P4701
Risø Aluminum Energy Wedge

DESCRIPTION

The P4701 Risø Aluminum Energy Wedge is used for the IQ/OQ testing of electron dose distribution and energy measurement at electron beam facilities. The P4701 Aluminum Wedge is manufactured to the specifications of the High Dose Reference Laboratory (HDRL) at Denmark's Risø Laboratory. Each wedge is tested and certified by Risø in a 10 MeV.

SPECIFICATIONS

Nominal Product Dimensions	Packaging Dimensions	Product Weight
12cm (L) x 14cm (W) x 2.9cm (H) ± 0.1mm	8.5" x 5" x 1.25" / 22.9cm x 15.2cm x 5.1cm	4.0 lbs. / 1.81 kg

Material:	Aluminum
Color:	Silver (natural)
Printing:	Engraved serial number denoting A (top) and B (bottom) halves of the wedge.
Angle:	16.0° ± 0.3°
Energy Range:	Using strip film: approximately 2 MeV to 20 MeV Using arrays of B3 WINdose dosimeters: 4 MeV to 12 MeV
Precision (MeV):	Precision of the measured energy will depend on the precision of the electron beam system, but experience confirms that the user should expect ± 0.3 MeV or better.

Certification:

Risø HDRL information sheet specifying Serial Number with accompanying test information.

- Actual aluminum density is specified, and a correction factor is specified based on the actual versus nominal density which can then be used in the specified energy equations from ISO/ASTM 51649 (see references).
- All wedges are tested and compared against 3 Risø HDRL reference wedges, and typical E_a and E_p results using specified equations are within 1%.

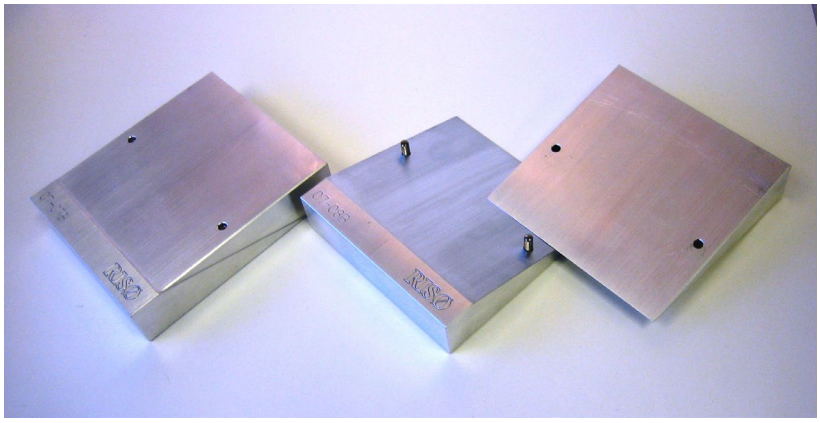
Packaging:

Unit is packaged in a cardboard box wrapped in bubble-wrap.

Storage:

Store inside of provided packaging or equivalent.

PRODUCT PHOTOS



USAGE

The "bottom" part is fitted with two alignment posts and the letter "B" is part of the engraved serial number. The "top" part has two alignment holes and the letter "A" is part of the engraved serial number.

1. Place the wedge on a flat surface and separate the A half (the "A" serial number) from B (the "B" serial number). Do this by gently moving wedge along the posts that join them and wiggle until the halves are separated.
2. Use of a Film Strip

2.1. Place a strip of film parallel to the edge of the wedge down the slope so that the film protrudes past the top and bottom of the wedge, allowing the entrance and exit points to be marked on the film. For further guidance, refer to the instructions from the manufacturer of the system used to measure the strip.

3. Use of a B3 Wedge Array Card (B3110/B3112/B3150)

3.1. Open a package of the Energy Wedge Array Card in a UV protected area or cover the dosimeters while preparing the wedge to protect from UV exposure.

3.2. *Refer to GEX Doc# 100-102, B3110/B3112 Energy Wedge Array Card – Product Specifications and Usage (PSU) or GEX Doc# 100-143, B3150 Energy Wedge Array Card – Product Specifications and Usage (PSU)* for additional details about the specific array card you are using.

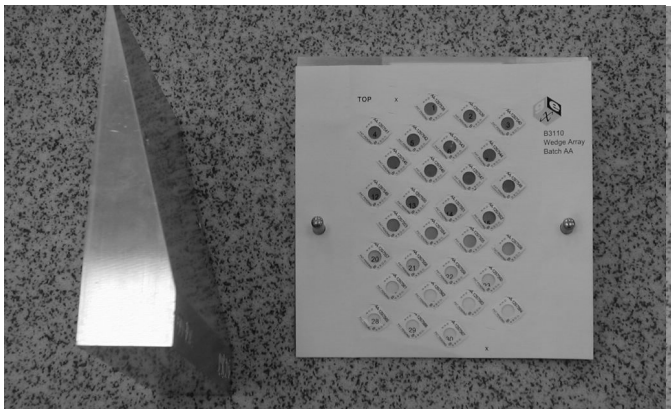
3.3. Orient the card so that the lowest numbered dosimeter will be over the thick end of the bottom part ("B" half of the wedge that has the posts) and align the card holes with the wedge posts.

3.4. The GEX logo should be located on the top right corner over the thicker part of the wedge.

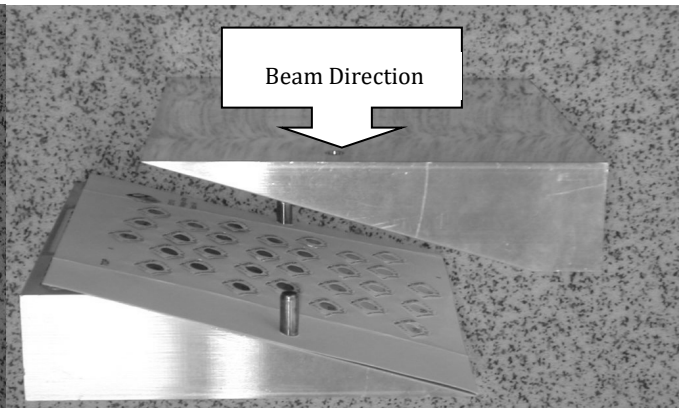
3.5. Press the card down against the aluminum.

3.6. Align the front part with the wedge posts and press it down until snug.

3.7. Correct orientation of an Energy Wedge Array Card on the Risø Aluminum Wedge (irradiated dosimeters were used for photographs to illustrate orientation; in actual use all dosimeters will be clear in this step).

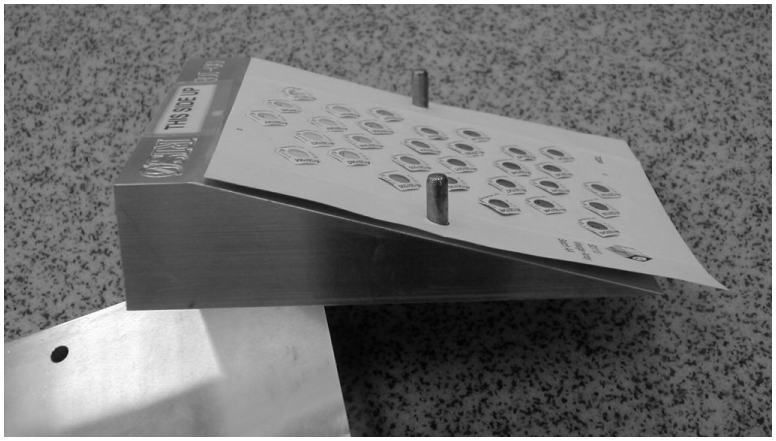


Top view



Side view

3.8. Incorrect orientation of B3110 card on aluminum wedge. Note that paper protrudes past the bottom of the wedge.



3.9. Place the top half of the wedge on top of the bottom half and use the same gentle wiggling to secure the top half onto the bottom half.

3.10. Verify the gap between the two halves is acceptable. Once tightened, there should be very little gap between the two halves all the way around the wedge.

3.11. Irradiation of the Wedge:

3.11.1. The wedge must always face perpendicular to the beam.

3.11.2. The wedge should traverse the beam area parallel to the length of the wedge. See Figure 1 below.

3.11.3. Wrap a single piece of tape around the entire wedge assembly to keep it together during irradiation.

3.12. A uniform density test fixture may be used to hold the wedge.

3.13. Place the wedge in the fixture and secure it to prevent movement during irradiation. Orient the wedge in the material handling system such that the electron beam will enter through the front part.

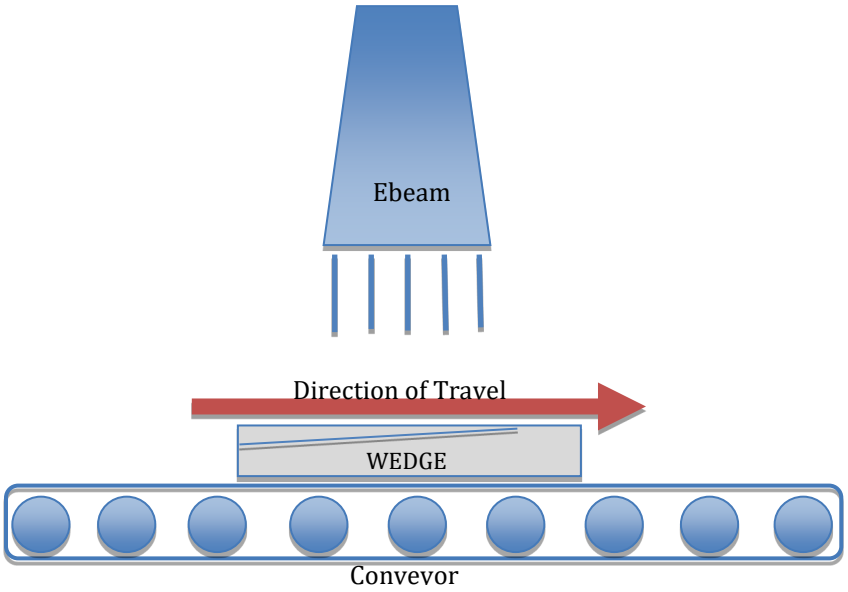
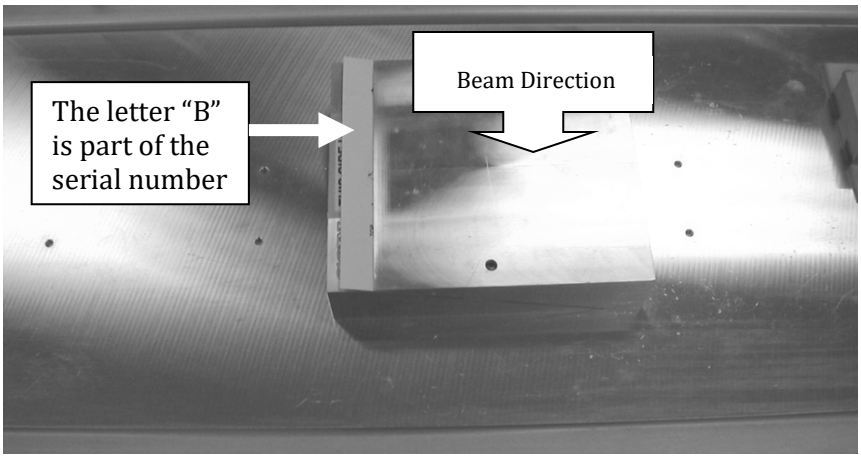
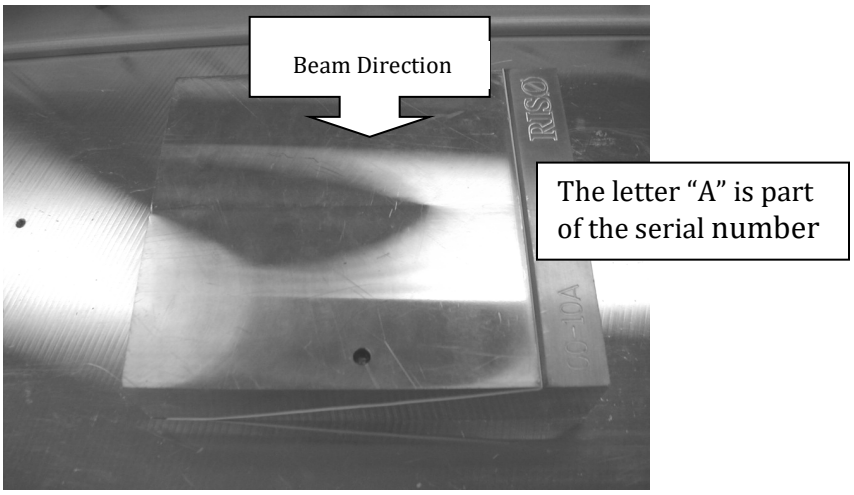


Figure 1

3.13.1.Correct orientation of wedge.



3.13.2.Incorrect orientation of wedge.



3.13.3. Perform only single-sided irradiation of the wedge. For best results, set the accelerator parameters to deliver a targeted dose of 15 kGy to the surface of the wedge.

3.13.4. Remove the wedge from the carrier as soon as possible after irradiation. Return it to the dosimetry laboratory. Carefully remove the front part of the wedge and pull the card array away from the back piece.

3.14. Measurement of the Dosimeters:

3.14.1. Measure the dosimeters in sequence from top to bottom of the wedge. The positions are numbered, and the dosimeters are in sequence by serial number from lowest to highest to assist the user in performing this step.

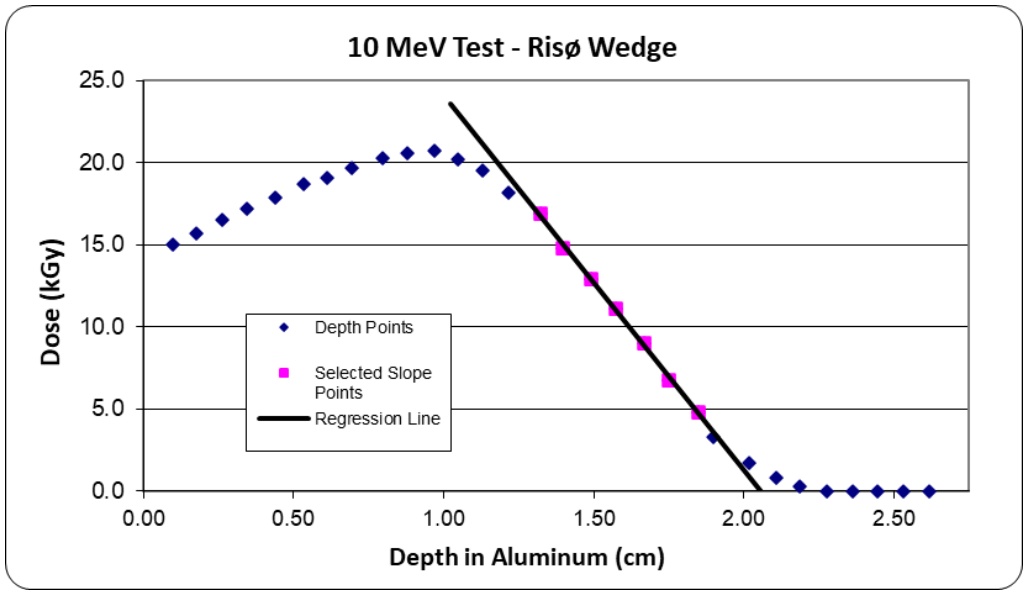
3.15. Analysis of Wedge Data

3.15.1. Plot the depth-dose profile using depth on the x-axis and dose (kGy) on the y-axis of a graph using depth values provided in Table 1 in Annex 1 below.

3.15.2. Determine the slope of the depth-dose profile and y-intercept of the tangent to the slope.

3.15.3. The depth information for each position is provided in the GEX Product Specification and Usage document for the Part No. of the Energy Wedge Array Card being used.

3.15.4. Depending on the system energy, the user may adjust the quantity and location of points that are used to define the slope that determines the intercept of the x axis. Some experimentation may be necessary to determine the "ideal" points used for the slope.



10 MeV Test using an array of B3 dosimeters at increasing depth in the P4701 Risø Aluminum Wedge

3.15.5. Refer to Annex A3 and A4 of ISO/ASTM 51649:2015(E) Standard Practice for Dosimetry in an Electron Beam Facility for Radiation Processing at Energies Between 300 keV to 25 for details on depth-dose measurement and estimation of electron energy from the results. The user may wish to use equations A4.4 and A4.5 for estimating energy of non-monoenergetic accelerators such as linear electron accelerators and A4.14 through A4.16 for near monoenergetic accelerators.

ACCESSORIES

GEX Part No.	Description
B3110 or B3112	Energy Wedge Card Arrays for Risø Wedge
B3150	Energy Wedge Card Array for GEX and Risø Wedges

LIMITATIONS/PRECAUTIONS

- The wedge is heavy and has sharp edges; it should be handled with care to avoid dropping which can damage the wedge rendering the results from it suspect or blatantly incorrect.
- The posts can bend, break, or dislodge if the wedge is dropped or mishandled.
- Do not place materials such as rubber bands around the wedge to hold it together during irradiation. No material should interfere between the incident electrons and the surface of the wedge. Securing with tape along the outer edges away from the interior dosimeters is acceptable.
- It is suggested to never use packaging tape to secure the wedge. This type of tape may become permanently adhered to or leave residue on the wedge that may not be desirable.
- The wedge does not require any calibration or re-certification at any time.

HEALTH/ENVIRONMENTAL INFORMATION

The wedge is fabricated from nearly pure aluminum. There are no health or environmental advisories.

REFERENCES

1) ISO/ASTM 51649 - Standard for Dosimetry in an Electron Beam Facility for Radiation Processing at Energies Between 300 keV and 25MeV.

RELATED DOCUMENTS

- GEX Doc# 100-102, Risø Wedge Array Card – Product Specifications and Usage (PSU)
- GEX Doc# 100-143, Energy Wedge Array Card – Product Specifications and Usage (PSU)

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