Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
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<tbody>
<tr>
<td>1. Geometry of the lens for measurement</td>
<td>Convex/Concave, Meniscus (Spherical or Non-spherical)</td>
</tr>
<tr>
<td>2. Measurement range (max.)</td>
<td>Convex 50 mm max. / Concave 30 mm max. (including meniscus)</td>
</tr>
<tr>
<td>3. Measurement range (min.)</td>
<td>90 µm min.</td>
</tr>
<tr>
<td>4. Measurable ID</td>
<td>20-80 mm</td>
</tr>
<tr>
<td>5. Accuracy</td>
<td>&lt; ±3 µm against thickness standard</td>
</tr>
<tr>
<td>6. External dimensions (Main unit)</td>
<td>312 W × 698 D × 698 H</td>
</tr>
<tr>
<td>7. External dimensions (Control box)</td>
<td>598 W × 698 D × 698 H</td>
</tr>
<tr>
<td>8. Displacement gauge</td>
<td>Keyence Multi-color Confocal Displacement Sensor CL-3000</td>
</tr>
<tr>
<td>9. Weight</td>
<td>Main Unit 10 kg approx. + Electrical Box 33 kg approx., 43 kg total</td>
</tr>
<tr>
<td>10. Power Consumption</td>
<td>10 A / 1500 W</td>
</tr>
</tbody>
</table>

Specification of Specimen

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Holding Device</th>
<th>Maximum Measurable Thickness</th>
<th>Maximum ±H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convex (0 to 80 mm)</td>
<td>By the standard stage</td>
<td>50 mm max.</td>
<td>—</td>
</tr>
<tr>
<td>Concave (0 to 80 mm)</td>
<td>By the standard stage</td>
<td>10 mm max.</td>
<td>5 mm max.</td>
</tr>
<tr>
<td>Concave (0 to 28 mm)</td>
<td>—</td>
<td>—</td>
<td>5 mm max.</td>
</tr>
<tr>
<td>Concave (0 to 80 mm)</td>
<td>Move the stage to lower 7 mm.</td>
<td>10 mm max.</td>
<td>5-15 mm max.</td>
</tr>
</tbody>
</table>

*Pay attention to the maximum scan angle (*2).

The specifications above may be subject to change without notice.

*1 A meniscus lens is included in concave lens category.
*2 Maximum Scan Angle = Specimen Diameter - 28

Manufacturer

G-Freude Co., Ltd.

Head Office
203 Itabashi Hilltop Mansion
2-20-5, Itabashi, Itabashi-ku, Tokyo 173-0004
Phone: +81-3-6905-7575 Fax: +81-3-6905-7576
URL: https://www.g-freude.co.jp

Distributor

Nagata Co., Ltd.

Head Office
2-4-15 Daimoncho, Nogoya City,
Nagoya, 460-0005
Phone: +81-52-731-4502
Fax: +81-52-731-0317
URL: https://www.nagata-ss.co.jp

Tokyo Sales Office
5-27-10 Owa-Cho, Hachioji City,
Tokyo, 192-0094
Phone: +81-42-631-1762
Fax: +81-42-631-1786

Osaka Sales Office
4-110, Hiraide Kogyo Danchi,
Ushimura City,
Tochigi, 321-0905
Phone: +81-28-613-0255
Fax: +81-28-613-0277

Jakarta Branch Office
Jl. Raya Sukabumi Km. 2,
Teluk Pinang, Ciawi 16720
Bogor, Jawa Barat INDONESIA
Phone: +62-251-8242-166
Fax: +62-251-8242-106

Nagata Shanghai International Trade Co., Ltd.
Room 903 Shanghai Huasheng Business Mansion No.398
Hankou Road, Huang Pu Dist., Shanghai
Phone: +86-21-6360-1527
Fax: +86-21-6360-1608
E-mail: cn.info@nagata-ss.co.jp

Nagata Hong Kong Co., Ltd.
4B, 11/F., Join-in Hang Sing
Ctr. 2-16 Sai Wai Fung Crescent,
Kwai Chung, HK.
Phone: +852-2614-7755
Fax: +852-2614-7767
E-mail: cn.info@nagata-ss.co.jp

Non-contacting Lens Center Thickness Gauge

CT gauge

Center Thickness Gauge

Seek and measure lens center thickness only an exact point you need.
Measurement of thickness of the lens at the center for 8K imaging

Next step of the single lens inspection

Higher definition of images is increasingly used, and the lenses manufactured by the conventional process cannot produce sufficiently sharp images. The number of lenses used in the optical system is increasing, and the use of non-spherical lenses also becomes common, which require complex construction of the lens barrel.

How should the precision of the lens be improved in the future? What comes next in the inspection of the surface contour and eccentricity?

G—Freude’s unique method of analysis of lens center thickness - HYPAS

High-intensity multi-color confocal displacement sensor and high-precision encoder for Z-axis displacement are used. Automatic detection is possible using our unique thickness analysis system HYPAS (Hybrid Peak Analysis System).

Measuring principle and method

The displacement sensor moves up and down smoothly along the two LM Guides located at the back of the machine. The system can measure a wide range of the thicknesses in combination with the measured value by the sensor.

Convex and Concave Lenses

Change in lens thickness can be detected by measuring displacement in the direction away from the WD in the case of a convex lens and in the direction toward the WD in the case of a concave lens.

Evolution for high-speed measurement

Line Scan System

Usually, height information is obtained for each measurement by the pitch of the stage. Our machine stores all the height information, which is then counted by computing the information of equal pitch. Measurements more than ten times faster than the conventional machine are realized.

Automatic Detection System

The lens center thickness is defined only at the point near the center of the lens. It is defined as the thickness measured at one point; accordingly, the maximum or minimum value of the X-Y scanning results provide the thickness. An automatic detection program makes identification of the thickness possible.

The machine provides a visual presentation of the measured data

Display as a 3-D map

You will not be able to be able to be confident with the result when the measured values are simply numerically presented. To be confident, a visual presentation showing that the measurement was made precisely at the center is the best approach. So the 3-D map display scheme is used. Confidence is further improved because the result is available for each measurement.
Measurement of thickness of the lens at the center for 8K imaging

Next step of the single lens inspection

Higher definition of images is increasingly used, and the lenses manufactured by the conventional process cannot produce sufficiently sharp images. The number of lenses used in the optical system is increasing, and the use of non-spherical lenses also becomes common, which require complex construction of the lens barrel.

How should the precision of the lens be improved in the future? What comes next in the inspection of the surface contour and eccentricity?

Non-contacting lens center thickness gauge

Lens center thickness needs to be measured accurately without contacting the surface.

The unprecedented machine eliminating the problems of the contact-type measuring machine

Although the lens center thickness is clearly defined in the drawing, it is impossible to measure the center thickness accurately. Furthermore, in the design of the optical system, smaller spacing between the lenses is now required. Such a trend requires accurate center thickness measurements, but the primary method of measurement is the contact type. The biggest problem of the contact type measurement is the creation of a contact mark and the difficulty in defining the point for measurement.

Our machine allows automatic non-contacting measurement

G-Freude’s unique method of analysis of lens center thickness – HYPAS

G-high-intensity multi-color confocal displacement sensor and high-precision encoder for Z-axis displacement are used. Automatic detection is possible using our unique thickness analysis system: HYPAS (Hybrid Peak Analysis System).

Measuring principle and method

The displacement sensor moves up and down smoothly along the two LM Guides located at the back of the machine. The system can measure a wide range of the thicknesses in combination with the measured value by the sensor.

Evolution for high-speed measurement

Line Scan System

Usually, height information is obtained for each measurement by the pitch of the stage. Our machine stores all the height information, which is then counted by computing the information of equal pitch. Measurements more than ten times faster than the conventional machine are realized.

Automatic Detection System

The lens center thickness is defined only at the point near the center of the lens. It is defined as the thickness measured at one point; accordingly, the maximum or minimum value of the X-Y scanning results provide the thickness. An automatic detection program makes identification of the thickness possible.

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Convex and Concave Lenses

Change in lens thickness can be detected by measuring displacement in the direction away from the WD in the case of a convex lens and in the direction toward the WD in the case of a concave lens.
To improve accuracy of the center thickness measurement

This machine measures displacement in the vertical direction. The machine is a kind of end measuring machine. In order to calibrate the machine, gage blocks are required to calibrate vertical displacement. It is also critical to measure the displacement precisely along the axis of the lens. Specific procedure of the calibration is explained below.

**Calibration procedure**

**Comparison to gage blocks**
The Z-axis encoder must be precisely calibrated using the number of gage blocks. As measurement of the lens thickness is made by reflection of light, the measurement does not depend on the refractive index of the lens material.

**Center Thickness = To ± Displacement of Encoder ± Measurement of Displacement Sensor**

**Comparison to gage blocks**
The gage blocks must be placed in the same configuration for every calibration. For this purpose, permanent magnets are installed in the jigs.

**Means to prevent measurement along the inclined axis**
The specimen holder stage is placed at a right angle to the displacement sensor. In order to establish the right angle, measurement is made using the optical flat to indicate the direction the stage is tilted using the 3-D map. Then adjustment of the tilt angle can be made.

**Horizontal check of the stage by the 3-D map**
Tilt adjustment of the stage is required to avoid the incidence of measuring light to the specimen not at a right angle. This machine has the capability to provide a 3-D map view of the measured surface. This feature allows easy identification of the direction the stage is tilted.

**Tilt adjustment device**
Adjustment of the right angle between the displacement sensor and the specimen can be made using the optical flat. Tilt adjustment device that does not easily shift is used.

**Tilt function is provided**
During measurement

**When various lens types need to be measured**
Standard Model for measurement of an individual lens

Every lens has a different geometry, diameter, and edge thickness. To make a special lens holder for different types of lenses is not practical. That problem is resolved by the lens holder mechanism that can center each specimen lens. It allows measurement anytime you want.

Centering is autonomously established for specimen lens with diameters of 20 to 80 mm. The soft resin is used for the holder section to prevent chipping of the lens edge.

**Numbers of the same specimen lenses need to be measured quickly**
Model for consecutive measurement with rotating lens holders

In the lens manufacturing process, many specimen lenses need to be measured within a short period of time. This machine can be equipped with the special feature of a rotating stage lens holder with multiple holes for specific diameters of the lenses to allow automatic center thickness measurements.

**Model for consecutive measurement with rotating lens holders**

During measurement
To improve accuracy of the center thickness measurement

This machine measures displacement in the vertical direction. The machine is a kind of end measuring machine. In order to calibrate the machine, gage blocks are required to calibrate vertical displacement. It is also critical to measure the displacement precisely along the axis of the lens. Specific procedure of the calibration is explained below.

Calibration procedure

Comparison to gage blocks

The Z-axis encoder must be precisely calibrated using the number of gage blocks. As measurement of the lens thickness is made by reflection of light, the measurement does not depend on the refractive index of the lens material.

Center Thickness = To ± Displacement of Encoder ± Measurement of Displacement Sensor

Placement of gage blocks on the stage

The gage blocks must be placed in the same configuration for every calibration. For this purpose, permanent magnets are installed in the jigs.

Means to prevent measurement along the inclined axis

Tilt adjustment device

Adjustment of the right angle between the displacement sensor and the specimen can be made using the optical flat. Tilt adjustment device that does not easily shift is used.

Horizontal check of the stage by the 3-D map

Tilt adjustment of the stage is required to avoid the incidence of measuring light to the specimen not at a right angle. This machine has the capability to provide a 3-D map view of the measured surface. This feature allows easy identification of the direction the stage is tilted.

Stage for Single Lens Stage for Number of Lenses

Every lens has a different geometry, diameter, and edge thickness. To make a special lens holder for different types of lenses is not practical. That problem is solved by the lens holder mechanism that can center each specimen lens. It allows measurement any time you want.

Center thickness measurement

Centering is autonomously established for specimen lens with diameters of 20 to 80 mm. The soft resin is used for the holder section to prevent chipping of the lens edge.

Model for consecutive measurement with rotating lens holders

In the lens manufacturing process, many specimen lenses need to be measured within a short period of time. This machine can be equipped with the special feature of a rotating stage lens holder with multiple holes for specific diameters of the lenses to allow automatic center thickness measurements.

Type 1 - When various lens types need to be measured

Standard Model for measurement of an individual lens

Every lens has a different geometry, diameter, and edge thickness. To make a special lens holder for different types of lenses is not practical. That problem is resolved by the lens holder mechanism that can center each specimen lens. It allows measurement any time you want.

Centering is autonomously established for specimen lens with diameters of 20 to 80 mm. The soft resin is used for the holder section to prevent chipping of the lens edge.

Type 2 - Numbers of the same specimen lenses need to be measured quickly

Model for consecutive measurement with rotating lens holders

In the lens manufacturing process, many specimen lenses need to be measured within a short period of time. This machine can be equipped with the special feature of a rotating stage lens holder with multiple holes for specific diameters of the lenses to allow automatic center thickness measurements.

Centering is autonomously established for specimen lens with diameters of 20 to 80 mm. The soft resin is used for the holder section to prevent chipping of the lens edge.

The center position is defined by rotation of the rotating stage, and measurements can be made.

Example: Ø20 holes × 25
Other features installed

Non-contact Sag measurement
Sag measurement using the contact-type plug gauge is also problematic. Can contact marks be avoided? Where is the bottom of the lens located? HYPAL, our unique analysis method of lens center thickness, also eliminates such problems.

The high-speed, non-contacting automatic measurement provides feedback data to the lens-forming machine very quickly. It simply requires determining the lens apex position after zero-resetting using the optical flat, and the Sag value is determined.

Other features of the software
Useful functions of 3-D map
The machine provides 3-D maps of both sides of the lens surfaces, and such views can be enlarged or presented as an oblique view. A guide is indicated at the apex for easy identification.

Examples of Measurement and Comparison of Data

Double-concave Lens
CT Measuring Condition
- Geometry: Double-concave, \( \Phi 40 \) mm
- Measurement range: 3 mm square scanning
- Scanning pitch: 0.3 mm
- Number of measuring points: 121
- Measurement time: 15 seconds

Continuous Measurement
- Geometry: Double-concave, \( \Phi 40 \) mm
- Measurement range: 4 mm square scanning
- Scanning pitch: 0.4 mm
- Number of measuring points: 121
- Measurement time: 17 seconds

Meniscus Lens
CT Measuring Condition
- Geometry: Meniscus lens, \( \Phi 37.8 \) mm
- Measurement range: 3 mm square scanning
- Scanning pitch: 0.1 mm
- Number of measuring points: 121
- Measurement time: 14 seconds

Continuous Measurement
- Geometry: Meniscus lens, \( \Phi 27.8 \) mm
- Measurement range: 3 mm square scanning
- Scanning pitch: 0.3 mm
- Number of measuring points: 121
- Measurement time: 17 seconds

Eliminate handling of large amount of data
Preparation of inspection report
Verification and reporting is required in lens making process. To assist in such work, the machine has a function to produce the datasheet with pass/reject results recorded.

Space saver
PC mounted on the Arm Stand
A space needed for the PC is reduced. A vibration isolating base is not required.
Other features installed

Sag measurement function

Non-contact Sag measurement

Sag measurement using the contact-type plug gauge is also problematic. Can contact marks be avoided? Where is the bottom of the lens located? HYPAL, our unique analysis method of lens center thickness, also eliminates such problems.

The high-speed, non-contacting automatic measurement provides feedback data to the lens-forming machine very quickly. It simply requires determining the lens apex position after zero-resetting using the optical flat, and the Sag value is determined.

\[ \text{Sag Value} = \text{Z-axis Displacement} + (\text{Measured Value by Displacement Sensor} - \text{WD}) \]

Other features of the software

Useful functions of 3-D map

The machine provides 3-D maps of both sides of the lens surface, and such views can be enlarged or presented as an oblique view. A guide is indicated at the apex for easy identification.

Expanded View

A guide for apex identification

Change view angle

Eliminate handling of large amount of data

Preparation of inspection report

Verification and reporting is required in lens making process. To assist in such work, the machine has a function to produce the datasheet with pass/reject results recorded.

Space saver

PC mounted on the Arm Stand

A space needed for the PC is reduced. A vibration isolating base is not required.

Examples of Measurement and Comparison of Data

CT Measuring Condition

- **Double-concave Lens**
  - Geometry: Double-concave, Ø10 mm
  - Measurement range: 1 mm square scanning
  - Scanning pitch: 0.5 mm
  - Number of measuring points: 121
  - Measurement time: 15 seconds

- **Meniscus Lens**
  - Geometry: Meniscus, Ø22 mm
  - Measurement range: 2 mm square scanning
  - Scanning pitch: 0.3 mm
  - Number of measuring points: 121
  - Measurement time: 17 seconds

CT Measuring Condition

- **Double-concave Lens**
  - Geometry: Double-concave, Ø10 mm
  - Measurement range: 1 mm square scanning
  - Scanning pitch: 0.5 mm
  - Number of measuring points: 121
  - Measurement time: 15 seconds

- **Meniscus Lens**
  - Geometry: Meniscus, Ø22 mm
  - Measurement range: 2 mm square scanning
  - Scanning pitch: 0.3 mm
  - Number of measuring points: 121
  - Measurement time: 17 seconds
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Specification of Specimen

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<th>Maximum Measurable Thickness</th>
<th>Maximum ±H</th>
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<tr>
<td>Convex (≤ 50 mm)</td>
<td>By the standard stage</td>
<td>50 mm max.</td>
<td>—</td>
</tr>
<tr>
<td>Concave (≤ 50 mm)</td>
<td>By the standard stage</td>
<td>10 mm max.</td>
<td>5 mm max.</td>
</tr>
<tr>
<td>Concave (≤ 28 mm)</td>
<td>Move the stage to lower 7 mm. Pay attention to the maximum scan angle (*2).</td>
<td>10 mm max.</td>
<td>±3 mm or larger</td>
</tr>
</tbody>
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The specifications above may be subject to change without notice.

*1 A meniscus lens is included in concave lens category.
*2 Maximum Scan Angle = Specimen Diameter - 28

Manufacturer

G-Freude Co., Ltd.
2-20-5, Itabashi-ku, Tokyo 173-0004
Phone: +81-3-6905-7575   Fax: +81-3-6905-7576
URL: https://www.g-freude.co.jp

Distributor

Nagata Co., Ltd.

Head Office
2-4-15 Daiichi-cho, Okuyama-ku, Nagoya, 460-0005
Phone: +81-52-233-4502
Fax: +81-52-261-0217
URL: https://www.nagata-ss.co.jp

Tokyo Sales Office
5-27-10 Osawa-cho, Hachioji-shi, Tokyo, 192-0045
Phone: +81-42-331-1782
Fax: +81-42-331-1786

Utsunomiya Sales Office
4-110, Hirokawa Kogyo Danchi, Utsunomiya-shi, Tochigi, 321-0905
Phone: +81-28-613-0255
Fax: +81-28-613-0277

Osaka Sales Office
Shinko Kensetsu Bldg. 405, 2-11 Kaimei-cho, Amagasaki-shi, Hyogo, 660-0862
Phone: +81-6-6430-0125
Fax: +81-6-6430-0135

Jakarta Branch Office
8-14-11 Saka-ku, Jakarta, 12970
Phone: +62-21-8242-168
Fax: +62-21-8242-169

Nagata Hong Kong Co., Ltd.
4B, 11/F., Jao In Hang Strg.
Ctn, 2-16 Kwai Fung Crescent, Kwai Chung, N.T., HK
Phone: +852-2614-7755
Fax: +852-2614-7755

Nagata Shanghai International Trade Co., Ltd.
Room 103 Shanghai Huasheng Business Mansion No.138
Hankou Road, Huang Pu Dist., Shanghai
Phone: +86-21-6360-1527
Fax: +86-21-6360-1528

E-mail: cns@nagata-ss.co.jp