

Date(dd/mm/yy): 13/05/22

Authorization from financial board to proceed to hardware procurement

Component name: Enhanced specular reflector (ESR) for the Veto

PBS Code: **DS.D.TAV.REF.ESR**

PBS Name: **ESR foils procurement**

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Revision history

Version	Date	Modification	Author/Editor
0.1	13/05/2022	Initial draft for discussion on the DS-Veto call on 13/05/2022	M. Walczak

Abstract

Enhanced Specular Reflector, Vikuiti ESR (from 3M) is the reflector material of choice for the DarkSide-20k Veto [1, 2]. The material is commercially available in 17in x 17in (43,18 cm x 43.18cm) or 26in x 16in (66.04 cm x 66.04 cm) sheets. Based on the current DS-Veto design, consistent with the TDR, this note estimates the exact number of sheets to be purchased for installation in the Veto, taking the exact shapes and dimensions of the foils to be cut from the foils delivered from the supplier, as well as the number of spare foils, into account.

Financial specifications

Cost (no VAT): **110k EUR (~451 kPLN)**

Funding Agency: **Other EU** (Foundation for Polish Science)

Grant/Funds identifier: **AstroCeNT** (International Research Agenda Programme AstroCeNT (MAB/2018/7) funded by the Foundation for Polish Science from the European Regional Development Fund)

Year: **2022**

Specifications

The arrangement of ESR foils in the veto has been implemented in the CAD model both for the inner surface of the Ti tank and for the outer surface of the TPC, as shown in in Fig. 1 []. An overlap of at least ... cm has been included in the design to ensure no gaps in reflector coverage is formed due to thermal contraction.

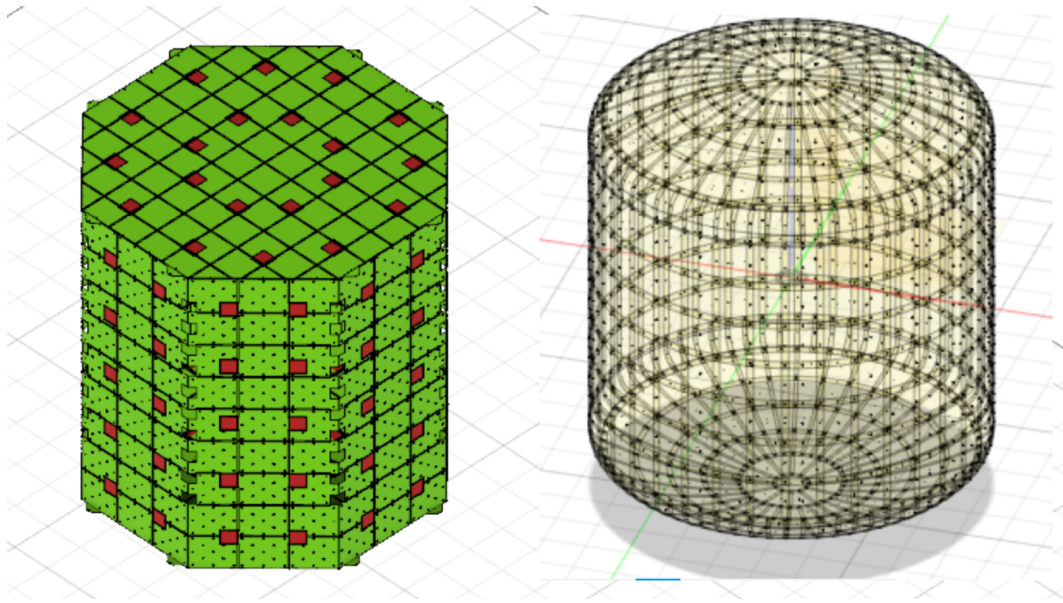


Fig. 1. CAD drawings of the TPC surface (left) and inner surface of the Ti vessel (right)

Larger sheets are primarily used for the vertical walls of both the TPC and the Ti tank, while the smaller sheets are used to cover the optical planes of the TPC and the Ti tank top and bottom caps.

The curvature of the Ti tank caps leads to a variety of trapezoid shapes to be used in that region. All unique shapes are summarized in **Tab. 1**.

Shape ID:	unique shape dimensions:			# needed	# of backups:	# OF FOILS for backup:	multiple sheet cutout:
1	430	430		122	13	13	C
2	430	360		16	2	2	
3	450	430		16	2	2	
4	375	360		16	2	2	
5	375	375		8	1	1	
6	560	465		16	2	2	
7	570	465		8	1	1	
8	560	455		16	2	2	
9	570	455		8	1	1	
10	560	470		96	10	10	
11	570	470		48	5	5	
12	570	498		8	1	1	
13	560	498		16	2	2	
14	486	600		252	26	26	
15	375	130	460	24	4	2	E
16	221	141	465	72	9	1	A
17	290	210	465	72	8	8	B
18	355	287	465	72	8	4	D
19	422	348	465	72	8	0	B
20	475	250		144	16	8	
				total: 1102		tot backup: 18	-- 17" foils
						75	-- 26" foils

Tab. 1. Table shows the dimensions of rectangular and trapezoid shapes in mm together with the number of each shape, number of backup cutouts and number of foils needed for the backups.

In certain cases multiple shapes can be cut out from a single sheet, which allows for a more efficient use of the material as shown in Fig. 2.

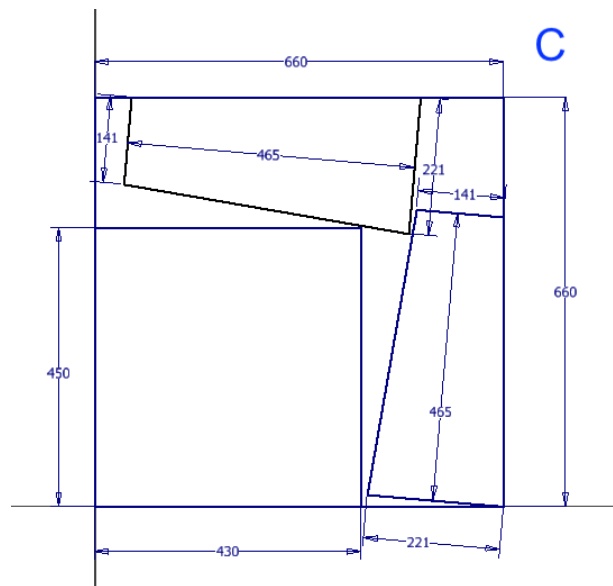


Fig. 2. Example stencil showing optimized usage of the 26in x 26in ESR foils for multiple shapes.

Number of foils in each of the foreseen shapes, including at least 10% of spare foils (rounded up to an integer number of foils), have been estimated, and translated to the number of sheets needed, with an additional 10% contingency on top of that (hence, overall material sufficient for ~20% of spares), see **Tab. 2**.

		with backup:
# of 17 x 17 foils =	162	180
# of 26 x 26 foils =	940	
optimized # of 26 x 26 foils=	686	761

Tab. 2: Number of needed ESR foils without (left) and with backup cutouts (right) for two foil sizes.

Based on that the final specification on the number of reflector foils to be purchased is:

Proposed final order with backup (foils are purchased in units of 20)	
# of 17 x 17 foils =	200
# of 26 x 26 foils =	840
estimated final USD:	101,560
estimated final PLN with VAT:	554,639

The required reflectance should be greater than **98%** (as per ESR specs sheet [3]).

The foil thickness should be **65 microns**.

Both sides of the reflector sheets should be covered with a protective removable film.

Reflector material is to be 100% polymeric

References

[1] Veto document

[2] TDR

[3] CAD model, private communication with Roberto Cereseto and Alessio Caminata,
9/05/2022

[4] ESR specs sheet