

FOIL COLLIMATORS

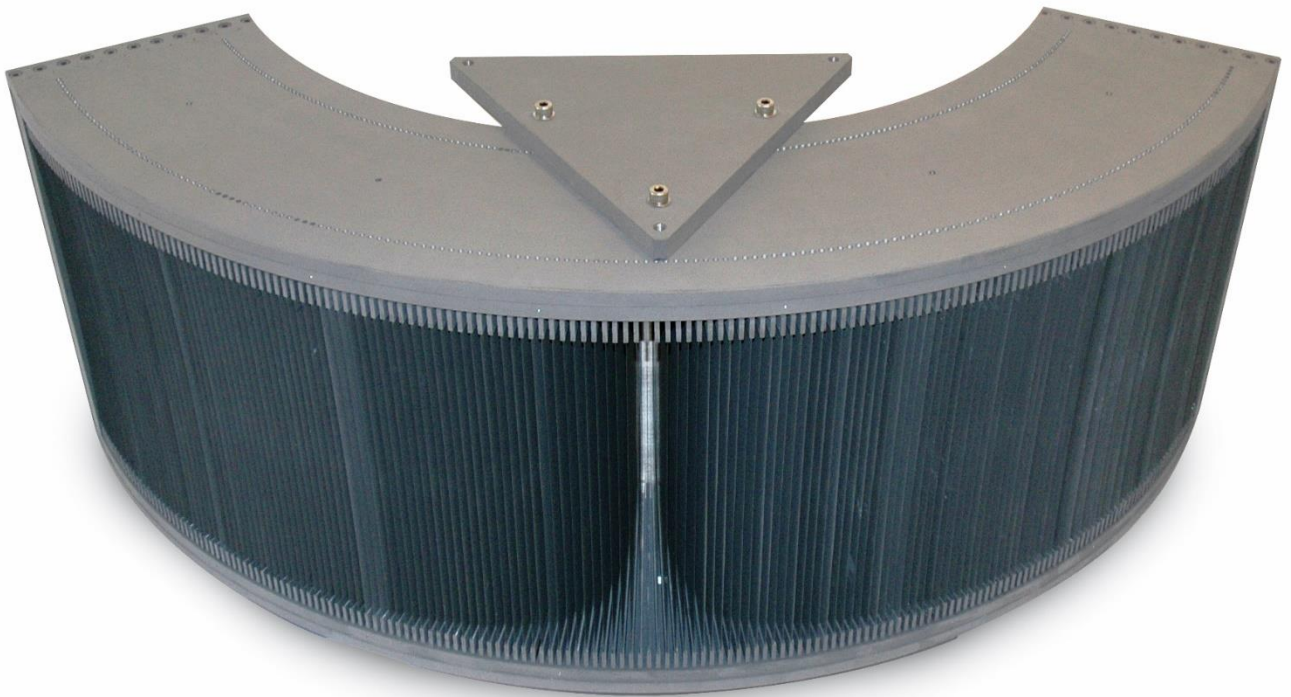


JJ X-RAY

Danish Science Design

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Foil Collimators

Building on thorough experience, JJ X-Ray has over the years provided numerous of collimators to both neutron and x-ray communities all over the world.

Our collimators are designed to meet each customers specific needs and in this catalogue, you will find a small extract of our portfolio. The examples illustrate the variety of designs and geometries.

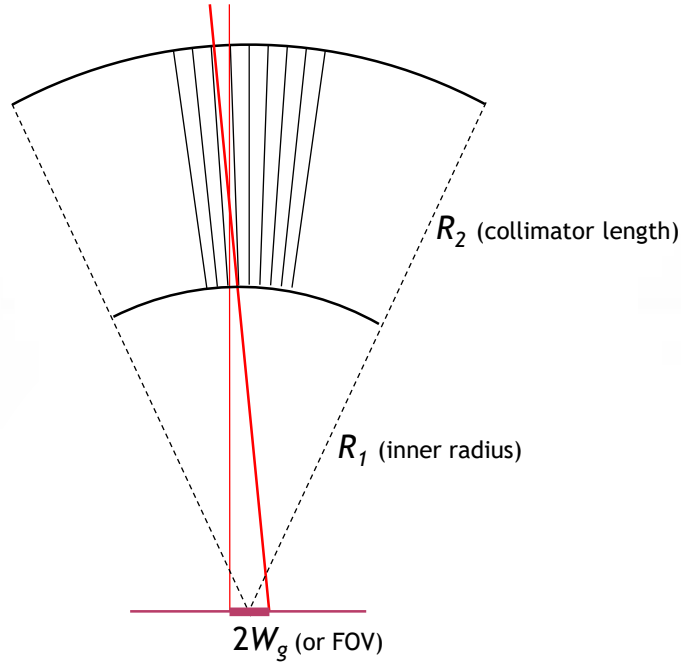
The collimating foils are typically made of thin PETP or Kapton sheets with a coating of gadolinium oxide (Gd_2O_3) or enriched Boron-10 Carbide ($^{10}B_4C$). The individual foils are supported using a stretch-foil technique where they are positioned and slightly stretched between accurately machined spacers. The result is a robust and cost efficient solution.

Some designs will, however, require additional solutions, such as individual tensioning of the foils and unique tools for generating some of the more complex geometries. Non-magnetic materials and vacuum compatibility are also common features.

The profound knowhow that we have gained, under such customized conditions, is an invaluable part of what JJ X-Ray applies to each and every one of our collimators.

Definition and Calculation of Gauge Width

Two important design parameters for both radial and double converging collimators are the gauge width and the angular foil separation.



The angular foil separation, α can be calculated as:

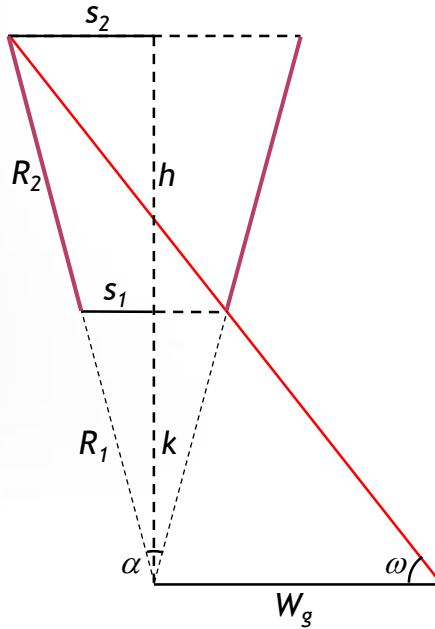
$$\alpha = 2 \sin^{-1} \left(\frac{W_g}{2} \cdot \frac{R_2}{R_1 R_2 + R_1^2} \right) \quad (1)$$

where W_g is the gauge width, R_1 is the inner radius of the foils and R_2 is the length of the foils. The intensity distribution through one collimator channel is approximately triangular, and thus the W_g is approximately $\text{FWHM}(\text{FOV}) \cong \text{FOV}/2$

The gauge width is then given by:

$$W_g = 2 \sin \left(\frac{\alpha}{2} \right) \left(\frac{R_1^2}{R_2} + R_1 \right) \quad (2)$$

The calculations of α and W_g is illustrated in the following figure with two succeeding foils.



$$h = R_2 \cos \frac{\alpha}{2}$$

$$k = R_1 \cos \frac{\alpha}{2}$$

$$s_1 = R_1 \sin \frac{\alpha}{2}$$

$$s_2 = (R_1 + R_2) \sin \frac{\alpha}{2}$$

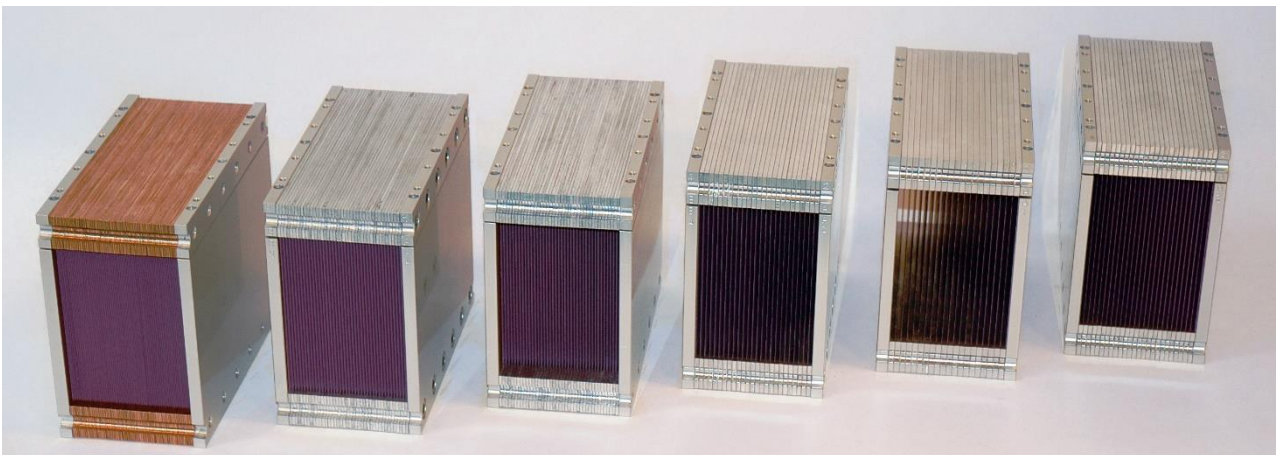
$$\frac{S_2 + w_g}{h + k} = \frac{S_1 + S_2}{h} \Rightarrow w_g = S_1 + \frac{k}{h} (S_1 + S_2) \Rightarrow$$

$$w_g = R_1 \sin \frac{\alpha}{2} + \frac{R_1 \cos \frac{\alpha}{2}}{R_2 \cos \frac{\alpha}{2}} \left(R_1 \sin \frac{\alpha}{2} + (R_1 + R_2) \sin \frac{\alpha}{2} \right) =$$

$$2 \sin \frac{\alpha}{2} \left(R_1 + \frac{R_1^2}{R_2} \right)$$

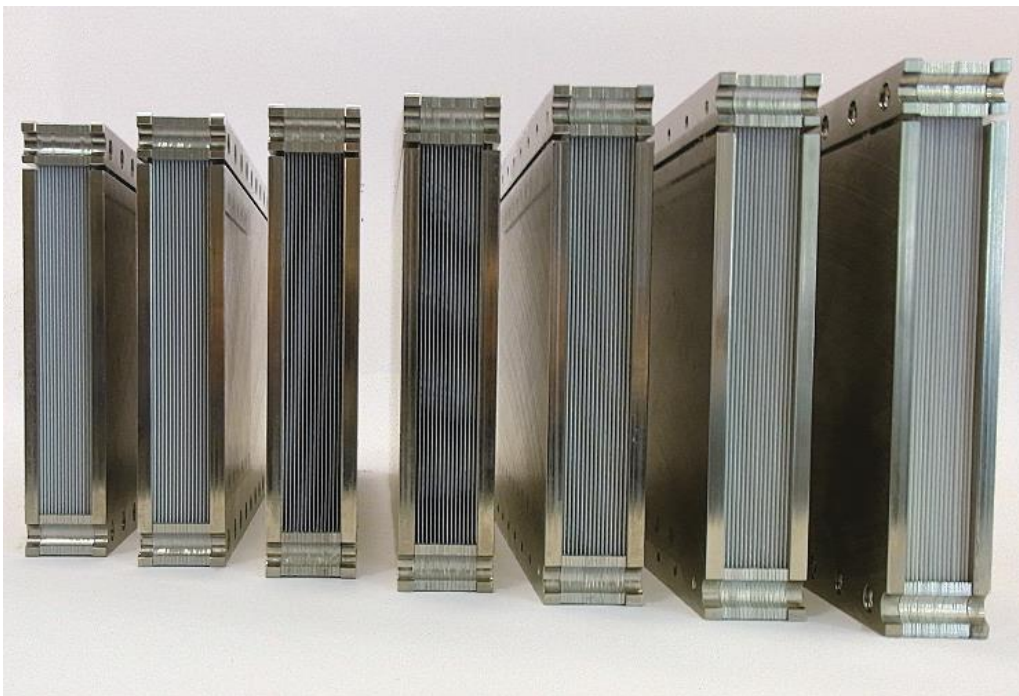
20', 40', 60' and 80' Soller Collimators

Key Facts	
Geometry	Soller (linear)
Collimation	0.33°, 0.66°, 1.00°, 1.33°
Overall dimensions w x h x l (mm)	75.40 x 127.00 x 146.00
Aperture dimensions w x h x l (mm)	62.70 x 90.00 x 129.00
Number of foils	74, 42, 28, 21
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.08 mm
Spacer thickness	0.75 mm, 1.5 mm, 2.25 mm, 3.0 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	-



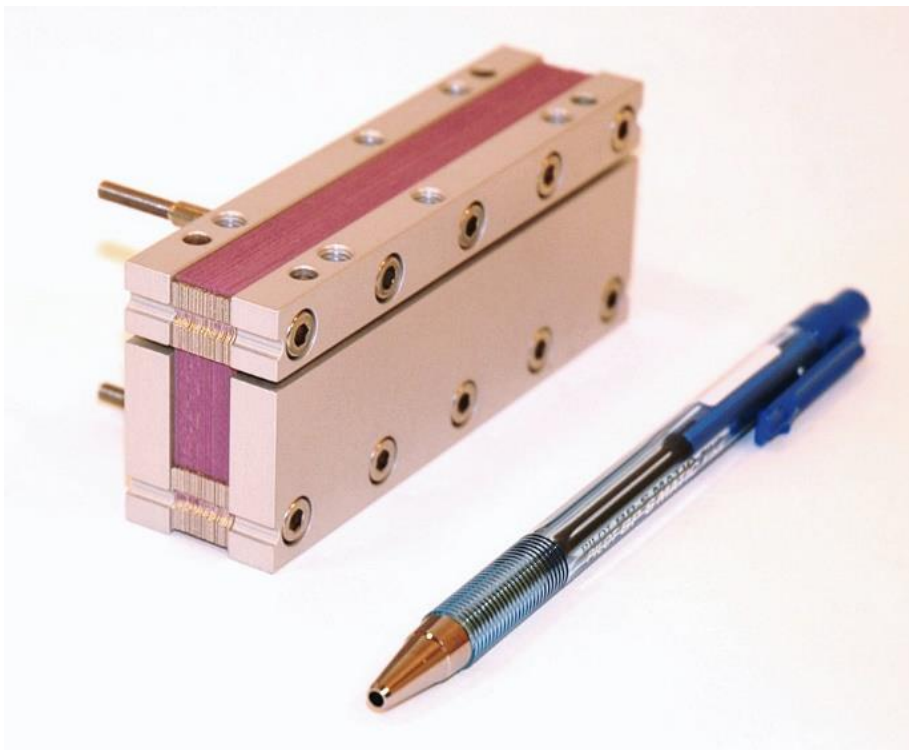
44 Soller 10' Collimators

Key Facts	
Geometry	Soller (linear)
Collimation	0.167°
Overall dimensions w x h x l (mm)	29.12 x 150.00 x 352.00
Aperture dimensions w x h x l (mm)	19.00 x 121.00 x 343.80
Number of foils (mm)	15
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.08 mm
Spacer thickness	1.00 mm
Frame material	Stainless steel
Spacer material	Stainless steel
Other features	-



X-Ray Soller Collimator

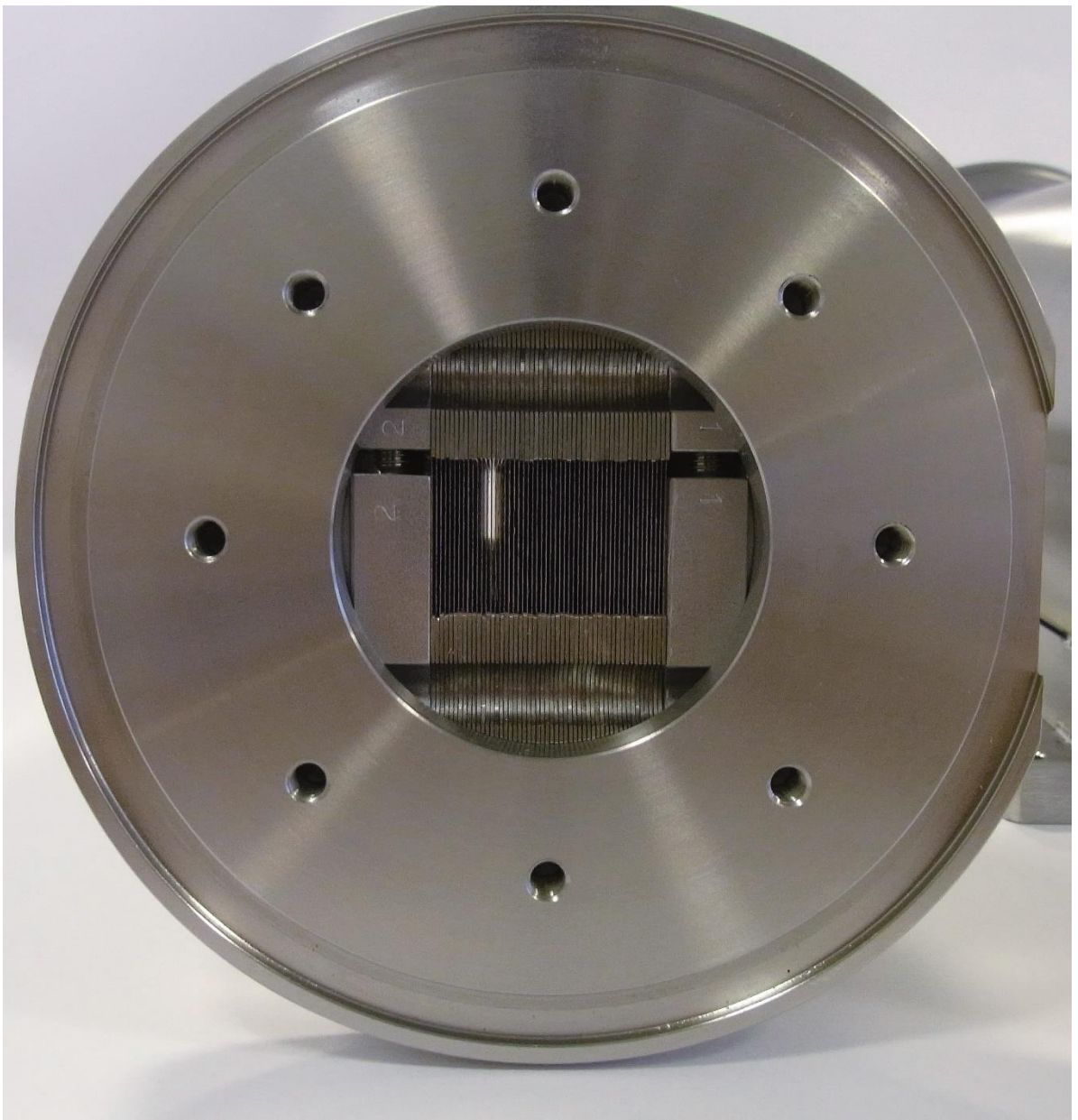
Key Facts	
Geometry	Soller (linear)
Collimation	3.5 mrad, 0.2°
Overall dimensions w x h x l (mm)	40.28 x 52.00 x 125.60
Aperture dimensions w x h x l (mm)	20.00 x 10.00 x 114.60
Number of foils	42
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.07 mm
Spacer thickness	0.40 mm
Frame material	Aluminum
Spacer material	Stainless Steel



Soller in Vacuum Tube

Key Facts	
Geometry	Soller (linear)
Collimation	0,11°
Overall dimensions w x h x l (mm)	62.00 x 50.44 x 331.30
Aperture dimensions w x h x l (mm)	30.44 x 20.00 x 256.00
Number of foils	52
Foil material	PETP
Coating	Aluminum
Total foil thickness	0.1 mm
Spacer thickness	0.5 mm
Frame material	Aluminum
Spacer material	Stainless Steel
Other features	Vacuum compatible





Soller Collimators in Shroud

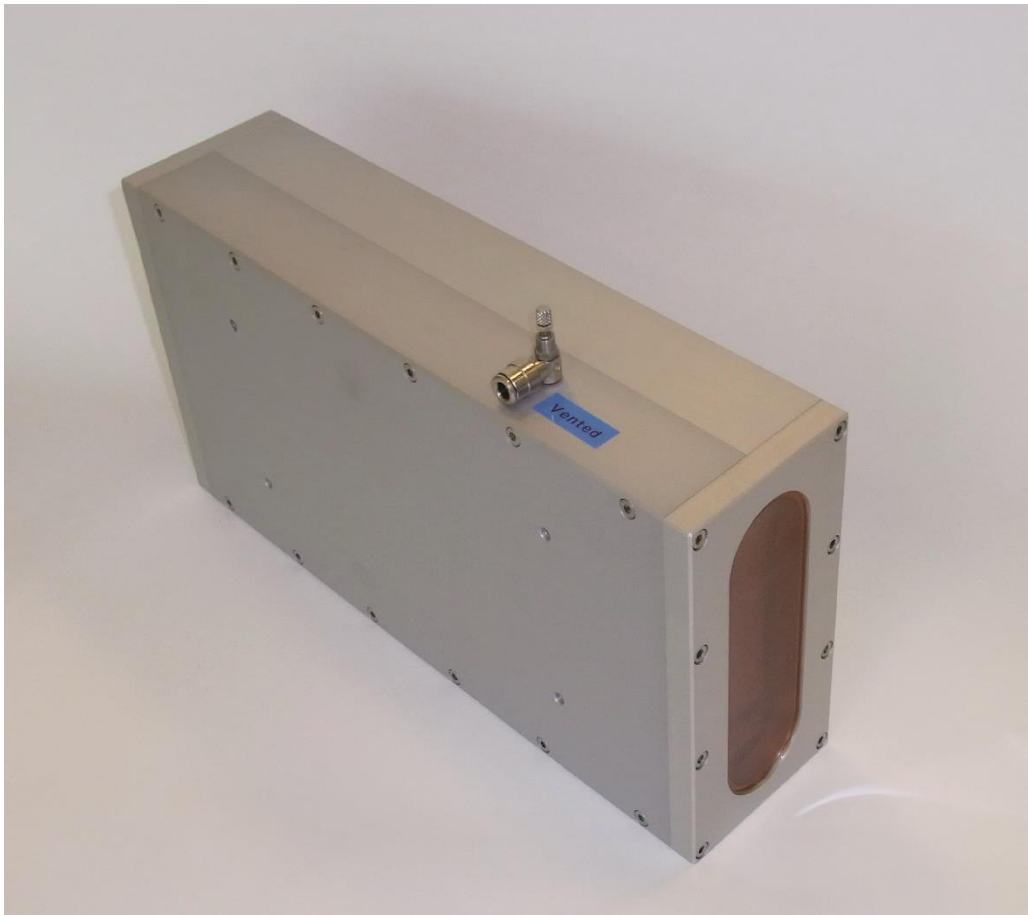
Key Facts - Short Version

Geometry	Soller (linear)
Collimation	0.11 ° (2 mrad)
Overall dimensions, shroud w x h x l (mm)	55 x 166 x 33
Aperture dimensions w x h x l (mm)	10.50 x 100.00 x 100.00
Number of foils	35
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Spacer thickness	0.2 mm
Frame material	Aluminum
Spacer material	Stainless Steel
Other features	Vacuum shroud with Kapton window

Key Facts - Long Version

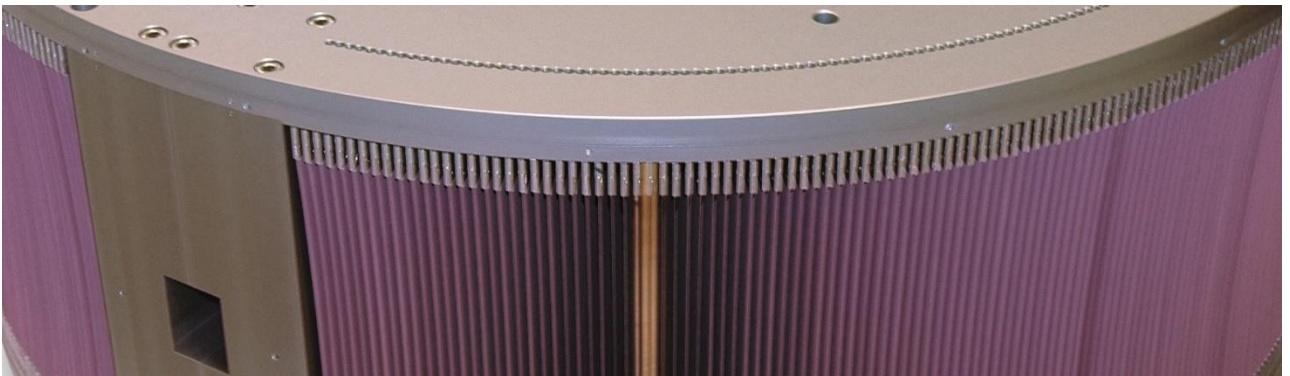
Geometry	Soller (linear)
Collimation	0.11 ° (2 mrad)
Overall dimensions, shroud w x h x l (mm)	82.50 x 159.00 x 331.00
Aperture dimensions w x h x l (mm)	37 x 92 x 298
Number of foils	61
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.09 mm
Spacer thickness	0.5 mm
Frame material	Aluminum
Spacer material	Stainless steel
Other features	Vacuum compatible, 125 micron Kapton window

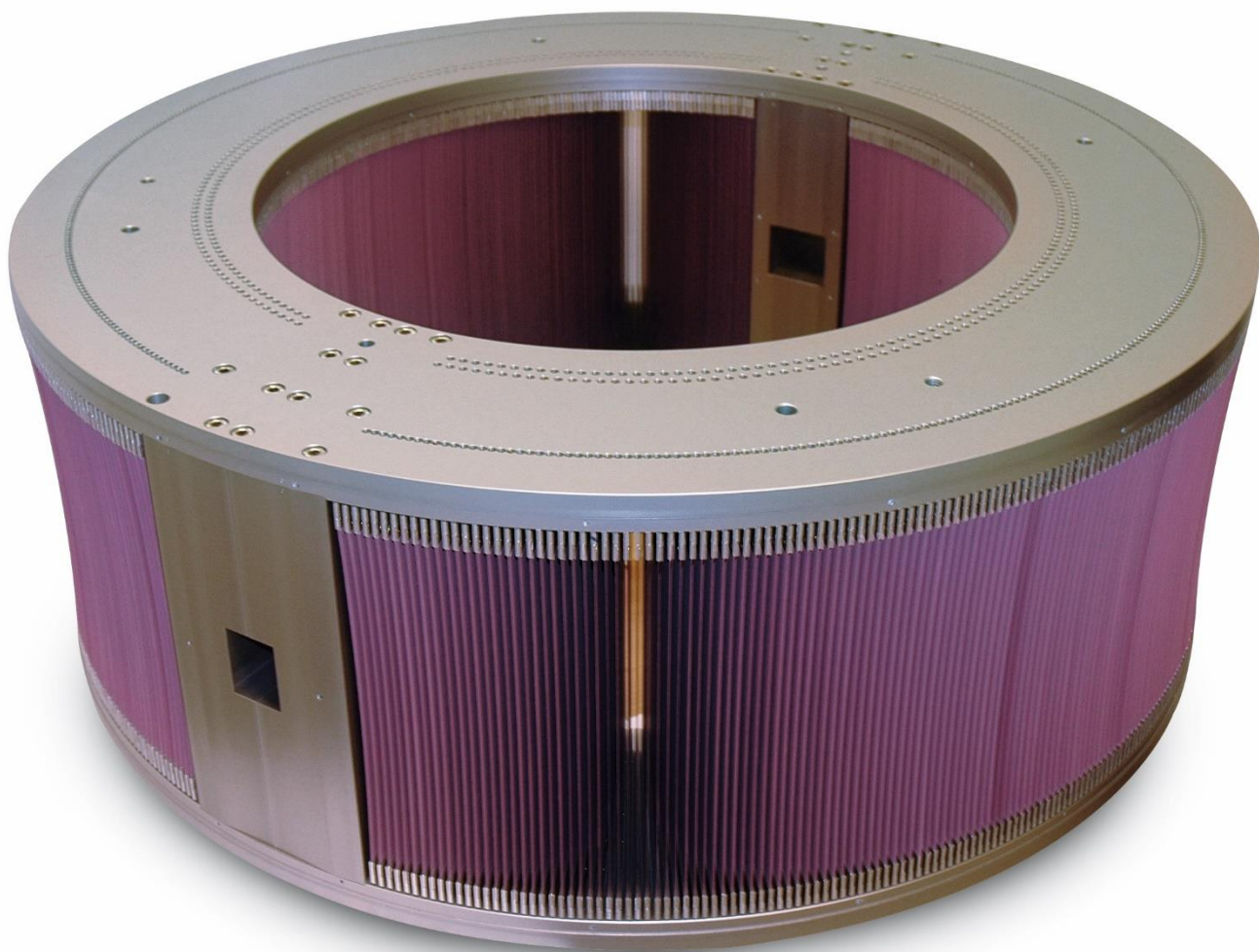




360° Circle Radial Collimator

Key Facts	
Geometry	Radial
Height of frame	340 mm
Angular dimension	360° (2 x 162°)
Inner diameter of frame	575 mm
Outer diameter of frame	922 mm
Angle between foils	0.75°
Number of foils	2 x 215
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Non-magnetic materials, vacuum compatible

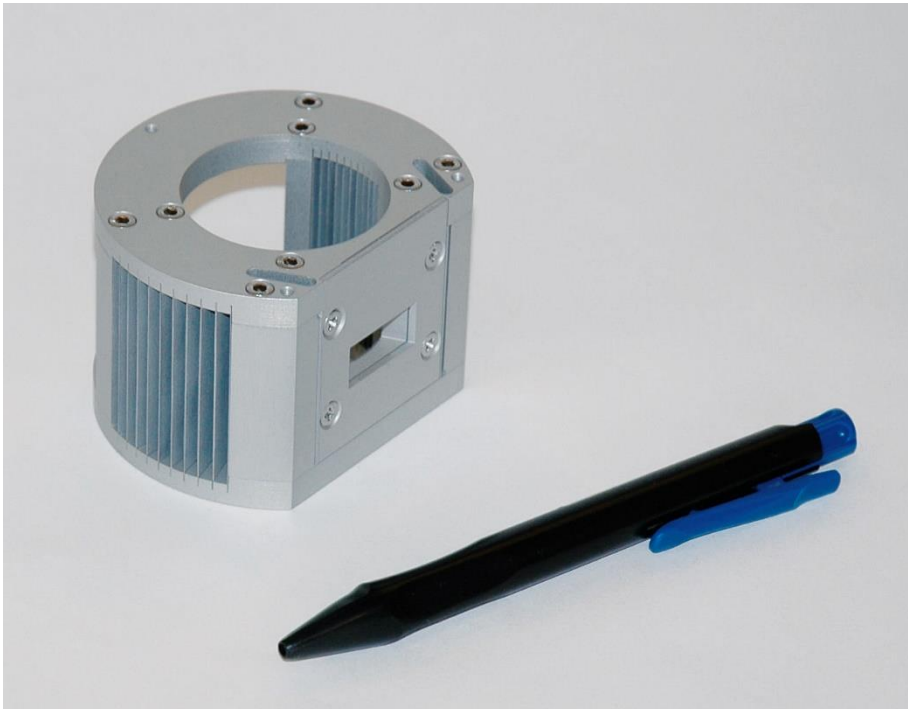




Radial Collimator for High Pressure Cell

Key Facts

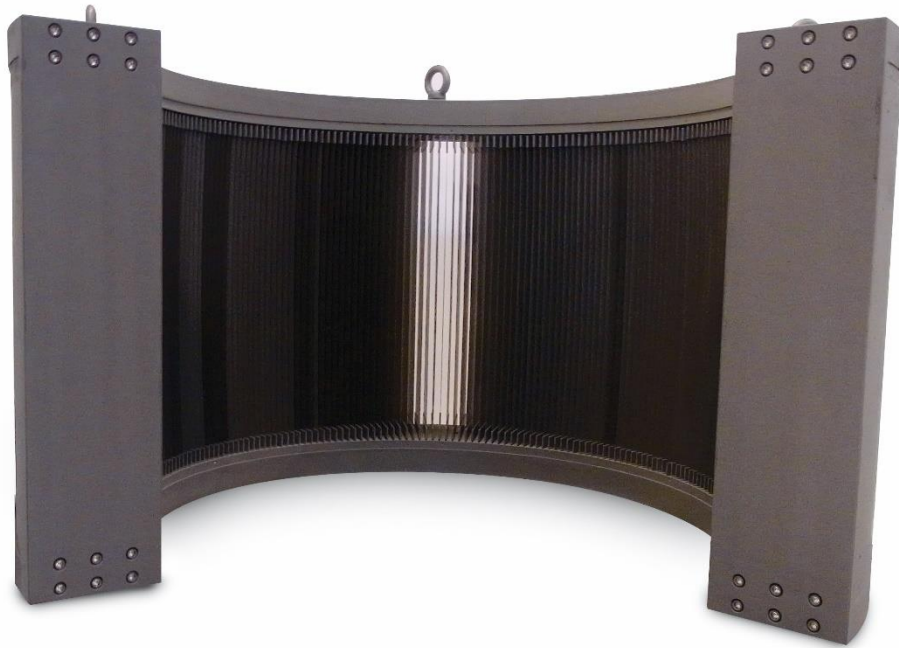
Geometry	Radial
Height of frame	50.80 mm
Angular dimension	360° (2 x 47.50°)
Inner radius of frame	42 mm
Outer radius of frame	76 mm
Angle between foils	4.75°
Number of foils	2 x 9
Foil material	Non-magnetic stainless steel
Coating	Gadolinium oxide
Total foil thickness	0.2 mm
Frame material	Aluminum
Spacer material	No spacers
Other features	Hartwood cell



Radial Collimator – Extended Height

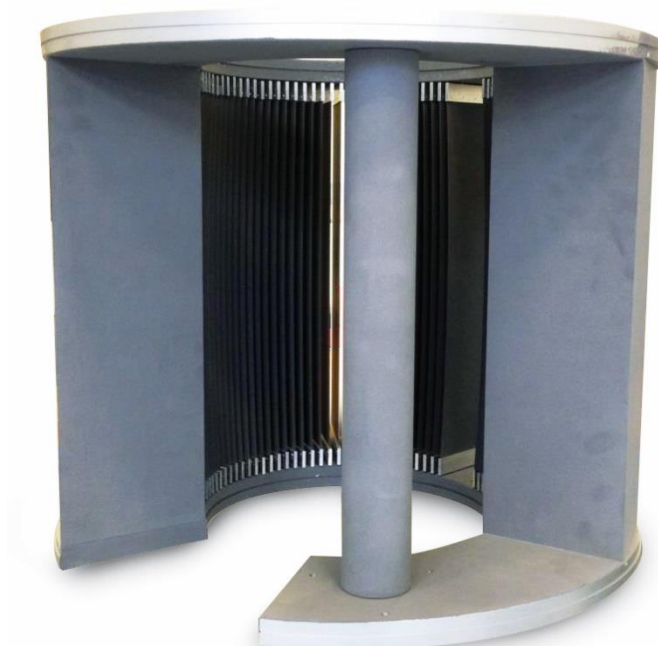
Key Facts	
Geometry	Radial
Height of frame	668 mm
Angular dimension	254° (230°)
Inner radius of frame	411 mm
Outer radius of frame	578 mm
Angle between foils	1.63°
Number of foils	142
Foil material	Kapton
Coating	Gadolinium Oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Vacuum compatible





Radial Collimator – Custom Geometry

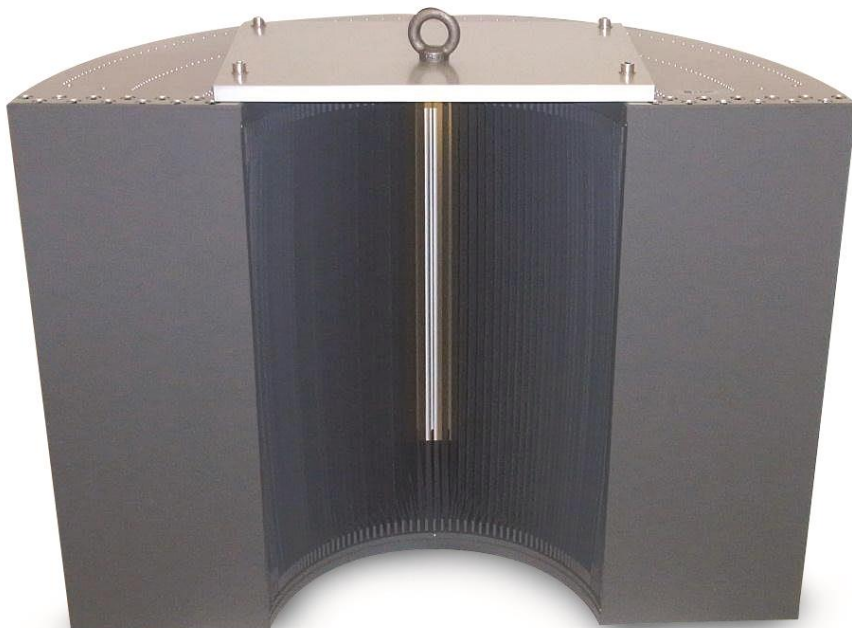
Key Facts	
Geometry	Radial
Height of frame	500 mm
Angular dimension	247° (186°)
Inner radius of frame	150 mm
Outer radius of frame	300 mm
Angle between foils	4°
Number of foils	33+8
Foil material	Kapton
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Vacuum compatible



Radial Collimator - $^{10}\text{B}_4\text{C}$ coating

Key Facts	
Geometry	Radial
Height of frame	722 mm
Angular dimension	180° (15°-165°)
Inner radius of frame	200
Outer radius of frame	490
Angle between foils	Changing
Number of foils	82
Foil material	Kapton
Coating	B10-enriched Boron Carbide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	2 levels of foils, vacuum compatible





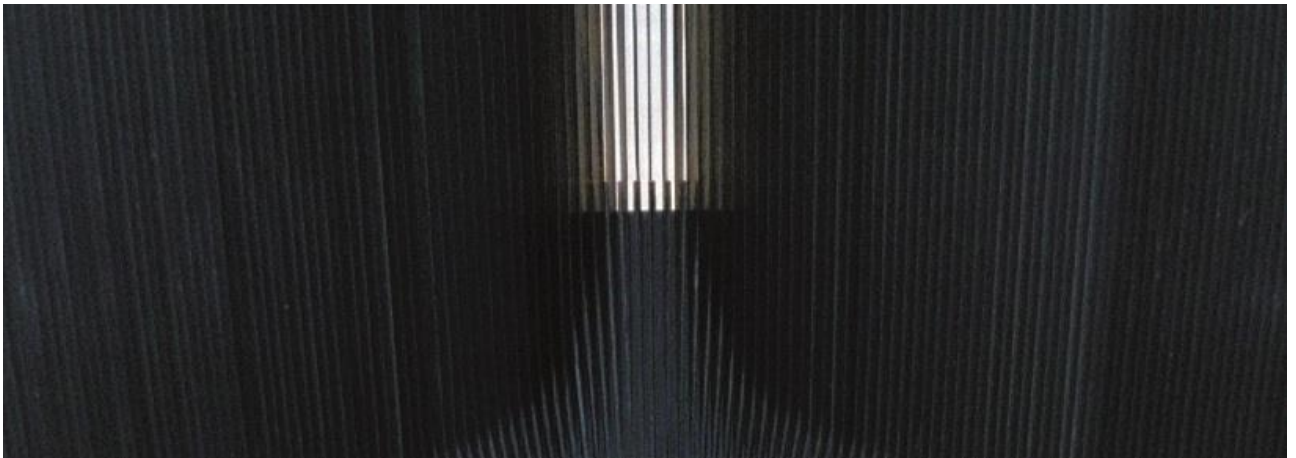
130° Radial Collimator

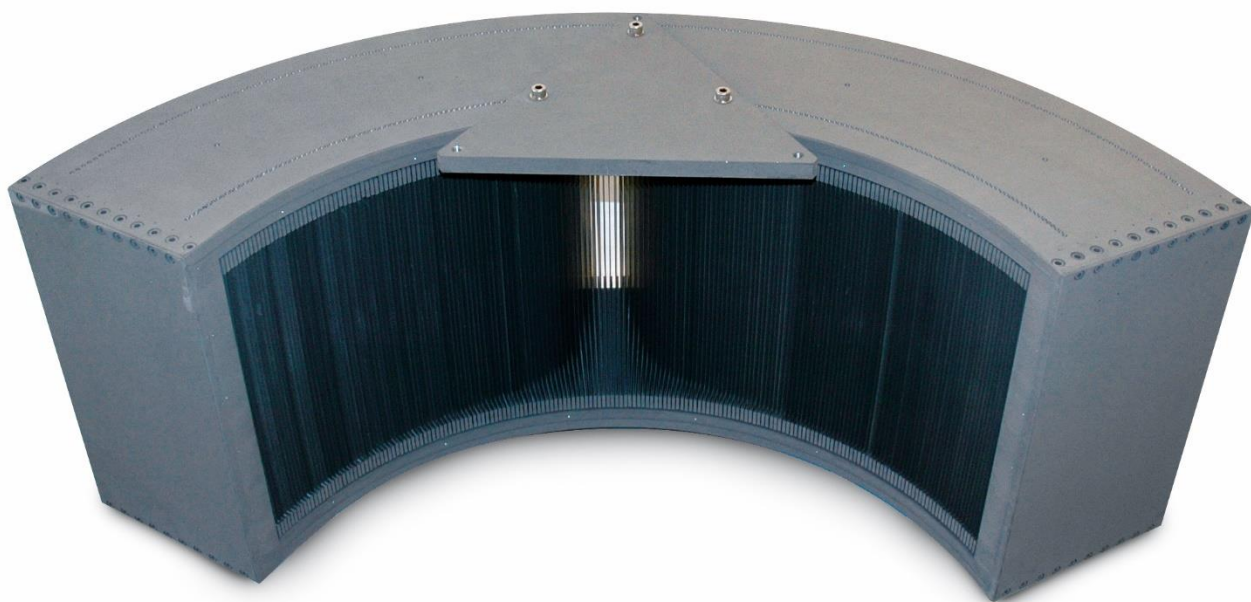
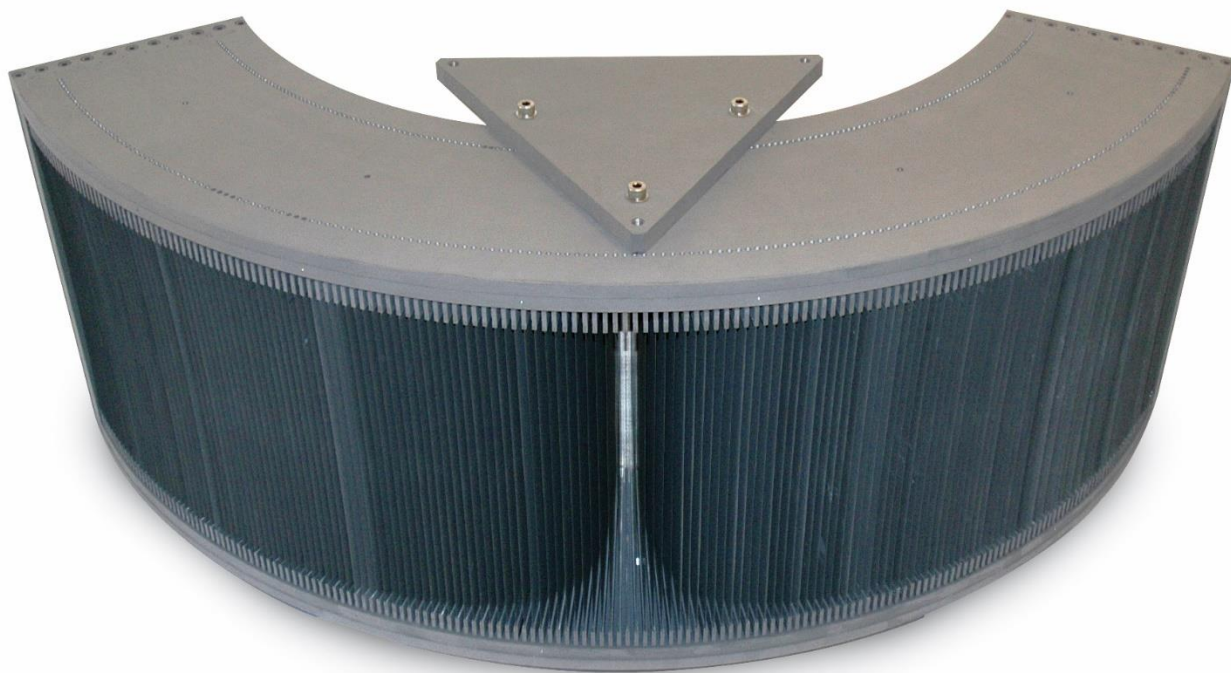
Key Facts	
Geometry	Radial
Height of frame	150 mm
Angular dimension	130°
Inner radius of frame	370 mm
Outer radius of frame	575 mm
Angle between foils	1.3°
Number of foils	99
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	-



125° Radial Collimator

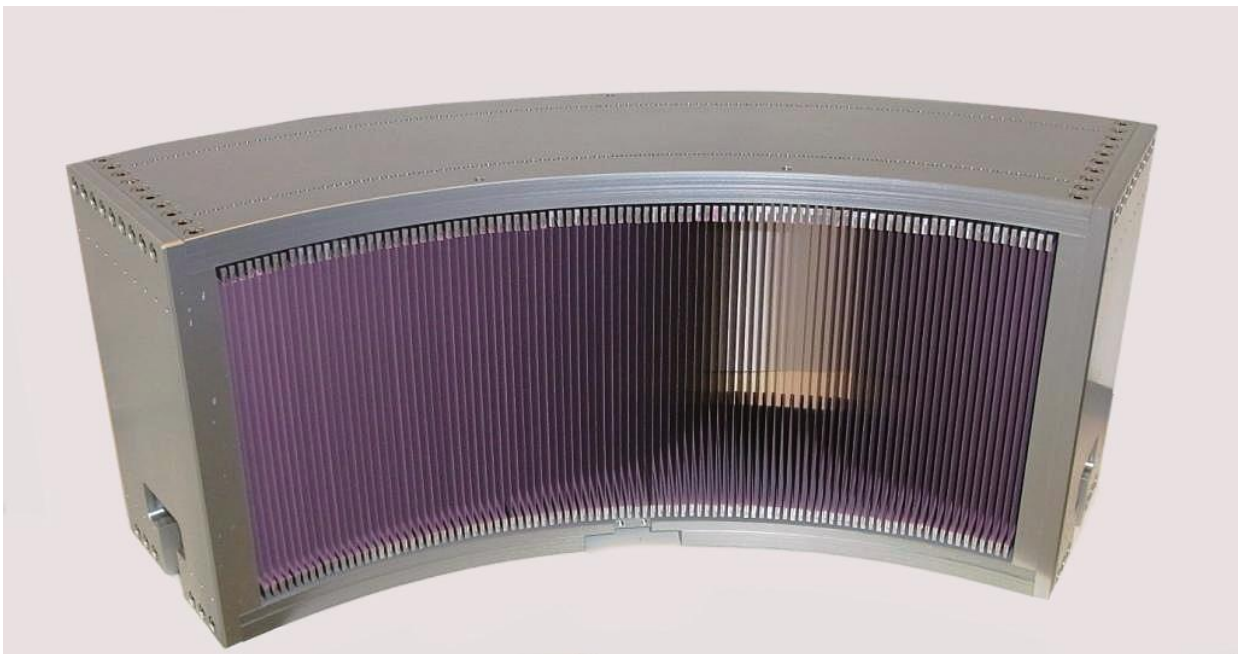
Key Facts	
Geometry	Radial
Height of frame	466 mm
Angular dimension	125.30°
Inner radius of frame	446.50 mm
Outer radius of frame	703.50 mm
Angle between foils	0.7°
Number of foils	178
Foil material	Kapton
Coating	Gadolinium oxide
Total foil thickness	0.14 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Vacuum compatible





65° Radial Collimator

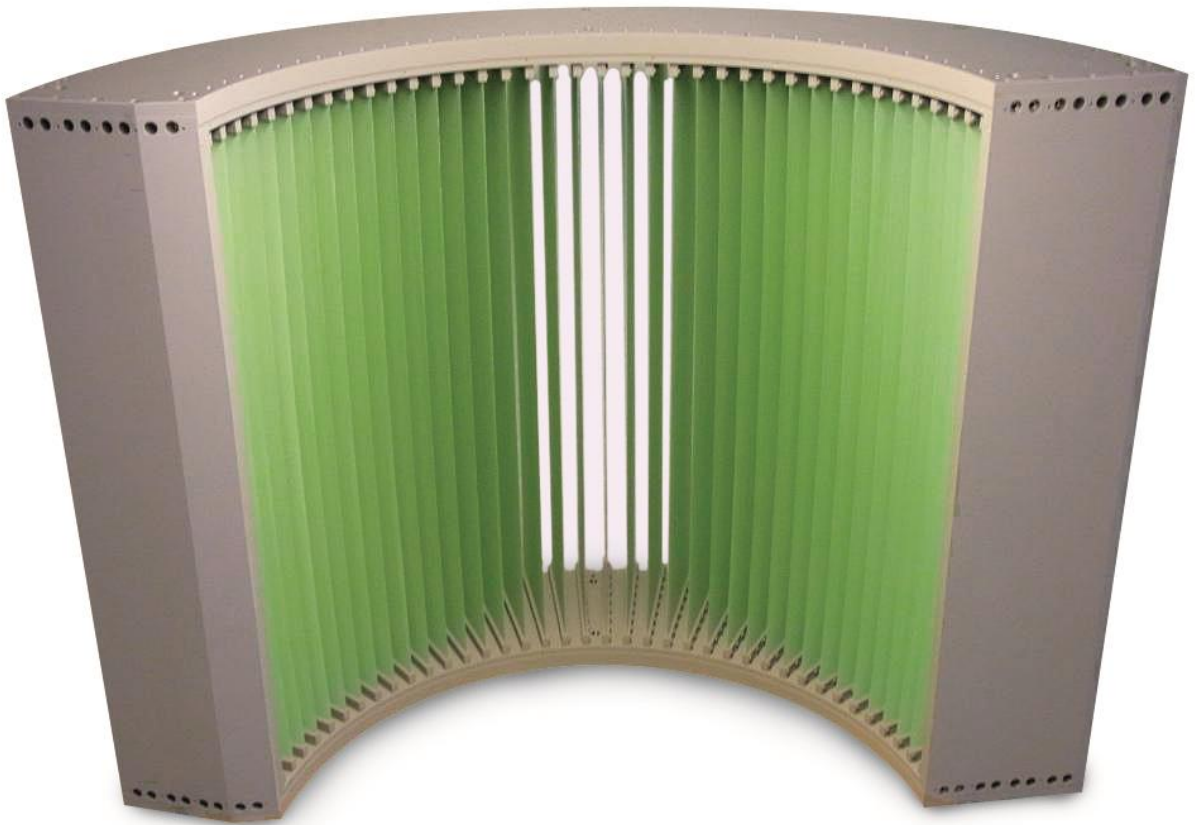
Key Facts	
Geometry	Radial
Height of frame	331.12 mm
Angular dimension	65°
Inner radius of frame	546.50 mm
Outer radius of frame	748.50 mm
Angle between foils	0.67°
Number of foils	96
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	-



150° Radial Collimator

Key Facts	
Geometry	Radial
Height of frame	888 mm
Angular dimension	150°
Inner radius of frame	400 mm
Outer radius of frame	610 mm
Angle between foils	4°
Number of foils	38
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	-
Frame material	Aluminum
Spacer material	Aluminum
Other features	-





22° Double Converging Collimator

Key Facts

Geometry	Double Converging
Frame dimensions front w x h (mm)	238.94 x 550.00
Frame dimensions back w x h (mm)	431.18 x 706.03
Vertical opening	34.50°
Horizontal collimation	21.99°
Angle between foils	0.115°
FWHM (focus)	~2 mm
Number of foils	200
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.1 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Vacuum compatible

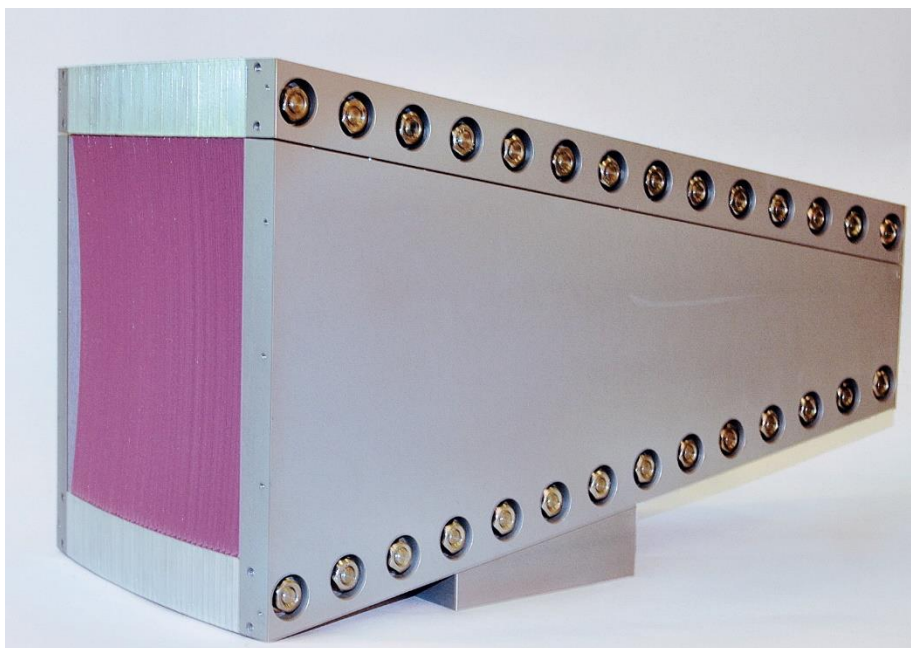




17° Double Converging Collimator

Key Facts

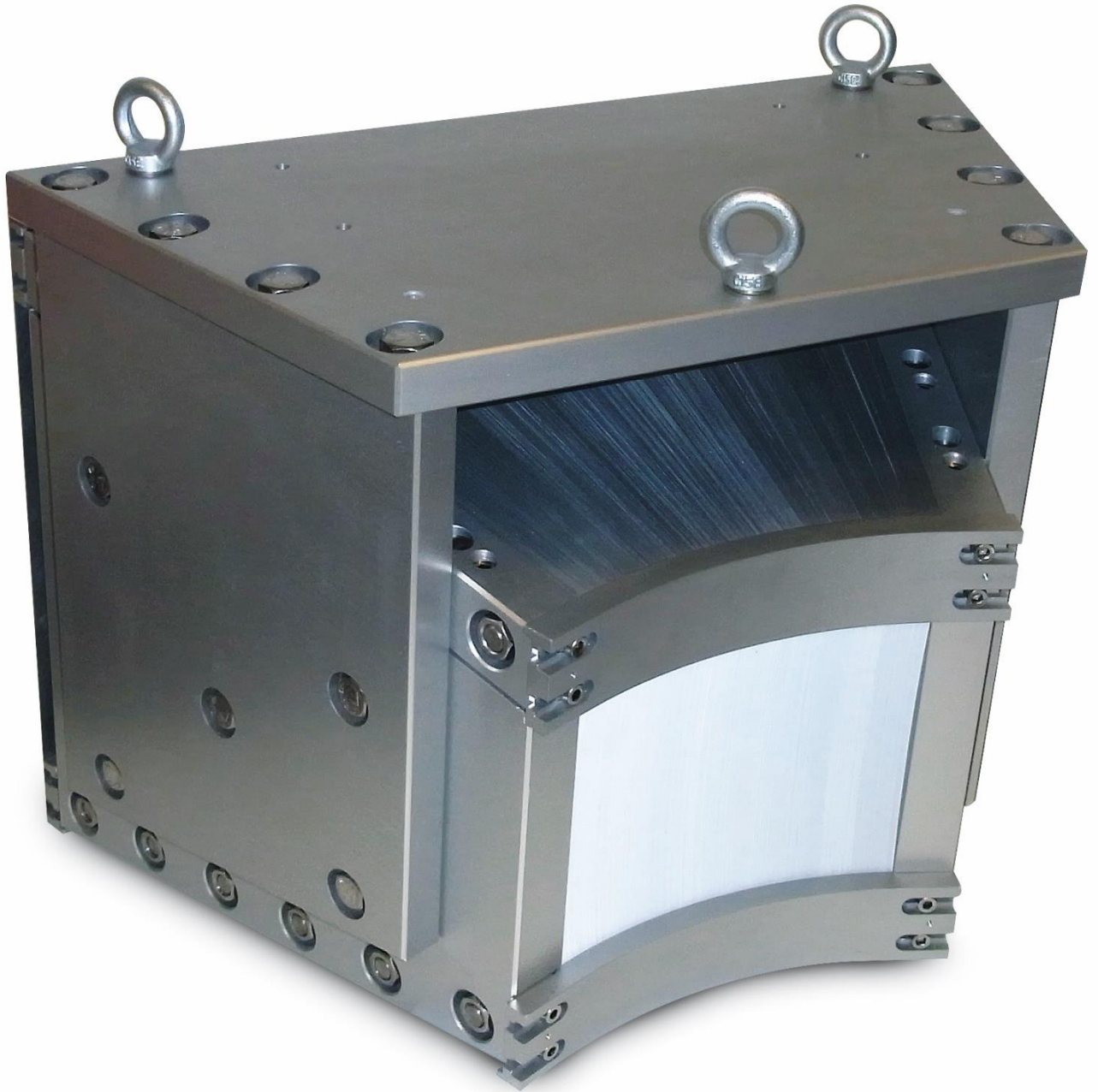
Geometry	Double Converging
Frame dimensions front w x h (mm)	140.67 x 108.57
Frame dimensions back w x h (mm)	305.06 x 271.16
Vertical opening	17°
Horizontal collimation	17°
Angle between foils	0.4146°
FWHM (focus)	2 mm
Number of foils	40
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.95
Frame material	Aluminum
Spacer material	Aluminum
Other features	Bottom plate



40° Double Converging Collimator

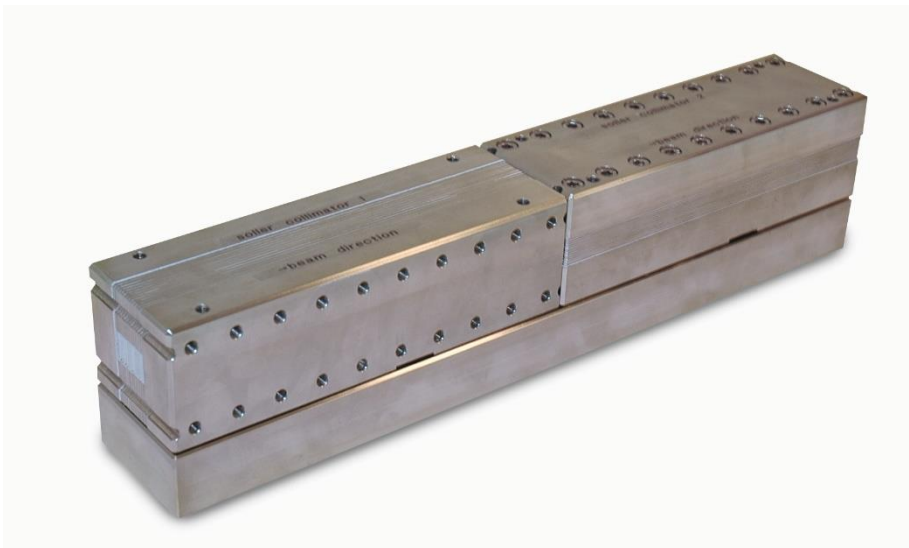
Key Facts	
Geometry	Double convergence
Frame dimensions front w x h (mm)	309.00 x 316.88
Frame dimensions back w x h (mm)	620.00 x 479.30
Vertical opening	20.28°
Horizontal collimation	40°
Angle between foils	0.16°
FWHM (focus)	1.77 mm
Number of foils	249
Foil material	PETP
Coating	Gadolinium oxide
Total foil thickness	0.08 mm
Frame material	Aluminum
Spacer material	Aluminum
Other features	Fixture

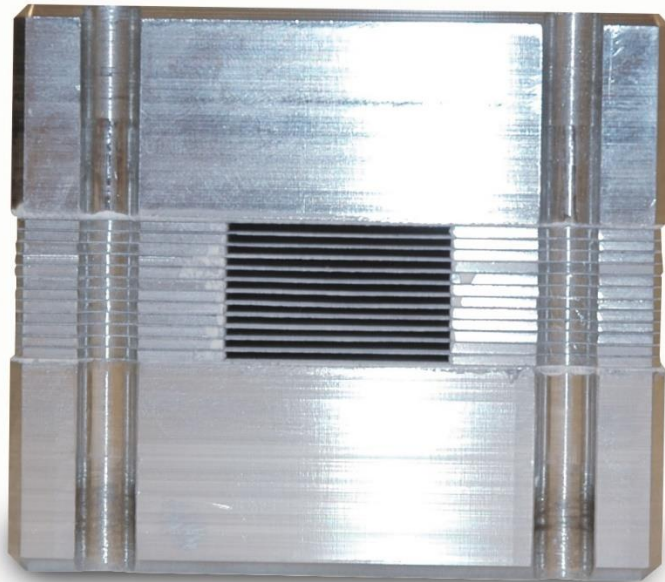
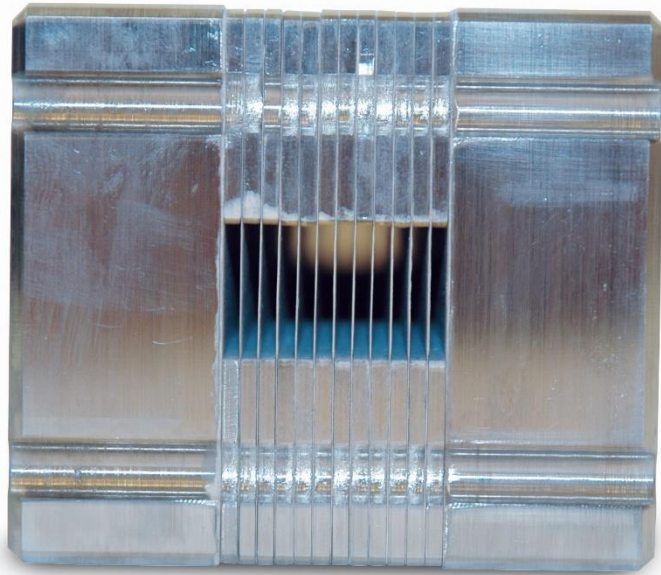




Two Combined Radial Collimators

Key Facts	
	Double convergence (two radial collimators in combination with respectively vertically and horizontally positioned foils).
Geometry	-
FWHM (focus)	-
Overall dimensions (mm)	57 x 66 x 200 (each)
Aperture dimensions (mm)	13.81 x 22.70 x 200.00 (each)
Number of foils (mm)	11
Foil material	Aluminum
Coating	Enriched boron carbide
Total foil thickness	0.11
Frame material	Stainless Steel
Spacer material	Stainless Steel
Other features	Kinematic alignment base





The JJ X-Ray Product Range

- Slit Systems (AIR, HV, UHV)
- Complete Beamline Solutions
- Spectrometers
- Refractive Optics
- Foil Collimators
- Positioning

Contact JJ X-Ray A/S

If you have any questions, concerns, request for quotations or need general advice, please feel free to contact us:

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