swivel center support No.172-197
- PJ-A3005D-50
- PJ-A3005F-150
- PJ-A3010F-100
- PJ-A3010F-200
- PJ-A3005D-150
- PJ-A3005F-200
- PJ-A3005D-200
- PJ-A3010F-300
- PJ-A3010F-400
- PJ-A3010F-500
- PJ-A3010F-600
- PJ-A3010F-700
- PJ-A3010F-800
- PJ-A3010F-900
- PJ-A3010F-1000

Note: If an optional unit is installed on the stage, the H (Max. workpiece height) length is reduced by the optional unit height.

Data Processing System Diagram

- PJ-A3000 Series main unit
- RS-232C cable (2m, cross) No.12AAA807
- QM-Data200 (Arm type) No.264-156*1
- Thermal printer with cable*2
  No.172-270
- Adjustable stand No.172-270
- Detector attachment (A) No.12AAE671
- OPTOEYE 200 No.332-151

Lamp replacement
515530: High-luminance halogen bulb of 24V/150W
512305*: Long-life halogen bulb of 24V/150W
(Long-life specification, Rating approx. 500 hours)
*3 This lamp is a standard accessory. Illuminance for lamp life specification is rather low.

For details, refer to the QM-Data200 and Vision Unit brochure.

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.
*2 Order numbers differ depending on the connector form.
No.12AAD032 (100-120V) for Japan, No.12AAD033(100-240V) for Europe, No.12AAD034(100-120V) for North America, and No.12AAM305(100-240V) for U.K.
Powerful PJ-series machine with the ultimate bright and crisp projection image. Equipped with a high-rigidity main unit and linear scales, this series achieves high-accuracy measurement. A total of 8 models are available including one equipped with the long-stroke stage of 300 x 179mm. Provided with quick-release wheels for smooth and rapid operation of the stage. Standard-equipped turret changes the projection lens smoothly and efficiently.

- Technical Data

<table>
<thead>
<tr>
<th>Projected image:</th>
<th>Erect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protractor screen:</td>
<td>Effective diameter: 306mm (12&quot;)</td>
</tr>
<tr>
<td></td>
<td>Screen material: Fine-ground glass</td>
</tr>
<tr>
<td></td>
<td>Screen rotation: ±360°, The counter displays up to ±370°.</td>
</tr>
<tr>
<td></td>
<td>Angle Reading: Digital counter (LED)</td>
</tr>
<tr>
<td></td>
<td>Resolution: ' 1 or 0.01&quot; (switchable)</td>
</tr>
<tr>
<td></td>
<td>Range: ±370°</td>
</tr>
<tr>
<td></td>
<td>ABS/INC mode switching, Zero Set</td>
</tr>
<tr>
<td></td>
<td>Angle Reading: Digital counter (LED)</td>
</tr>
<tr>
<td></td>
<td>Resolution: 1 or 0.01 (switchable)</td>
</tr>
<tr>
<td></td>
<td>Range: ±370°</td>
</tr>
<tr>
<td></td>
<td>ABS/INC mode switching, Zero Set</td>
</tr>
<tr>
<td></td>
<td>Angular reading: Solid lines</td>
</tr>
<tr>
<td></td>
<td>Projection lens: 10X (Standard accessory)</td>
</tr>
<tr>
<td></td>
<td>Optional: 5X, 20X, 50X, 100X</td>
</tr>
<tr>
<td></td>
<td>Lens rotation: Half-reflecting mirror for surface illumination</td>
</tr>
<tr>
<td></td>
<td>Parfocal lens</td>
</tr>
<tr>
<td>Lens mount:</td>
<td>3-mirror turret, Bayonet mount</td>
</tr>
<tr>
<td>Magnification accuracy:</td>
<td>Contour illumination: ±0.1% or less</td>
</tr>
<tr>
<td></td>
<td>Surface illumination: ±0.15% or less</td>
</tr>
<tr>
<td>Maximum workpiece height:</td>
<td>105mm (when rotary table is not equipped).</td>
</tr>
<tr>
<td>Contour illumination:</td>
<td>Light source: Halogen bulb (24V, 150W)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface illumination:</td>
<td>Light source: Halogen bulb (24V, 150W)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Focusing:</td>
<td>Projection screen head driving</td>
</tr>
<tr>
<td>Resolution for X/Y counter:</td>
<td>0.001mm or 0.001mm</td>
</tr>
<tr>
<td>Power supply:</td>
<td>ON/OFF switch, 100 - 240V AC, GND terminal, 50/60Hz, power cord (2m)</td>
</tr>
<tr>
<td>Mass:</td>
<td>178kg - 212kg</td>
</tr>
<tr>
<td>Power consumption:</td>
<td>Approx. 420W</td>
</tr>
</tbody>
</table>

*For the stage specification, refer to the page 12.

- Dimensions

(Unit: mm)

- Projection lenses (10X is a standard accessory)

- Main unit side panel
### System Diagram

- **Standard scale**: 50mm / 2" No. 172-116 / No. 172-117
- **Reading scale**: 200mm / 8" No. 172-118 / No. 172-119
- **Reading scale**: 300mm / 12" No. 172-161 / No. 172-162
- **Overlay chart set**: No. 12AAM027 (12 pcs.)
- **Green filter**: No. 12AAG981
- **Adjustable stand**: No. 172-270
- **Lens cleaning set**: No. 12AAA165
- **Projection lens 5X**: No. 172-271
- **Projection lens 10X** (standard accessory): No. 172-472
- **Projection lens 20X**: No. 172-473
- **Projection lens 50X**: No. 172-474
- **Projection lens 100X**: No. 172-475
- **Overlay chart set**: No. 12AAM027 (12 pcs.)
- **Green filter**: No. 12AAG981
- **Adjustable stand**: No. 172-270
- **Lens cleaning set**: No. 12AAA165
- **Projection lens 10X** (standard accessory): No. 172-472
- **Projection lens 20X**: No. 172-473
- **Projection lens 50X**: No. 172-474
- **Projection lens 100X**: No. 172-475

#### Note:
If an optional unit is installed on the stage, the H (Max. workpiece height) length is reduced by the optional unit height.

### Data Processing System Diagram

- **PI-H30 Series main unit**
- **Detector mounting bracket**: No. 12AAG983
- **Detector attachment (A)**: No. 12AAAE671
- **OPTOEYE 200**: No. 332-151
- **Thermal printer (with connecting cable)**: No. 937179T
- **Optoeye 200**: No. 332-151
- **Real-time process control program MeasurLink**
- **Inspection table generation program MeasureReport**
- **Note**: An appropriate PC is required.

#### Lamp replacement
- **515530**: High-luminance halogen bulb of 24V/150W
- **512305**: Long-life halogen bulb of 24V/150W

*3 This lamp is a standard accessory.
*4 Illuminance for Long life specification is rather low.

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.
*2 Order numbers differ depending on the connector form.

No. 12AAD032 (100-120V) for Japan, No. 12AAD033 (100-240V) for Europe, No. 12AAD034 (100-120V) for North America, and No. 12AAM305 (100-240V) for U.K.
To mount the counter (KA-212) and counter stand, approximately 300mm space is required on the right-hand side of the main unit.

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**Technical Data**

- **Projected image:** Inverted
- **Protractor screen:**
  - **Effective diameter:** 508mm (20")
  - **Screen material:** Fine-ground glass
  - **Screen rotation:** ±360°, The counter displays up to ±370°.
  - **Angle reading:** Digital counter (LED)
  - **Resolution:** 1" or 0.01" (switchable)
  - **Range:** ±370°
  - **ABS/INC mode switching, Zero Set**
- **Cross hairs:** 90° Solid lines
- **0 Line (Index):** Built-in, With a LED back light
- **Projection lens:**
  - 10X (Standard accessory)
  - Optional: 5X, 20X, 50X, 100X
- **Lens mount:** Insert type mount
- **Magnification accuracy**
  - **Contour illumination:** ±0.1% or less
  - **Surface illumination:** ±0.15% or less
- **Maximum workpiece height:** Refer to the projection lenses (H) right.
- **Contour illumination**
  - **Light source:** Halogen bulb (24V, 150W)
  - **Optical system:** Zoom Telecentric
  - **Functions:** 2-step (High/Low) brightness switch, Heat-absorbing filter, Cooling fan
- **Surface illumination**
  - **Light source:** Halogen bulb (24V, 150W)
  - **Optical system:** Vertical illumination
  - **Functions:** Adjustable condenser lens, Oblique illumination (for 5X, 10X and 20X), Heat-absorbing filter, Cooling fan
- **Focusing:** Stage part drive, Manual
- **Resolution for X/Y counter:** 0.001mm or 0.001" (using optional KA counter)
- **Power supply:** 100 - 240V AC, 50/60Hz, power cord (2m)
- **Mass:** 190kg
- **Power consumption:** Approx. 560W

Note: X and Y counters are not built into the PV-5110 main unit. If a counter display is required, it is recommended that a QM-Data200 or KA-212 is purchased separately.

*For the stage specification, refer to the page 13.

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**Projection lenses (10X is a standard accessory)**

<table>
<thead>
<tr>
<th>Lens set</th>
<th>5X</th>
<th>10X</th>
<th>20X</th>
<th>50X</th>
<th>100X</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Magnification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>View field</td>
<td>101.6</td>
<td>105.8</td>
<td>123.4</td>
<td>130.16</td>
<td>155.08</td>
</tr>
<tr>
<td>W</td>
<td>125</td>
<td>181</td>
<td>206</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>D</td>
<td>60 (27)</td>
<td>60</td>
<td>60</td>
<td>32.4</td>
<td>22.5</td>
</tr>
<tr>
<td>Max. Workpiece Height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>64.8</td>
<td>45</td>
</tr>
</tbody>
</table>

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Optimal for comparative inspection such as tracing of a projected image or observation of a contour with the 500mm forward-tilted screen.

This model supports improvement in efficiency of the inspection of mass-production precision parts.
System Diagram

PV-5110 main unit

- Standard scale: 50mm / 2
  - No.172-116 / No.172-117
- Reading scale: 200mm / 8
  - No.172-118 / No.172-119
- Reading scale: 300mm / 12
  - No.172-161 / No.172-162
- Reading scale: 600mm
  - No.172-329
- Green filter
  - No.172-160-2
- Canopy
  - No.172-319
  - External view: 1200(W) x 1500(D) x 2200(H) mm

Stage adapter C
- No.176-317

Rotary table with fine feed wheel
- No.172-198

Holder with clamp
- No.176-107

V-block with clamp
- No.172-378

Swivel center support
- No.172-197

Projection lens 5X set
- No.172-401
- No.172-402
- No.172-403
- No.172-404
- No.172-405

KA-212 (Counter)
- No.174-146*1

PV-5110
- No.304-919

Thermal printer
- (with connecting cable)*3

detector attachment B
- No.12AAE672

OPTOEYE 200
- No.172-406

PV-5110 (Arm type)
- No.264-156*2

QMA-Data200
- No.264-520*2

Note: If an optional unit is installed on the stage, the W (Working distance) length is reduced by the optional unit height.

*1 To denote your AC power cable add the following suffixes to the order No.:
  - A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.

*2 To denote your AC power cable add the following suffixes to the order No.:
  - A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.

*3 Order numbers differ depending on the connector form.
  - No.12AAD032 (100-120V) for Japan, No.12AAD033(100-240V) for Europe,
  - No.12AAD034(100-120V) for North America, and No.12AAM305(100-240V) for U.K.

Data Processing System Diagram

PV-5110

QMA-Data200 (Arm type)
- No.264-156*2

Detector attachment B
- No.12AAE672

OPTOEYE 200
- No.332-151

Thermal printer
- (with connecting cable)*3

For details, refer to the QM-Data200 and Vision Unit brochure.

*4 Illuminance for Long life specification is rather low.

Lamp replacement
512305*: Long-life halogen bulb of 24V/150W

For details, refer to the QM-Data200 and Vision Unit brochure.

*2 To denote your AC power cable add the following suffixes to the order No.:
  - A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.

*3 Order numbers differ depending on the connector form.
  - No.12AAD032 (100-120V) for Japan, No.12AAD033(100-240V) for Europe,
  - No.12AAD034(100-120V) for North America, and No.12AAM305(100-240V) for U.K.
Optimal for contour observation/measurement of cutting tools (end mills, lathe tools, tipped saws, etc.), screws and springs.

Projected image: Erect*(PH-3515F), Inverted(PH-A14)

Technical Data

- Effective diameter: 353(13.9")mm (PH-3515F), 356(14")mm (PH-A14)
- Screen material: Fine-ground glass
- Screen rotation: ±360°, The counter displays up to ±370°.
- Angle reading: Digital counter (LED)
  - Resolution: 1° or 0.01° (switchable)
  - Range: ±370°
  - ABS/INC mode switching, Zero Set
  - Vernier (graduation: 2")
- Angle reading: (for PH-A14)
- Cross hairs: 90° Solid lines
- Projection lens: 10X (Standard accessory)
- Optional: 5X (PH-3515 only), 20X, 50X, 100X
- Lens mount: Screw mount
- Magnification accuracy:
  - Contour illumination: ±0.1% or less of nominal magnification
  - Surface illumination: ±0.15% or less of nominal magnification
- Maximum workpiece height: Refer to the projection lenses (L) right.
- Contour illumination:
  - Light source: Halogen bulb (24V, 150W)
  - Optical system: Telecentric
  - Functions:
    - 2-step (High/Low) brightness switch: PH-3515F,
      (Lit together with main power activation: PH-A14)
    - Heat-absorbing filter, Cooling fan
- Surface illumination:
  - Light source: Parabolic halogen bulb (24V 200W: PH-3515F),
    (24V 150W, common to the contour illumination: PH-A14)
  - Optical system: Vertical illumination
  - Functions:
    - Adjustable condenser lens,
      Vertical/Oblique surface illumination selectable: PH-3515F,
      (Lit together with main power activation: PH-A14)
    - Heat-absorbing filter, Cooling fan
- Focusing:
  - Stage part drive, Manual
  - Resolution for X/Y counter: 0.001mm or .0001"/0.001mm (using optional KA counter)
- Power supply: 100 - 240V AC, 50/60Hz, power cord (2m)
- Mass: 150kg (PH-3515F), 140kg (PH-A14)
- Power consumption: Approx. 410W (PH-3515F), 200W (PH-A14)

Note1) X and Y counters are not built into the projector main unit. If a counter display is required, it is recommended that a QM-Data200 or KA-212 is purchased separately.

Note2) The indicated value of a measurement may be slightly smaller than the actual value due to optical distortion caused by the illumination conditions.

- The projected image of the workpiece is erect but inverted horizontally, which means that the vertical orientation and displacement direction of the image is the same as on the workpiece side, but the horizontal orientation and displacement direction are reversed.
- For the stage specification, refer to the page 13.

Dimensions

PH-3515F

Projection lenses (10X is a standard accessory)

PH-3515F

PH-A14

Technical Data

- Effective diameter (PH-3515F): 353(13.9")mm, 356(14")mm (PH-A14)
- Screen material: Fine-ground glass
- Screen rotation: ±360°, The counter displays up to ±370°.
- Angle reading: Digital counter (LED)
  - Resolution: 1° or 0.01° (switchable)
  - Range: ±370°
  - ABS/INC mode switching, Zero Set
  - Vernier (graduation: 2")
- Angle reading (for PH-A14)
- Cross hairs: 90° Solid lines
- Projection lens: 10X (Standard accessory)
- Optional: 5X (PH-3515 only), 20X, 50X, 100X
- Lens mount: Screw mount
- Magnification accuracy:
  - Contour illumination: ±0.1% or less of nominal magnification
  - Surface illumination: ±0.15% or less of nominal magnification
- Maximum workpiece height: Refer to the projection lenses (L) right.
- Contour illumination:
  - Light source: Halogen bulb (24V, 150W)
  - Optical system: Telecentric
  - Functions:
    - 2-step (High/Low) brightness switch: PH-3515F,
      (Lit together with main power activation: PH-A14)
    - Heat-absorbing filter, Cooling fan
- Surface illumination:
  - Light source: Parabolic halogen bulb (24V 200W: PH-3515F),
    (24V 150W, common to the contour illumination: PH-A14)
  - Optical system: Vertical illumination
  - Functions:
    - Adjustable condenser lens,
      Vertical/Oblique surface illumination selectable: PH-3515F,
      (Lit together with main power activation: PH-A14)
    - Heat-absorbing filter, Cooling fan
- Focusing:
  - Stage part drive, Manual
  - Resolution for X/Y counter: 0.001mm or .0001"/0.001mm (using optional KA counter)
- Power supply: 100 - 240V AC, 50/60Hz, power cord (2m)
- Mass: 150kg (PH-3515F), 140kg (PH-A14)
- Power consumption: Approx. 410W (PH-3515F), 200W (PH-A14)

Note1) X and Y counters are not built into the projector main unit. If a counter display is required, it is recommended that a QM-Data200 or KA-212 is purchased separately.

Note2) The indicated value of a measurement may be slightly smaller than the actual value due to optical distortion caused by the illumination conditions.

- The projected image of the workpiece is erect but inverted horizontally, which means that the vertical orientation and displacement direction of the image is the same as on the workpiece side, but the horizontal orientation and displacement direction are reversed.
- For the stage specification, refer to the page 13.
System Diagram

- Standard scale 50mm / 2”
  No.172-116 / No.172-117
- Reading scale 200mm / 8”
  No.172-118 / No.172-119
- Reading scale 300mm / 12”
  No.172-161 / No.172-162
- Surface illumination unit
  No.172-423
  (only for PH-3515F)
- Green filter
  No.172-286
- Overlay chart set
  No.12AAM027
  (12 pcs.)
- Tipped-saw support stand*1
  No.172-001
- Cutter support stand*1
  No.172-002
- Vertical holder
  No.172-132
- Center support riser
  No.172-143
- Rotary vice
  No.172-144
- V-block with clamp
  No.172-234
- Projection lens 5X set
  No.172-145 (PH-3515F)
- Projection lens 10X set
  (Standard accessory)
  No.172-184 (PH-3515F)
  No.172-011 (PH-A14)
- Projection lens 20X set
  No.172-173 (PH-3515F)
  No.172-012 (PH-A14)
- Projection lens 50X set
  No.172-165 (PH-3515F)
  No.172-013 (PH-A14)
- Projection lens 100X set
  No.172-166 (PH-3515F)
  No.172-014 (PH-A14)
- Counter stand
  No.12AAF182
- KA-212 (Counter)
  No.174-146*2
- Lamp replacement
  515530*5: High-luminance halogen bulb of 24V/150W
  512305*6: Long-life halogen bulb of 24V/150W
  (Long-life specification, Rating approx. 500 hours)
  12BAA637*5: Parabolic halogen bulb 24V/200W
  (for only PH-3515F)
- For half-reflection mirror F
  For 5X
  No.172-294 (PH-3515F)
  For 10X
  No.172-295 (PH-3515F)
- *1 Mounting fixtures for tipped saws and cutters are compatible with the center hole diameter of 25.4mm.
- *2 To denote your AC power cable add the following suffixes to the order No.:
  A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.
- *3 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.
- *4 Order numbers differ depending on the connector form.
  No.12AAD032 (100-120V) for Japan, No.12AAD033(100-240V) for Europe,
  No.12AAD034(100-120V) for North America, and No.12AAM305(100-240V) for U.K.

Data Processing System Diagram

- PH-3515F, PH-A14
  main unit
- QM-Data200
  (Arm type)
  No.264-156*3
- Thermal printer
  (with connecting cable)*4
  No.12AAE671
- Adjustable stand
  No.172-270
- Detector attachment (A)
  No.12AEE671
- OPTOEYE 200
  No.332-151

* For details, refer to the QM-Data200 and Vision Unit brochure.

*3 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, 00 for CCC, E for BS, K for KC, C and No suffix are required for PSE.

*4 Order numbers differ depending on the connector form.

*5 This lamp is a standard accessory.

*6 Illuminance for Long life specification is rather low.
# Stage

## PJ-A3000

<table>
<thead>
<tr>
<th>XY range</th>
<th>50 × 50mm</th>
<th>100 × 100mm</th>
<th>150 × 50mm</th>
<th>200 × 100mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PJ-A3000 main unit</td>
<td>Model</td>
<td>Order No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-A3005D-S0</td>
<td>302-704*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-A3010F-100</td>
<td>302-703*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-A3005F-150</td>
<td>302-702*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-A3010F-200</td>
<td>302-701*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring unit</td>
<td>Digital micrometer head</td>
<td>Digital scale</td>
<td>Digital scale</td>
<td>Digital scale</td>
</tr>
<tr>
<td>Quick-release mechanism</td>
<td>X and Y axes</td>
<td>X and Y axes</td>
<td>X and Y axes</td>
<td>X and Y axes</td>
</tr>
<tr>
<td>Top surface size</td>
<td>152 × 152mm</td>
<td>250 × 250mm</td>
<td>280 × 152mm</td>
<td>380 × 250mm</td>
</tr>
<tr>
<td>Effective size of stage glass</td>
<td>82 × 82mm</td>
<td>142 × 142mm</td>
<td>185 × 84mm</td>
<td>266 × 170mm</td>
</tr>
<tr>
<td>Stage glass thickness</td>
<td>5mm</td>
<td>5mm</td>
<td>6mm</td>
<td>6mm</td>
</tr>
<tr>
<td>Stage glass No.</td>
<td>380405</td>
<td>12BAE041</td>
<td>381349</td>
<td>382762</td>
</tr>
<tr>
<td>Swivel adjustment range</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>± 3</td>
</tr>
<tr>
<td>Maximum loading</td>
<td>10kg</td>
<td>10kg</td>
<td>8kg</td>
<td>8kg</td>
</tr>
</tbody>
</table>

* To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, -1D for CEE, -1 DC for CCC, -1E for BS, -1K for KC, C and No suffix are required for PSE.

## PJ-H30

<table>
<thead>
<tr>
<th>XY range</th>
<th>100 × 100mm</th>
<th>200 × 100mm</th>
<th>200 × 170mm</th>
<th>300 × 170mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protractor screen</td>
<td>Model</td>
<td>Order No.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-H30A1010B</td>
<td>303-712-1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-H30A2010B</td>
<td>303-713-1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-H30A2017B</td>
<td>303-714-1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>PJ-H30A3017B</td>
<td>303-715-1*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring unit</td>
<td>High-accuracy digital scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quick-release mechanism</td>
<td>X and Y axes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top surface size</td>
<td>300 × 240mm</td>
<td>350 × 280mm</td>
<td>410 × 342mm</td>
<td>510 × 342mm</td>
</tr>
<tr>
<td>Effective size of stage glass</td>
<td>180 × 150mm</td>
<td>250 × 150mm</td>
<td>270 × 240mm</td>
<td>370 × 240mm</td>
</tr>
<tr>
<td>Stage glass thickness</td>
<td>6mm</td>
<td>6mm</td>
<td>8mm</td>
<td>8mm</td>
</tr>
<tr>
<td>Stage glass No.</td>
<td>380412</td>
<td>382762</td>
<td>12BAD363</td>
<td>12BAD330</td>
</tr>
<tr>
<td>Swivel adjustment range</td>
<td>± 3˚ (right)</td>
<td>± 3˚ (left)</td>
<td>± 5˚ (left)</td>
<td></td>
</tr>
<tr>
<td>Maximum loading</td>
<td>10kg</td>
<td>10kg</td>
<td>20kg</td>
<td></td>
</tr>
<tr>
<td>Measuring accuracy</td>
<td>(3 + 0.02L) L: Measured length (mm)</td>
<td>The measurement method conforms to JIS B 7184.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.
PV-5110

XY range 200 × 100mm
PV-5110 main unit Order No. 304-919*

Measuring unit Digital scale
Quick-release mechanism X and Y axes
Top surface size 380 × 250mm
Effective size of stage glass 266 × 170mm
Stage glass thickness 6mm
Stage glass No. 382762
Swivel adjustment range ±3°
Maximum loading 5kg

* To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.

PH-3515F PH-A14

(Picture right is PH-3515F)

Model No. PH-3515F PH-A14
XY range 254 × 152mm 200 × 100mm
PH main unit Order No. 172-868*1 172-810*2

Measuring unit Digital scale
Quick-release mechanism Only X-axis
Top surface size 450 × 146mm 407 × 152.4mm
Dovetail groove Two (Pitch = 43mm)
Minimum swivel angle reading 30° —
Maximum measuring diameter (horizontally fixed)*3 ø340mm ø300mm
Swivel adjustment range ±10° —
Maximum loading 45kg

Dimensions of PH-A14

(Uunit: mm)

*1 To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, DC for CCC, E for BS, K for KC, C and No suffix are required for PSE.
*2 To denote your AC power cable add the following suffixes to the order No.: -10A for UL/CSA, -20D for CEE, -20DC for CCC, -20E for BS, -20K for KC.
*3 When using the projection lens 10X (Standard accessory).
2-D Data Processing Unit QM-Data200

The QM-Data200 is a geometric readout/analysis unit for optical instruments such as profile projectors. This unit features powerful 2-D coordinate measurement capabilities with easy-to-use key operation. Measurement results can be visualized on the LCD display and printed out if required.

FEATURES

- High contrast color graphic displays on the large LCD screen with LCD back light.
- One-key operation for combined measurements that are often used (circle-circle distance, etc.)
- Equipped with the measurement procedure teaching function and measuring position navigation in Repeat mode.
- Easy measurement using combination of visual cross-hair alignment and automatic edge detection (Optoeye positioning function).
- The AI measurement function (automatic identification of measuring item) eliminates switching between the measurement command keys.
- The user menu function allows user to store measurement commands or part programs to create his/her own menu.
- Tolerance zone judgment of data processing result and statistical processing for each item are possible.
- Measurement result output to "MS-Excel®" in spreadsheet (CSV) format*
- The measurement procedure and measurement result can be saved, using USB memory.**
- Two models are available: a stand-alone type with tilt system and a flexible arm type that can be mounted on a Profile Projector.
- Measurement possible even during printout

* Ms-Excel® is a registered trademark of Microsoft Corporation.
** Operation is not assured for all commercial USB memories.

Specifications

<table>
<thead>
<tr>
<th>Code</th>
<th>Order No.</th>
<th>Display languages (selectable)</th>
<th>Measured value unit</th>
<th>Resolution</th>
<th>Program functions</th>
<th>Statistical processing</th>
<th>Display system</th>
<th>Edge Sensor/Position Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stand-mount type</td>
<td>Japanese/English/German/French/Italian/Spanish/Portuguese/Czech/Chinese/ Korean/Turkish/Swedish/Polish/Dutch/Hungarian</td>
<td>Length: mm Angle: degree</td>
<td>0.1μm / degree-minute-second (selectable)</td>
<td>Part program creation, execution, editing</td>
<td>Number of data, maximum value, minimum value, mean value, standard deviation, range, histogram, statistics on a measuring function basis (by command)</td>
<td>COLOR TFT LCD (with LED backlight)</td>
<td>Supported (Projector)</td>
</tr>
</tbody>
</table>

Input/Output

- X,Y,Z: Maximum of three Linear Scales
  - RS-232C 1: For connecting to external PC
  - RS-232C 2: For connecting to counter of measuring instrument
  - OPTOYE: For inputting edge signal from OPTOYE (OPTOYE M2)
  - F5: For connecting to optional foot switch
  - PRINTER: For connecting to optional printer
  - OPTOEYE: For connecting to OPTOEYE (OPTOEYE M2)

Measurement result file output

- RS-232C output (CSV format, MUX-10 format)

Power

- AC100 - 240V

External dimensions (WxDxH)

- Approximately 260x242x310 (including the stand)
- Approximately 318x153x275mm (when the arm is in the horizontal posture)

Mass

- Approximately 2.9kg
- Approximately 2.8kg

Applicable models

- PJ2500/PJ-3000 Series
- PJ-H3000 Series, PV600A
- PH-3515F
- PJ-2500/PJ-3000 Series
- PJ-A3000 Series, PJ-H30, PV-5110
- PH-3515F, PH-A44

Standard accessories

- AC adapter, power cable, Easy operation guide

Note1: To denote your AC power cable add the following suffixes to the order No.: A for UL/CSA, D for CEE, 00 for CCC (power cord for CCC and User’s Manual set of Simplified Chinese are provided for separately), E for BS, K for KC, C and No suffix are required for PSE.

Note2: Refer to the QM-Data200 and Vision Unit leaflet (E14008) for more details.
## Rotary tables

<table>
<thead>
<tr>
<th>Order No.</th>
<th>176-106</th>
<th>172-198</th>
<th>176-305</th>
<th>176-306</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Name</td>
<td>Rotary table</td>
<td>Rotary table with fine feed wheel</td>
<td>Rotary table with fine feed wheel A</td>
<td>Rotary table with fine feed wheel B</td>
</tr>
<tr>
<td>Rotary stage size</td>
<td>ø112mm</td>
<td>ø146mm</td>
<td>ø240mm</td>
<td>ø270mm</td>
</tr>
<tr>
<td>Fine adjustment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Effective glass diameter</td>
<td>ø60mm</td>
<td>ø96mm</td>
<td>ø182mm</td>
<td>ø238mm</td>
</tr>
<tr>
<td>Minimum angle reading</td>
<td>6°</td>
<td>2°</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>External dimensions (WxDxH)mm</td>
<td>152x152x21.5</td>
<td>240x172x19.7</td>
<td>280x280x23.7</td>
<td>342x342x23.2</td>
</tr>
<tr>
<td>Mass</td>
<td>1.7kg</td>
<td>2.4kg</td>
<td>5.5kg</td>
<td>6.5kg</td>
</tr>
<tr>
<td>Applicable models</td>
<td>PJ-A3000</td>
<td>✓</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>PJ-H30</td>
<td>—</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>PV-5110</td>
<td>—</td>
<td>—</td>
<td>✓</td>
</tr>
</tbody>
</table>

## Holder with clamp

<table>
<thead>
<tr>
<th>Order No.</th>
<th>176-107</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PJ-A3000 Series PJ-H30 Series PV-5110</td>
</tr>
<tr>
<td>Maximum width to be clamped</td>
<td>0 - 35mm</td>
</tr>
<tr>
<td>Mass</td>
<td>0.4kg</td>
</tr>
</tbody>
</table>

## V-block with clamp

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-234</th>
<th>172-378</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PH-3515F</td>
<td>PJ-A3000 Series PJ-H30 Series PV-5110</td>
</tr>
<tr>
<td>Maximum workpiece diameter to be clamped</td>
<td>ø50mm</td>
<td>ø25mm</td>
</tr>
<tr>
<td>Central height from a mounting surface</td>
<td>38 - 48mm</td>
<td>38 - 48mm</td>
</tr>
<tr>
<td>Mass</td>
<td>1.24kg</td>
<td>0.8kg</td>
</tr>
</tbody>
</table>

## Swivel center support

<table>
<thead>
<tr>
<th>Order No.</th>
<th>176-105</th>
<th>172-197</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum workpiece size to be clamped*</td>
<td>ø70mm (45x140mm)</td>
<td>ø80mm (65x140mm)</td>
</tr>
<tr>
<td>Inclination</td>
<td>±10°</td>
<td>±10°</td>
</tr>
<tr>
<td>Mass</td>
<td>2.4kg</td>
<td>2.5kg</td>
</tr>
</tbody>
</table>

*The maximum possible size to be measured differs depending on the projection magnification selected. The size enclosed in parentheses ( ) indicates that for an inclination of 10°.
Accessories (Optional)

**Rotary vise**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-144</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PH-3515F, PH-A14</td>
</tr>
<tr>
<td>Rotation range</td>
<td>360˚</td>
</tr>
<tr>
<td>Size between mounting surface and top surface</td>
<td>76mm</td>
</tr>
<tr>
<td>Minimum angle reading</td>
<td>5˚</td>
</tr>
<tr>
<td>Mass</td>
<td>2.8kg</td>
</tr>
</tbody>
</table>

**Center support**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-142</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PH-3515F, PH-A14</td>
</tr>
<tr>
<td>Maximum workpiece diameter to be clamped</td>
<td>120mm (240mm)</td>
</tr>
<tr>
<td>Mass</td>
<td>3.3kg</td>
</tr>
</tbody>
</table>

*When center support riser (No.172-143) is used.

**Center support riser**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-143</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PH-3515F, PH-A14</td>
</tr>
<tr>
<td>Height</td>
<td>60mm</td>
</tr>
<tr>
<td>Mass</td>
<td>2.2kg</td>
</tr>
</tbody>
</table>

**Vertical holder**

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-132</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable models</td>
<td>PH-3515F, PH-A14</td>
</tr>
<tr>
<td>Glass size</td>
<td>—</td>
</tr>
<tr>
<td>Mass</td>
<td>1.3kg</td>
</tr>
</tbody>
</table>

**Standard scale**

Glass scale used for checking magnification accuracy

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-116, 172-330, 172-117</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>50mm, 80mm, 2&quot;</td>
</tr>
<tr>
<td>Graduation</td>
<td>0.1mm, 0.01&quot;</td>
</tr>
<tr>
<td>Accuracy (20˚C)</td>
<td></td>
</tr>
</tbody>
</table>
\[
\frac{3+5L}{1000} \mu m \\
L=\text{Measured length (mm)}
\]

**Reading scale**

Glass scale specially designed for inspecting the magnified image of a standard scale on the projection screen

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-118, 172-161, 172-329</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>200mm, 300mm, 600mm</td>
</tr>
<tr>
<td>Graduation</td>
<td>0.5mm</td>
</tr>
<tr>
<td>Accuracy (20˚C)</td>
<td></td>
</tr>
</tbody>
</table>
\[
\frac{15+5L}{1000} \mu m \\
L=\text{Measured length (mm)}
\]

<table>
<thead>
<tr>
<th>Order No.</th>
<th>172-119, 172-162</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>8&quot;, 12&quot;</td>
</tr>
<tr>
<td>Graduation</td>
<td>0.2&quot;</td>
</tr>
<tr>
<td>Accuracy (20˚C)</td>
<td></td>
</tr>
</tbody>
</table>
\[
\frac{600+15L}{10^4} \times 10^{-6} \\
L=\text{Measured length (inch)}
\]
**OPTOEYE (Projected image position detecting device)**

- **Built-in OPTOEYE (only PJ-H30D)**

- **Thermal printer DPU-414**

- **Adjustable stand**

- **Machine stand**

**Optoeye's condition**

- An edge detecting device for improving the measuring efficiency and reliability of a profile projector by removing the need to position the cross hairs on an edge manually. This has the effect of eliminating the operator variability factor from data entry and shortening the measurement time.
- The detector uses an optical fiber that can be easily fixed on the screen with chart clips.
- The device is provided with an error detection function that works if the screen light intensity changes.
- This device can be retrofitted onto the QM-Data200 and does not need an AC adapter since power is supplied from the QM-Data200 through the connecting cable.
- The X and Y-axis linear scales on the projector main unit are directly connected to the QM-Data200 during use of the Optoeye system.
- This system can be used in combination with the QM-Data200 but is only available for the PJ-H30A. (PJ-H30D does not need this system because it has a built-in Optoeye sensor.)

**Order No.** 332-151  
**Model** OPT-200  
**Illumination** Contour/surface*  
**Detecting directivity** Non direction  
**Minimum detectable circle** ø2mm  
**Minimum detectable line width** 1mm  
**Maximum response speed** 1000mm/s  
**Illumination range (Bright)** 30 - 1500 lx  
**Bright-Dark field difference** 20 & X or higher  
**Repeatability (contour illumination)** σ = 1μm**  
**Counter/angle display value printout*  
**Printer method** Dot-matrix thermosensitive method  
**Number of print digits** 40 digits (normal character 9x7 dot-matrix)  
**Printing speed** Maximum 52.5 characters/sec (normal character)  
**External dimensions** 190(W) x 170(D) x 65.5(H) mm  
**Standard accessories** Printer cable, printer paper (1 roll), AC adapter (for 100VAC)  
**Order No.** No. 908535 (5 rolls)  
*Counter/angle display value printout is for PJ-3000 series and PJ-H30 series.*

**Porjector stand**  
For QM-Data200 (stand-type specification), thermal printer, etc.

- **Order No.** 172-270  
- **Platform position** Adjustable to a height of 720 to 1020 mm  
- **Platform size** 600 x 450 mm

**Order No.** 172-269  
**External dimensions** 500(W) x 330(D) x 650(H) mm

*Recommended for PJ-A3000 series*
Overlay charts

To quickly check an image projected on the screen, an appropriate chart is used. 12 types of overlay charts are available according to the application.

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Overlay chart No.11

Overlay chart No.12

Overlay chart No.13

Overlay chart No.14

Overlay chart No.15

Overlay chart No.16

Overlay chart No.17

Overlay chart No.18

Overlay chart No.19

Overlay chart No.20

Overlay chart No.21

Overlay chart No.22

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<th>Specification</th>
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<td>12AAM027</td>
<td>Set of 12 charts (Overlay charts No.11 – No.22)</td>
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<td>Concentric circles (at intervals of 5 mm in radius) with cross hairs (1 mm graduation)</td>
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<td>Overlay chart No.14</td>
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<td>Horizontal: Parallel lines at intervals of 50 mm (50 times enlargement of 1 mm) Vertical: Parallel lines at intervals of 20 mm (20 times enlargement of 1 mm)</td>
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<td>Overlay chart No.20</td>
<td>12AAM596</td>
<td>Concentric circles (at intervals of 1 mm in radius) and radial lines (at intervals of 1 mm)</td>
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Quick guide to Profile Projectors

■ Erect Image and Inverted Image
An image of an object projected onto a screen is erect if it is orientated the same way as the object on the stage. If the image is reversed top to bottom, left to right and by movement with respect to the object on the stage (as shown in the figure below) it is referred to as an inverted image (also known as a reversed image, which is probably more accurate).

■ Magnification Accuracy
The magnification accuracy of a projector when using a certain lens is established by projecting an image of a reference object and comparing the size of the image of this object, as measured on the screen, with the expected size (calculated from the lens magnification, as marked) to produce a percentage magnification accuracy figure, as illustrated below. The reference object is often in the form of a small, graduated glass scale called a ‘stage micrometer’ or ‘standard scale’, and the projected image of this is measured with a larger glass scale known as a ‘reading scale’. (Note that magnification accuracy is not the same as measuring accuracy.)

\[
\Delta M(\%) = \frac{L - L_M}{L_M} \times 100
\]

- \( \Delta M(\%) \): Magnification accuracy expressed as a percentage of the nominal lens magnification
- \( L \): Length of the projected image of the reference object measured on the screen
- \( L_M \): Length of the reference object
- \( M \): Magnification of the projection lens

■ Type of Illumination
- Contour illumination: An illumination method to observe a workpiece by transmitted light and is used mainly for measuring the magnified contour image of a workpiece.
- Coaxial surface illumination: An illumination method whereby a workpiece is illuminated by light transmitted coaxially to the lens for the observation/measurement of the surface. (A half-mirror or a projection lens with a built-in half-mirror is needed.)
- Oblique surface illumination: A method of illumination by obliquely illuminating the workpiece surface. This method provides an image of enhanced contrast, allowing it to be observed three-dimensionally and clearly. However, note that an error is apt to occur in dimensional measurement with this method of illumination. (An oblique mirror is needed. Models in the PJ-H30 series are supplied with an oblique mirror.)

■ Telecentric Optical System
An optical system based on the principle that the principal ray is aligned parallel to the optical axis by placing a lens stop on the focal point on the image side. Its functional feature is that the image will not vary in size though the image blurs as the object is shifted along the optical axis. For measuring projectors and measuring microscopes, an identical effect is obtained by placing a lamp filament at the focal point of a condenser lens instead of a lens stop so that the object is illuminated with parallel beams. (See the figure below.)

■ Working distance
Refers to the distance from the face of the projection lens to the surface of a workpiece in focus. It is represented by \( L \) in the diagram below.

■ Parallax error
When a reading scale is used to measure the size of a workpiece feature there is always a certain distance between the reading scale, which is laid on the top of the stage glass, and the projected image of the feature which is on the underneath surface. Unless the reading scale is always viewed from the same direction, ideally from directly above, the image will appear to shift against the reading scale graduations and thus cause a measurement error.

■ Field of view diameter
The maximum diameter of workpiece that can be projected using a particular lens.

\[
\text{Field of view diameter (mm)} = \frac{\text{Screen diameter of profile projector}}{\text{Magnification of projection lens used}} \times 100
\]

Example: If a 5X magnification lens is used for a projector with a screen of ø500mm:
Field of view diameter is given by \( \frac{500\text{mm}}{5} = 100\text{mm} \)
Specifications are subject to change without notice.

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