

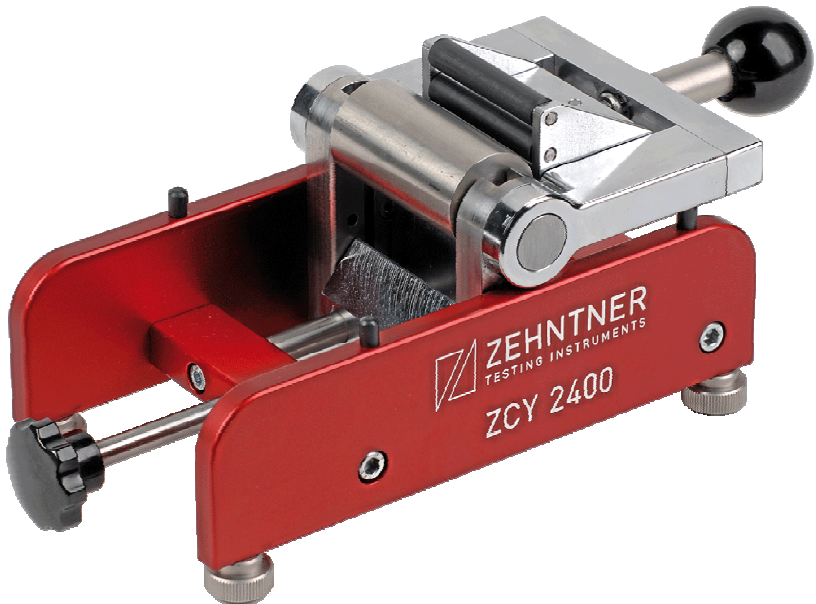
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Instruction manual

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ZCY 2400 Zehntner-Cylindrical mandrel tester



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Exclusion of liability

The figures and descriptions as well as the technical data correspond to the present operating instructions at the time of printing. Changes of any type, resulting from technical progress, modified design or similar, are reserved. The operating instructions have been prepared with the greatest care. Nevertheless, errors cannot be completely excluded. The manufacturer cannot be made liable for any errors in these operating instructions and possible damage resulting from these.

The manufacturer is always grateful for suggestions, proposals for improvement and indications of errors.

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1. Description of device

1.1 Summary

The ZCY 2400 cylindrical mandrel tester can be used for assessing the resistance of a coating of paint, varnish or related product to cracking and/or detachment from a substrate when subjected to bending round a cylindrical mandrel under standard conditions.

For this purpose, test panels are bent around a cylindrical mandrel by 180° and assessed afterwards.

Application / application areas:

- laboratory test apparatus for the paint, varnish and processing industry, e.g. powder coatings
- practically applicable to almost all single and multi-coat systems on test panels
- for quality control and research and development

In particular, this instrument has the following **features**:

- Innovative, extra sturdy mandrels enable bending of test panels with comparatively smaller mandrels and the use of comparatively thicker test panels.
- The generously dimensioned test panel area of the versions ZCY 2400.A.G. and ZCY 2400.I.G. allows testing of larger test panels. Extra cutting for fitting can be avoided.
- The ZCY 2400 cylindrical mandrel tester is equally easy to use by right- and left-handed operators. Simply place the handle of the instrument on the corresponding side.
- Robust, stainless design.
- No maintenance necessary
- Easy to handle

2. Safety and working notes

2.1 Dangers




Attention!

This note is included in this instruction manual wherever it is warned about dangers which will arise to life and limb of persons if the apparatus is handled improperly. Observe these notes and be particularly careful in these cases. Also inform other users on all safety notes. Besides the notes in these instruction manual the generally applicable safety instructions and regulations for prevention of accidents have to be taken into account.

Caution

This note comprises instructions to be observed in order to comply with guidelines, instructions, notes and the proper procedure of the work, and to avoid damaging or destruction of the apparatus.

2.2 Safety notes

-  The cylindrical mandrel tester is exclusively intended for the determination of flexibility, adhesion and elongation of paint applied to test panels and is suitable for table-top use. Any other use is considered as being not in accordance with the intentions of the manufacturer. For damages resulting thereof the manufacturer is not liable; the risk for this is taken by the user alone.
-  Reconstruction without permission and modifications of the cylindrical mandrel tester are not permitted. Please use only the accessories available together with the apparatus. For damages resulting from the non-observance of the safety notes the manufacturer is not liable; the risk for this is taken by the user alone. .
-  All maintenance and repair work which is not explicitly permitted and described in the present instruction manual shall only be carried out by **Zehntner GmbH Testing Instruments** or your authorized ZEHNTNER trader, otherwise all the guarantee and liability claims will expire.

3. Delivery of apparatus

3.1 Damages during carriage

During carriage the Cylindrical mandrel tester is to be handled with the usual care. To ensure carriage without damages the device is to be transported in the original packaging and under normal freight conditions. Pushes during carriage are to be avoided.

At the destination take out the device of the packaging and check immediately for any damages from the transport; if there are any damages your authorized ZEHNTNER trader or Zehntner GmbH Testing Instruments directly should be informed immediately.

At the receipt of the goods, you have to check if there are any visible damages at the outer packaging. If the packing is alright, you can sign the receipt documents. If you even suspect by your visual impression that damage has occurred, make a note of the suspected damage on the delivery receipt or freight papers and get the carrier to sign it. Moreover, the forwarding agent/courier service must be held responsible for the damage in writing.

If a hidden damage is discovered while unpacking, you have to inform and must held the forwarding agent / courier service immediately in the following way: "When opening the parcel we had to notice that etc. etc." This superficial checking of the goods has to be done before the time limit of the forwarding agent / courier service expires which is normally within 7 days. However, the period could be less. Hence, it is recommended to check the exact time limit when receiving the goods.

If there are any damages inform also immediately your authorized ZEHNTNER trader or Zehntner GmbH Testing Instruments directly

- ! For the protection of persons and apparatus care is to be taken when the apparatus is lifted or carried. It is recommendable to hold the ZCY 2400 on both metal sheets at the sides of the housing.

3.2 Extent of delivery

The following parts are included in the delivery:

- 1 Cylindrical mandrel tester
- 12 mandrels (for EN ISO 1519 versions) or 6 mandrels (for ASTM D 522 versions) respectively
- 1 certificate of manufacturer

3.3 Optional accessories

- additional mandrels with different diameters
- ACC402 tabletop fixing
- ACC403 microscope with possibility of taking digital pictures
- Zehntner- applicator
- ZND 2050 - 2054 Zehntner-Wet film thickness gauge
- ZNW 2055 Zehntner-Wet film thickness wheel
- ZWW 2100 – 2108 Zehntner-Wet film wheel

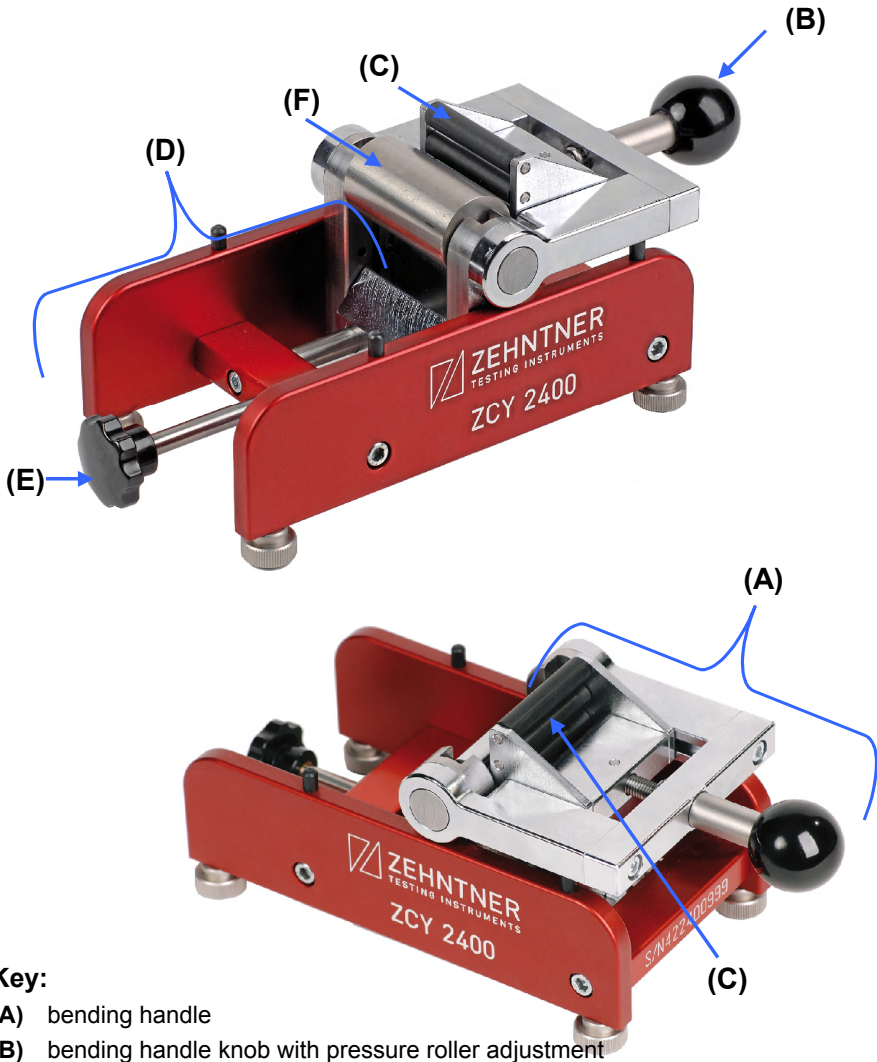


ACC402 with ZCY 2400 and tabletop fixing

- ! **Zehntner GmbH Testing Instruments** refuses all warranty and liability claims for damages caused by usage of the ZCY 2400 in combination with **non-original accessories**, or accessories from 3rd party suppliers.

4. Operational elements

4.1 Abridged survey



Key:

- (A) bending handle
- (B) bending handle knob with pressure roller adjustment
- (C) pressure rollers
- (D) clamping unit
- (E) black rotary knob
- (F) mandrel

5. Test panel

5.1 Substrate

Unless otherwise specified or agreed, the test panels are made of steel, tinplate or soft aluminium in accordance with the requirements of ISO 1514.

Plastic substrates can also be used with the ZCY 2400 Cylindrical mandrel tester.

5.2 General

The test panels shall be flat and free from distortion, and both the front and the back shall be free from any visible ridges or cracks.

A piece of thin paper may be inserted over the coated surface between the panel holder and the bending piece to prevent the coating being scratched during the bending operation.

- ❗ A new test panel has to be used for every test.
- ❗ The test panels can be cut to the required size after drying / curing, provided that they are not deformed in the process. For test panels made from aluminium, the longitudinal direction shall be parallel to the direction of rolling during manufacturing.

5.3 Shape and dimensions

5.3.1 Form

The test panels shall be rectangular.

Measures

mandrel	length
20 – 30 mm	130 mm
10 – 19 mm	105 mm
5 – 9 mm	90 mm
2 – 4 mm	85 mm

The measures of the test panels are described in chapter 8 starting on page 18.

5.4 Preparation and coating of panels

Unless required otherwise, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test.

If the product under test is applied by brushing, the brush marks shall be parallel to the longer side of the panel.

5.5 Drying and conditioning

Dry /cure (or stove) and age, if applicable, each coated test panel for the specified time under the specified conditions. Before testing, condition the coated panels at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % (see ISO 3270), unless otherwise agreed, for a minimum period of 16 h. Carry out the test procedure as soon as possible but in any case not later than 30 min after removal the test panels from conditioning.

5.6 Thickness of coating

Determine the dry film thickness of the coating according to one of the procedures described in ISO 2808.

6. Handling

6.1 Type of bending test

The bend test can be carried out as:

- **“pass/fail” test**
by carrying out the test with a single specified size of mandrel, to assess compliance with a particular requirement.
- **„test series“**
for the determination of the diameter of the first mandrel to cause failure.

For the "test series" please see also paragraph 6.5 „Determination of the diameter of the first mandrel to cause failure “ on page 17.

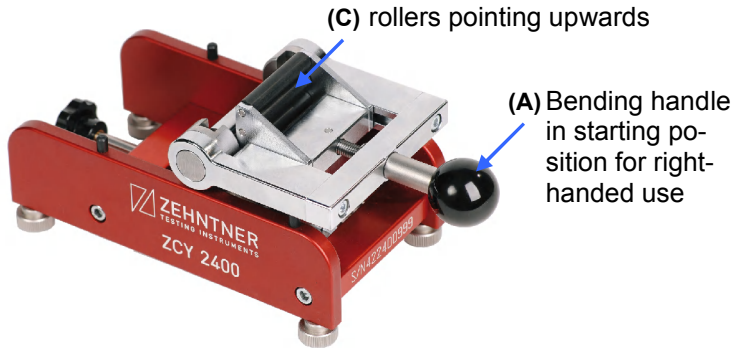
6.2 Test conditions

Unless otherwise agreed, carry out the test at a temperature of $23^{\circ} \text{C} \pm 2^{\circ} \text{C}$. Measure the relative humidity during the test and state it in the test report.

Place or secure the Cylindrical mandrel tester so that it cannot be displaced during the test procedure and the screw handle can be operated freely, for example near the edge of a bench.

6.3 Bending test

- Determine the type of bending test ("Pass/Fail" or "test series"), see paragraph 6.1 on page 10.
- Please follow test conditions according to paragraph 6.2 on page 10.
- Insert test panel and clamp it, following the subsequent procedure:
 - 1) Open bending handle **(A)** to starting position, rollers **(C)** pointing upwards.
for right-handed use: place apparatus in front of you so that the bending handle **(A)** is on the right-hand side

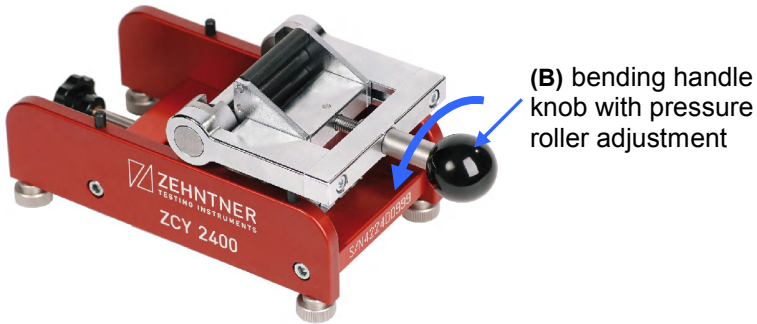


For left-handed use: place apparatus so that the bending handle **(A)** is on the left –hand side.

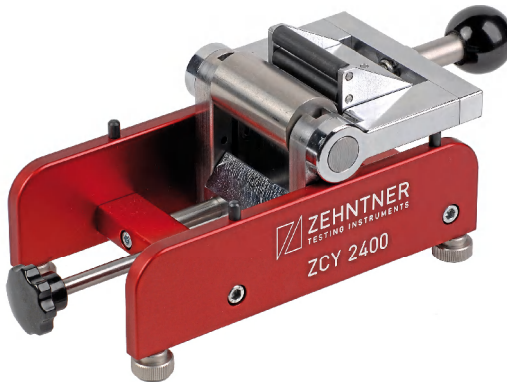
Picture: demonstration of left-handed use with the option ACC402 tabletop fixing (also suitable for right-handed use)



- 2) Loosen the rollers **(C)** in the direction of the bending handle **(A)** by turning the bending handle knob with pressure roller adjustment **(B)**

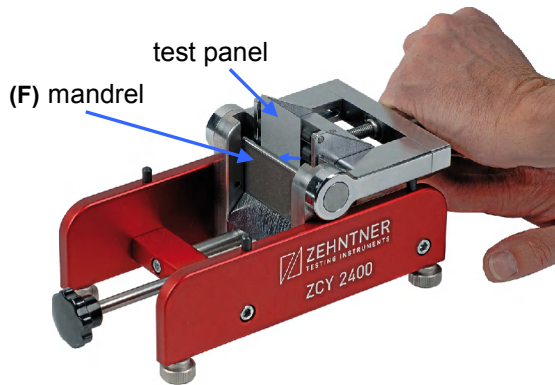


- 3) Insert mandrel **(F)**.

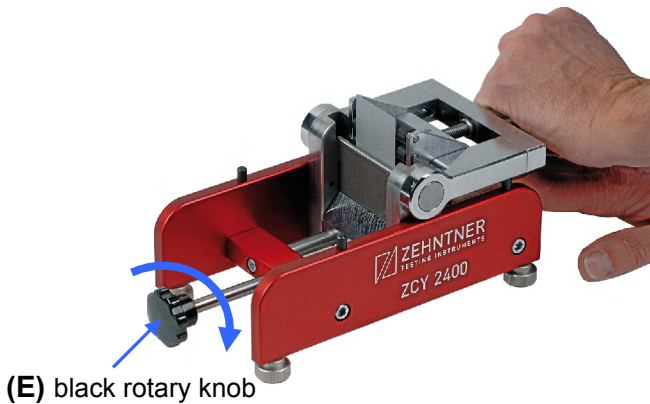


Picture: right-handed use with thick mandrel

- 4) Insert the test panel on the side of the rollers **(C)** with the coating to be tested facing towards the rollers **(C)** (away from the mandrel), lightly fix the clamping unit **(D)** with the black rotary knob **(E)** so that the clamping unit **(D)** can still be moved.
- 5) Pull the test panel towards the mandrel **(F)**, the test panel shall rest evenly without convolution and shall touch the mandrel **(F)**.



6) Now fix the test panel with the black rotary knob (E).



7) Place the pressure rollers (C) without exerting pressing force on the test panels by turning bending handle knob with pressure roller adjustment (B).



(B) turn bending handle knob with pressure roller adjustment

- 8) bend the test panel around the mandrel (**F**) with the bending handle (**A**) at a steady rate through 180° over a period of 1 to 2 seconds.



Picture: right-handed use without ACC403 tabletop fixing

- ! When using the ZCY 2400 without ACC022 tabletop fixing, the apparatus shall be held stable.
For right-handed use hold the ZCY 2400 steady with your right hand on the right side and hold the bending handle (**A**) with your left hand.
For left-handed use hold the ZCY 2400 steady with your left hand on the left side and hold the bending handle (**A**) with your right hand.

- ⚠ Please keep your fingers or other body parts clear of the bending area at all times. Otherwise you risk pinching and injuring these body parts.

Demonstration of left-handed use with ACC403 tabletop fixing:




starting position



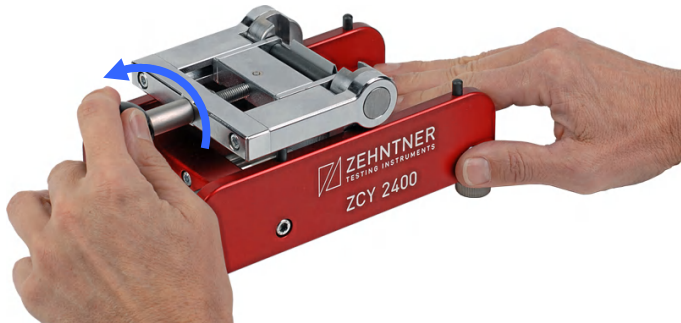
position at the end of the bending process

For left-handed use it is easier to use the left hand for bending the handle.

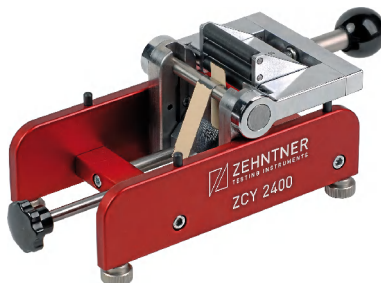
The ACC203 tabletop fixing can also be used for right-handed operation. In this case, it is easier to use the right hand for the bending process.

 Please keep your fingers or other body parts clear of the bending area at all times. Otherwise you risk pinching and injuring these body parts.

- Remove the test panel from the mandrel tester for assessment following the subsequent procedure:
- 9) Loosen the pressure rollers **(C)** in the direction of the bending handle **(A)** by turning the bending handle knob with pressure roller adjustment **(B)**.



- 8) Bring bending handle **(A)** back into starting position, the pressure rollers **(C)** shall point upwards.
for right-handed use: place apparatus in front of you so that the bending handle **(A)** is on the right-hand side

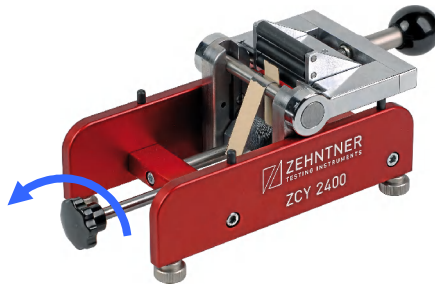


For left-handed use: place apparatus so that the bending handle (A) is on the left –hand side.

Picture: demonstration of left-handed use with the option ACC402 tabletop fixing (also suitable for right-handed use)



- 10) Loosen the clamping unit (D) by turning the black rotary knob (F).



- 11) Remove test panel and assess according to chapter 6.4 Examination of the test panel on page 16.

- For each test a new test panel shall be used.
- Issue a test report.
- For further details please see the corresponding standards.

6.4 Examination of the test panel

Examine the coating immediately after bending under good illumination. Use normal corrected vision or, by agreement, a lens of 10fold magnification, and examine the coating for cracking and/or detachment from the substrate, ignoring the surface of the coating less than 10 mm from the edge of the panel.

If a lens is used, it is essential to mention this fact in the test report in order to avoid misleading comparisons with results obtained using normal vision only.

Recommendation:

Use a microscope with possibility of taking digital photos. This facilitates assessment considerably. Furthermore, the photos can be saved for documentation. We offer the optional accessory ACC203.

6.5 Determination of the diameter of the first mandrel to cause failure

Assess the test panel according to paragraph 6.4 Examination of the test panel on page 16.

Record the diameter of the first mandrel at which the coating cracks and/or becomes detached from the substrate. In the event of failure not occurring with the mandrel of the smallest diameter, record this fact.

7. Maintenance and cleaning

7.1 Maintenance and cleaning work that can be carried out by the user

Clean the ZCY 2400 cylindrical mandrel tester with a clean, soft, dry tissue.

- ❗ Do not use any liquids for cleaning.

8. Technical specification

Versions	Mandrels	Dimensions (LxBxH)	Weight	Standards
2400.A.G	6 mandrels with diameter: 3.2 mm (0.125"), 6.4 mm (0.25"),	205 mm x 158 mm x 115 mm (8.07" x 6.22" x 4.53") length incl. bending handle: 270 mm (10.63")	3.725 kg (8.212 lbs)	ASTM D 522
2400.A.K	9.5 mm (0.375"), 12.7 mm (0.5"), 19 mm (0.75"), 25 mm (1")	205 mm x 123 mm x 115 mm (8.07" x 4.84" x 4.53") length incl. bending handle: 270 mm (10.63")	2.925 kg (6.449 lbs)	
2400.I.G	12 mandrels with diameter: 2 mm (0.079"), 3 mm (0.118"), 4 mm (0.157"), 5 mm (0.197"),	205 mm x 158 mm x 115 mm (8.07" x 6.22" x 4.53") length incl. bending handle: 270 mm (10.63")	3.725 kg (8.212 lbs)	EN ISO 1519
2400.I.K	6 mm (0.236"), 8 mm (0.315"), 10 mm (0.394"), 12 mm (0.472"), 16 mm (0.63"), 20 mm (0.787"), 25 mm (0.984"), 32 mm (1.26")	205 mm x 123 mm x 115 mm (8.07" x 4.84" x 4.53") length incl. bending handle: 270 mm (10.63")	2.925 kg (6.449 lbs)	

Material: mandrels: stainless steel,
housing: red anodised aluminium,
remaining components: chrome-plated steel.

Test panels: length of the test panels

mandrel	length
20 – 30 mm	130 mm
10 – 19 mm	105 mm
5 – 9 mm	90 mm
2 – 4 mm	85 mm

Width of the test panels:

version	width
2400.A.G	100 mm
2400.A.K	45 mm
2400.I.G	100 mm
2400.I.K	45 mm

Test panel thickness versions 2400.A.K and 2400.I.K:

material	max thickness	from mandrel Ø
steel S235JR (St37)	0.5 mm (0.02“)	2 mm (0.08“)
	1 mm (0.04“)	4 mm (0.16“)
aluminium	1 mm (0.04“)	3 mm (0.12“)
	1.5 mm (0.06“)	4 mm (0.16“)
bending stress < aluminium	max 4 mm (0.016“)	4 mm (0.16“)

Warranty: 2 years

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