



# VERROTEC

Testing, inspection and certification  
body (RPF14)

Content: **Test Report**

Project: Bohle VetroMount Side profile Y

Project number: VT 19-0954

Report: VT 19-0954 - 07

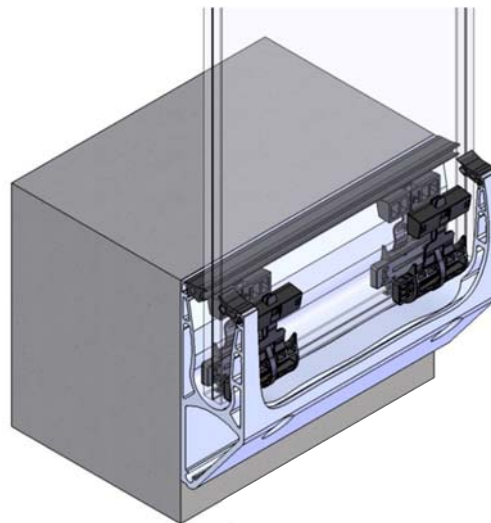
Contract: Impact test with twin-tyre impactor according to DIN 18008-4 to regulate the usability in form of an "Allgemeines bauaufsichtliches Prüfzeugnis (AbP)"

Client: Bohle AG  
Dieselstraße 10  
D-42781 Haan

Date: 10<sup>th</sup> November 2020

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-	-	10.11.2020



# 1. General

The company VERROTEC GmbH located in Mainz (Germany) was assigned by the company Bohle AG located in D-42781 Haan to verify the guardrail effect of the VetroMount Side profile Y balustrade system by impact tests.

In this test report, the relevant glass formats, including their direct substructure, are evaluated under impact loading. The glazing must resist the impact load of category B according to the DIN 18008-4. Additionally, tests were conducted with a higher fall height.

**Subject of this report is only the resistance of the balustrade system under impact loading. The verification of the glass under static loads shall be executed separately.**

A transfer of the results of this test report is not permitted, unless within the scope of this report.

Note:

Glazing with guardrail function for which the usability has to be verified by an “Allgemeines bauaufsichtliches Prüfzeugnis” (AbP) are listed under Verwaltungsvorschrift Technische Baubestimmungen NRW (VV TB NRW) No. C 4.12. The guardrail system to be evaluated in this report shows no relevant deviation from DIN 18008-4. The system concerned is a product according to Verwaltungsvorschrift Technische Baubestimmungen NRW (VV TB NRW) from the 7<sup>th</sup> December 2018, last changed on 14<sup>th</sup> June 2019.

For these reasons, the usability of this system has to be regulated in form of a

**“Allgemeines bauaufsichtliches Prüfzeugnis” (AbP)**

by a notified laboratory according to “Landesbauordnung”. AbPs are valuable in all federal states of Germany for 5 years. The validity can be extended.



## 2. Remarks

- Glazing with guardrail function for which the usability has to be verified by an “Allgemeines bauaufsichtliches Prüfzeugnis” (AbP) are listed under administrative provision – technical building rules section C3 no. C 3.18 or section C4 no. C 4.12 respectively.
- The edge protection profile for balustrade systems is to be executed according to the requirements of DIN 18008-4.
- Material compatibilities are to be verified when using different plastic materials (silicon, PVB, etc.).
- Corrosion of metallic materials is to be prevented by suitable means (e.g. different alloy choice, coating, prevention of contact corrosion, constructive means, etc.). Corrosive categories are to be considered object related.
- Due to material and production related nickel sulphide inclusion, tempered glass is susceptible to spontaneous breakage of glass. We recommend the general use of tempered glass with Heat Soak Test. Due to the additional Heat Soak Test the risk of glass breakage due to nickel sulphide inclusion is considerably minimized.
- A constraint-free bearing of the glass is to be ensured.
- Contact between metal and glass or glass and glass are to be avoided permanently.
- In case of glass breakage, the affected areas are to be secured, the broken glass panes are to be replaced immediately.
- This document is only valid for the tested system. The results of this document are only valid if the boundary conditions defined in this document are provided on-site. This is to be verified on-site.
- This document is to be published unabridged; partial publication requires the permission of Verrotec GmbH.
- A transfer of the results on other positions and/or systems is not allowed, unless described within this document.
- The company VERROTEC GmbH located in Mainz, Germany, takes responsibility only for the appraised construction parts under the described preconditions. If there are any changes or discrepancies, we demand notification.
- The written results are intended exclusively for the client, so that no claims can be made by third parties. In addition, Verrotec GmbH does not assume any obligation in favor of third parties or any liability towards third parties from and in connection with the services rendered for the customer.



### 3. Standards and guidelines

The following standards are basis for the present report:

- [1] DIN 18008-1 Glass in Building – Design and construction rules – Part 1: Terms and general bases
- [2] DIN 18008-2 Glass in Building – Design and construction rules – Part 2: Linearly supported glazing
- [3] DIN 18008-4 Glass in Building – Design and construction rules – Part 4: Additional requirements for barrier glazing

### 4. Current plans

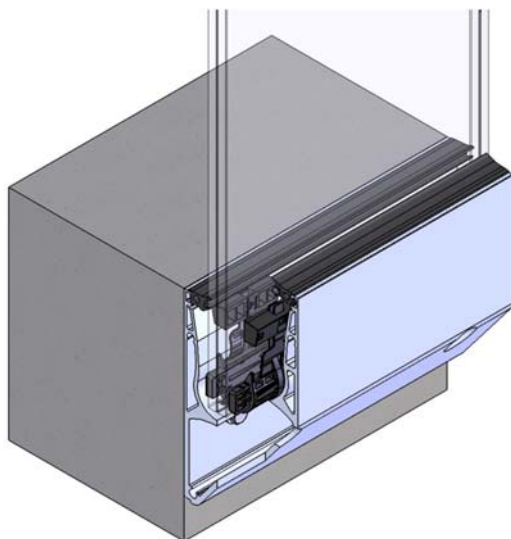
The following current plans are the basis of this document:

- [4] Installation drawing VetroMount Y-profile No. 0005609 from 03.09.2020
- [5] SideL-Profile: 3953-TopL from 10.02.2020
- [6] Handlauf (handrail): BO\_5215248 from 17.09.2018.
- [7] Handlauf (edge protection): BO\_5215257 from 17.09.2018.
- [8] Kantenschutz + Acrylband 0005543 vom 15.06.2020.

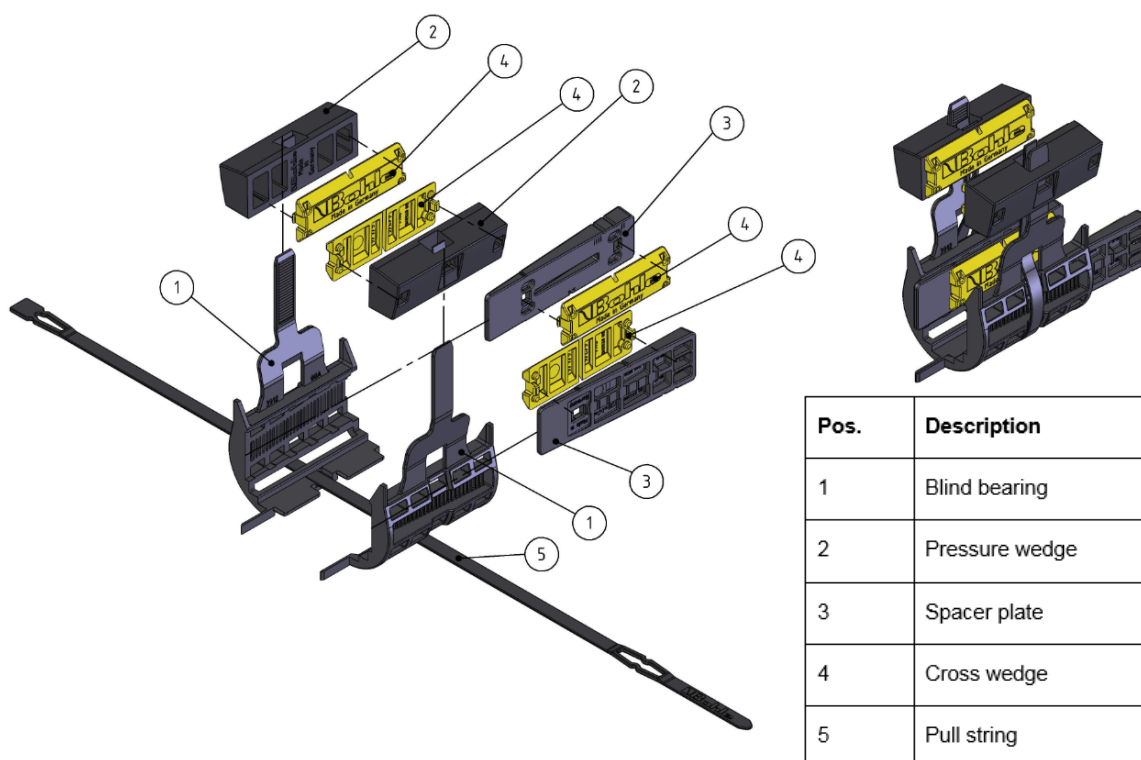




The clamping is secured with the glass pane bearings at least every 250 mm, with at least two bearings per glass pane. The glass pane bearing consists of a blind bearing with two oppositely situated cross-wedges and pressure wedges shown in Image 4. The glass pane bearings have different attachments for each glass assembly, which are illustrated in Table 1.



**Image 3** Isometry of the glass pane bearing of VetroMount Side profile Y



Pos.	Description
1	Blind bearing
2	Pressure wedge
3	Spacer plate
4	Cross wedge
5	Pull string

**Image 4** Exploded drawing of the glass bearing

**Table 1** VetroMount Profile Y cross section, dependent on the glass assembly

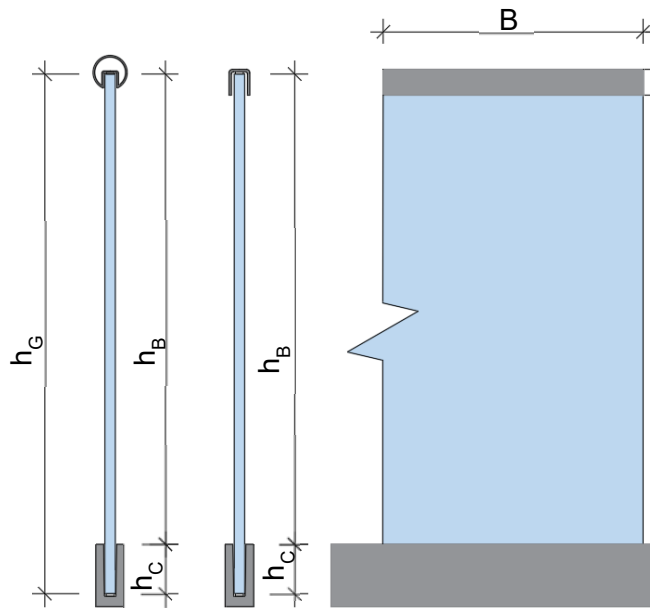
Glass assembly	12,76 mm - 13,52 mm	16,76 mm - 17,52 mm	20,76 mm - 21,52 mm
Profile section			



### 5.3 Glazing

The denomination of the glass dimensions are specified in Image 5. The maximum glass height is  $h_G = 1300$  mm and the minimum height is 400 mm. The glass panes are placed in the substructure at a height of  $h_c = 103$  or 105 mm. That leaves a glass height  $h_B$  varying between min. 300 mm and max. 1200 mm. The glass width is min. 300 mm or 500 mm depending on the glass assembly.

The VSG is made of TVG or ESG with a PVB interlayer of at least 1,52 mm.



**Image 5** Denomination of the glass dimensions

The following glass products can be used according to chapter 7:

**VSG (LSG)** laminated safety glass with PVB film according to EN 14449 taking into account the defined characteristics described in Annex A 1.2.7./2 of Verwaltungsvorschrift Technische Baubestimmungen NRW (VV TB NRW) from the 7. December 2018, last modified on 14. June 2019

Tensile strength of the PVB-interlayer  $\geq 20$  N/mm<sup>2</sup>, elongation at fracture of the PVB-interlayer  $\geq 250\%$  in case of a test temperature of 23°C and a test velocity of 50 mm/min.

or alternatively:

The interlayer shall consist of PVB, which shall be rated in tests according to DIN EN 12600 as 1 (B) 1 and class P1A in tests according to DIN EN 356.

**TVG (HSG)** Heat strengthened soda lime silicate glass according to EN 1863 for use according to DIN 18008 with all of its parts.

In order to verify the sufficient fragmentation of heat strengthened glass with regard to the residual load capacity, the following additional tests to EN 1863 shall be carried out:

- The fracture pattern of two test panes with dimensions of at least 1000 mm x 1500 mm shall be examined quarterly.
- The test pane shall be supported on a flat table without mechanical constraints.
- The test plate shall be fractured with a pointed steel tool according to EN 1863-1, Section 8.3. The fracture pattern is to be examined with regard to the area share of critical fragments in relation to the total area. Critical fragments are fragments into which a circle with a diameter of 120 mm cannot be inscribed. If the area share of critical fragments is less than 1/5 of the total area, the test is passed.

The results of the factory production control shall be recorded and evaluated. The records shall contain at least the following information:

- Existing influences and selected strengthening process parameters for the manufacture of strengthened glass
- type of control or audit,
- date of production and testing of the construction product or ground material respectively,
- result of the controls and tests and comparison with the requirements,
- Signature of the person responsible for factory production control.

The records shall be kept for at least five years and shall be submitted to the inspecting body upon request during the construction phase. In the event of insufficient test results, the manufacturer shall immediately take the necessary measures to remedy the defect. Construction products which do not meet the requirements may not be used. After rectification of the defect - as far as technically possible and necessary to prove that the defect has been rectified - the relevant test shall be repeated without delay.

ESG (TTG): Thermally toughened soda lime safety glass according to EN 12150-2 for use according to DIN 18008 and all its parts.

Instead of TTG, heat-soaked soda lime safety glass according to EN 14179-2 may be used.



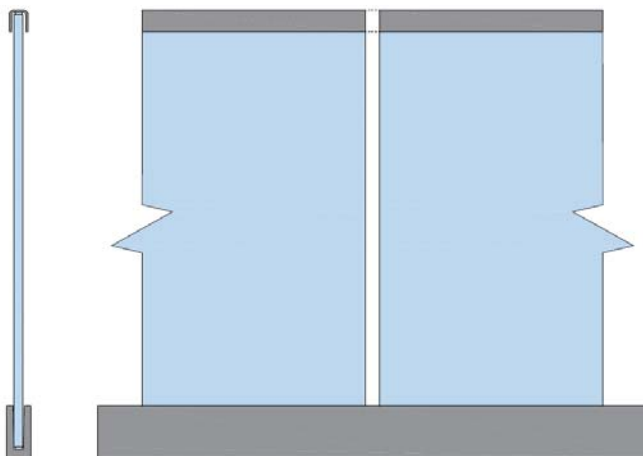
## 5.4 Edge Protection/Handrail

A stainless steel or aluminum handrail shall be fitted to the upper edge of the pane in accordance with Annex A.3. There are three handrail variations:

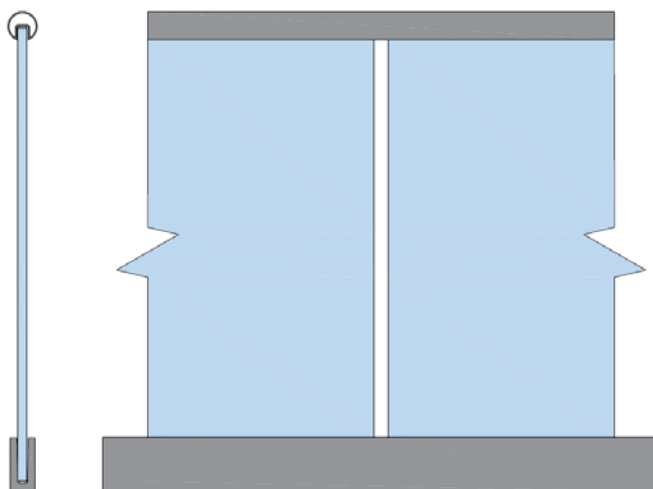
- The glass panes are not connected to the neighbouring glass panes by the attached handrail (design variant  $\alpha$ , Image 6).
- The glass panes are connected to the neighbouring glass panes by a continuous handrail (design variant  $\beta$ , Image 7)
- The glass panes are connected to the neighbouring glass panes by a continuous handrail and secured by a post-corner connection (design variant  $\gamma$ , Image 8)

Possible edge protections are shown in Image 9 and Image 10, possible handrail profiles for the design variant  $\beta$  and  $\gamma$  are shown in Image 11. Further information about the edge protection and handrails is given in A.3.

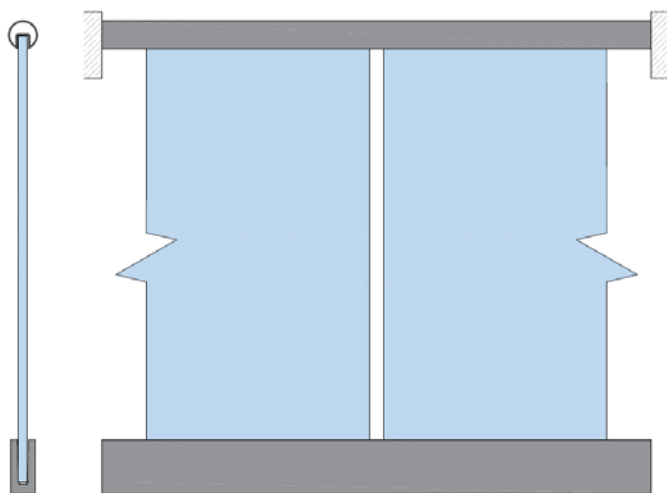
All free edges must be protected in accordance with DIN 18008-4.



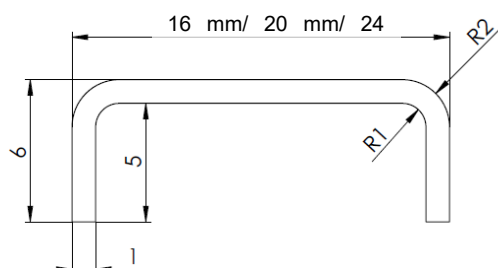
**Image 6** System  $\alpha$ : Version with attached handrail without connection between the panes



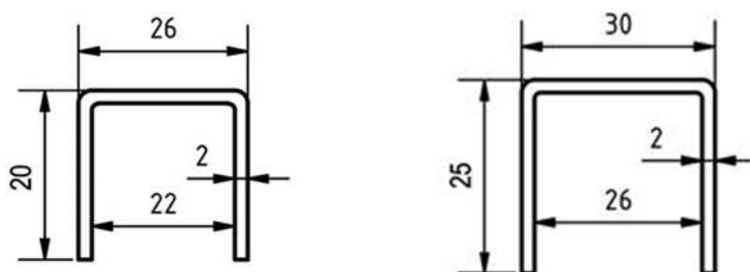
**Image 7** System  $\beta$ : Version with continuous handrail without lateral end connection of the handrail



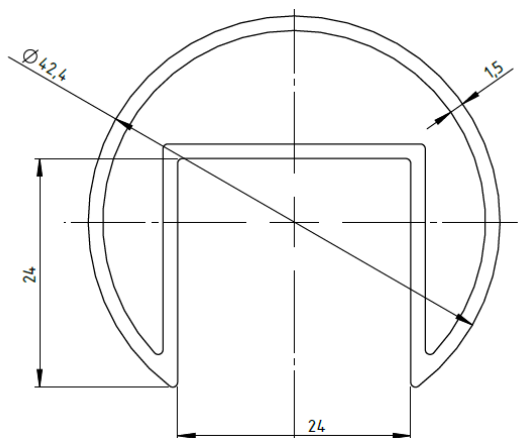
**Image 8** System γ: Version with continuous handrail and lateral end connection of the handrail



**Image 9** Stainless steel edge protection



**Image 10** Stainless steel edge protection



**Image 11** Stainless steel handrail

## 6. Impact tests

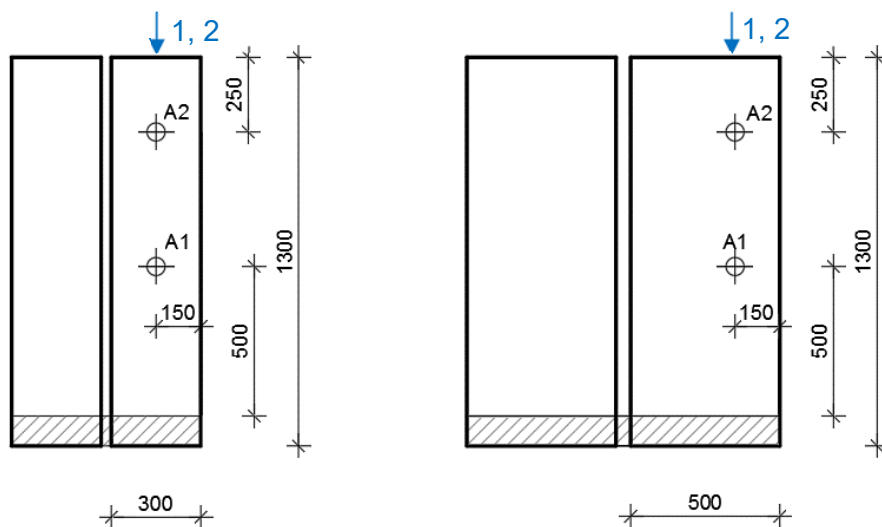
### 6.1 General

The system's guardrail function is verified taking into account the regulations for impact tests of DIN 18008-4. The pendulum impact tests are based on DIN 18008-4 with a twin-tyre (weight = 50 kg, tyre pressure = 3.5 bar). The drop heights and impact points are chosen acc. to DIN 18008-4. They vary between 700 mm and 900 mm depending on the tested handrail or edge protection.

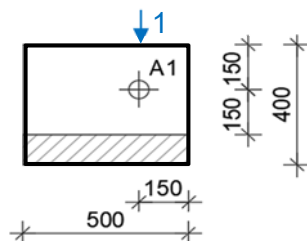
The designs of the edge protection listed in Image 9 and Image 10 do not comply with the specifications of DIN 18008-4 and therefore, the verification of the edge protection must be provided in accordance with DIN 18008-4 Appendix E. The edge protection test is to be executed as a "hard impact test". These tests shall be conducted with a steel ball with a diameter  $d = 63,5$  mm and mass  $m = 1,03$  kg.

Before each pendulum impact test, a hard impact shall be performed on the glass edge including the edge protection. The location of the hard impact is determined by the position of the pendulum impact and the orientation of the tested edge. It is located in the extension of the relevant point of impact coordinate (see Image 12). The impact energy of the steel ball is 20 Nm.

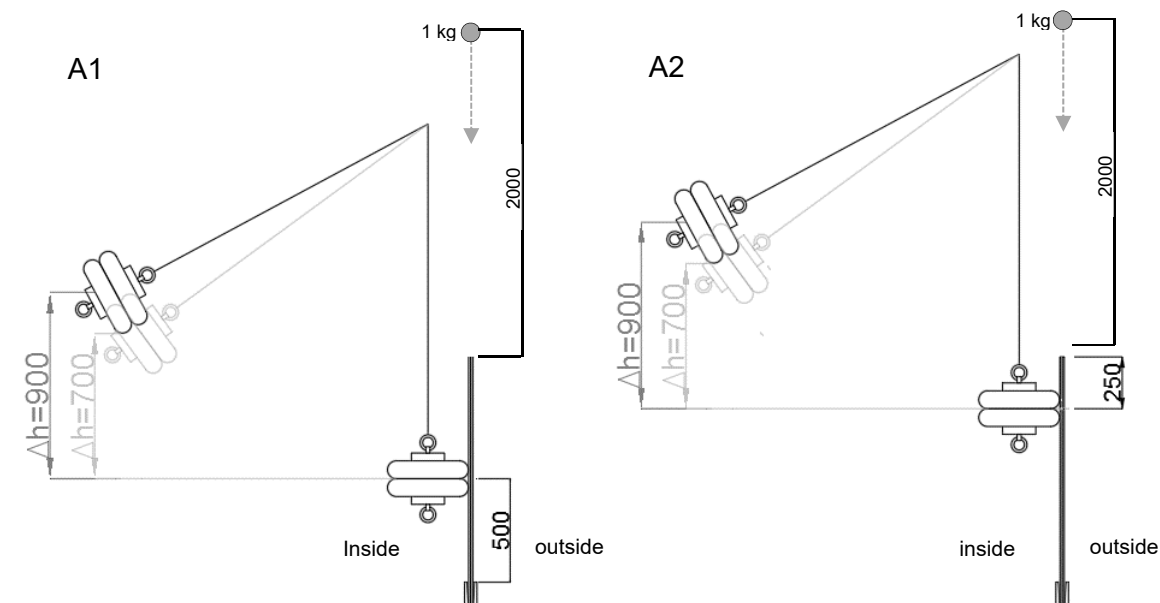
The relevant points of impact are selected according to DIN 18008-4 and based on previously performed experiments with similar systems. Image 12 displays the points of impact.



**Image 12** Impact points for  $h_G = 1300$  mm for the glass width 300 mm and 500 mm

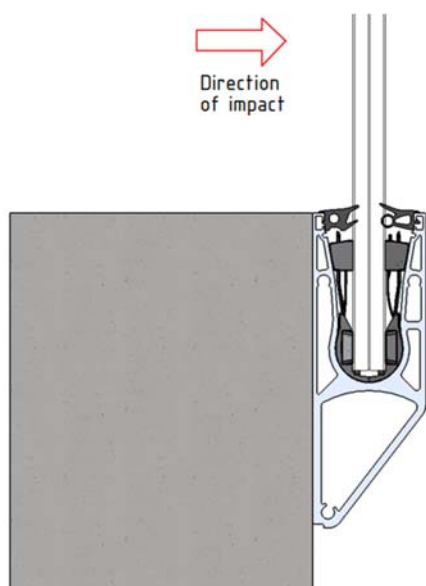


**Image 13** Impact points for  $h_G = 400$  mm and a width of 500 mm



**Image 14** Drop heights  $\Delta h$  for the impact points

The pendulum impact direction for VetroMount Side profile Y is shown in Image 15, the system VetroMount Y is always mounted with the largest cross section lateral on the impact side.



**Image 15** Direction of the impact

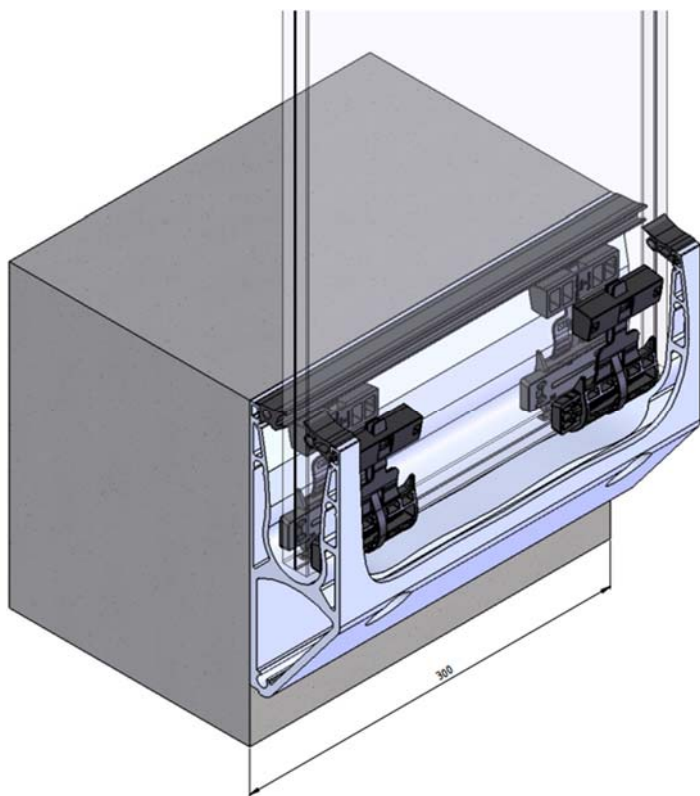
## 6.2 Test set-up and procedure

The tests are to be performed on glass panes with a width of 300 mm or 500 mm and a height of 1300 mm and 400 mm. The amount of glass pane bearings are given in Table 2.

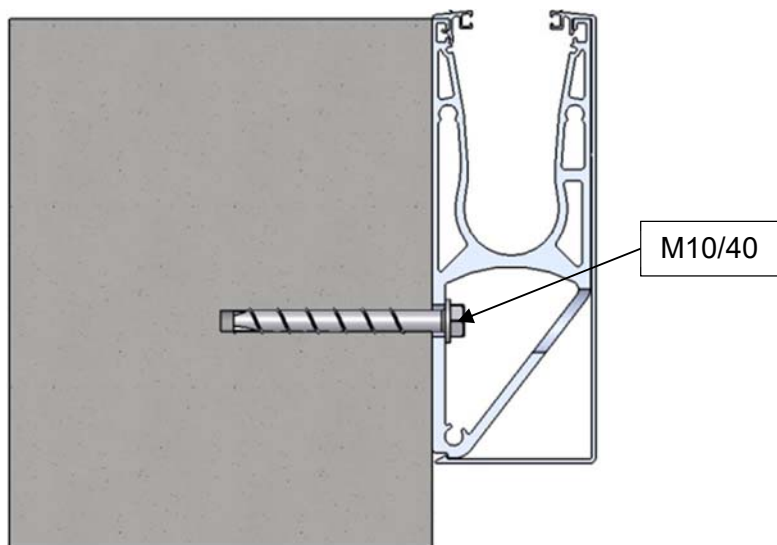
The VetroMount Y Side profiles are to be mounted on a steel plate with screws M10/40 8.8 (see Image 17) with a distance of 200 mm.

**Table 2** : Amount of glass pane bearings

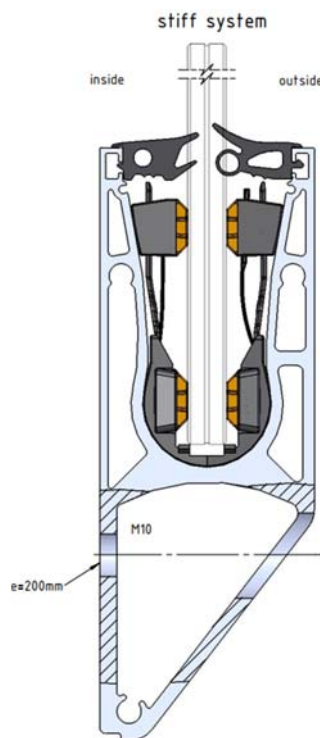
Glass pane width	Glass pane bearing
From 300 mm to <500 mm (Image 16)	At least two
More than 500 mm	Maximum distance 250 mm, a smaller distance is allowed.



**Image 16** Glass pane bearings for a glass width from 300 mm to < 500 mm



**Image 17** Vetromount Side profile Y mounted on the construction with screws M10/40



**Image 18** Vetromount Side profile Y





**Image 19** Connected handrail, handrailsystem  $\beta$



**Image 20** Fixed handrail, handrailsystem  $\gamma$





**Image 21** Test setup for the impact test with twin-type impactor

## 6.3 Test results

**Table 3** Results of the dynamic tests

Sample no.	Glass assembly	Glass width / height [mm]	Handrail-System	Fall Height [mm]	Impact Point	Result
D1.1	VSG 88.2 of TVG	500 / 1300	$\beta$	900	A1	No visible damage to the glazing or the substructure, passed
					A2	No visible damage to the glazing or the substructure, passed
D1.2				900	A1	No visible damage to the glazing or the substructure, passed
					A2	No visible damage to the glazing or the substructure, passed
D2.1	VSG 1010.2 TVG	300 / 1300	$\alpha$	900	A1	No visible damage to the glazing, light bending of the profile, passed
					A2	No visible damage to the glazing, further bending of the profile, passed
D2.2				900	A2	No visible damage to the glazing, light bending of the profile, passed
D3.1	VSG 66.2 heat soaked ESG	500 / 1300	$\gamma$	700	A1	Twisting the handrail, no visible damage to the glazing or the substructure, passed
					A2	Twisting the handrail, no visible damage to the glazing or the substructure, passed
D3.2				700	A1	No visible damage to the glazing or the substructure, passed
					A2	No visible damage to the glazing or the substructure, passed
D4.1	VSG 88.2 heat soaked ESG	300 / 1300	$\beta$	900	A1	No visible damage to the glazing or the substructure, passed
					A2	No visible damage to the glazing or the substructure, passed

Sample no.	Glass assembly	Glass width / height [mm]	Handrail-System	Fall Height [mm]	Impact Point	Result
D5.1	VSG 88.2 heat soaked ESG	500 / 1300	$\alpha$	900	A1	No visible damage to the glazing, light bending of the profile, passed
					A2	No visible damage to the glazing, light bending of the profile, passed
D5.2				900	A1	No visible damage to the glazing, light bending of the profile, passed
D6.1	VSG 1010.2 heat soaked ESG	300 / 1300	$\alpha$	900	A1	No visible damage to the glazing, bending of the profile, passed
D6.2				900	A2	No visible damage to the glazing, bending of the profile, passed
D7.1	VSG 88.2 heat soaked ESG	500 / 400	$\alpha$	900	A1	No visible damage to the glazing or the substructure, passed
D7.2				900	A1	No visible damage to the glazing or the substructure, passed

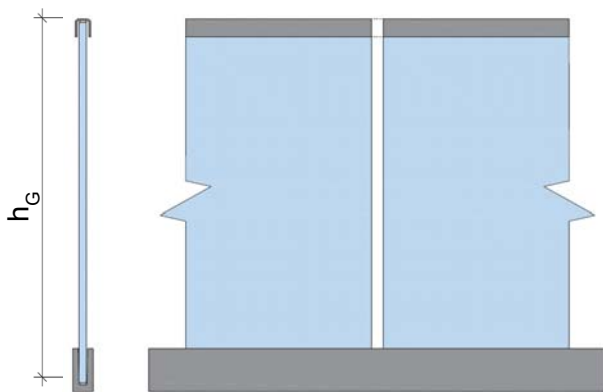
## 7. Conclusion

The company VERROTEC GmbH located in Mainz (Germany) was assigned by the company Bohle AG located in D-42781 Haan to verify the guardrail effect of the VetroMount Side profile Y balustrade system by impact tests.

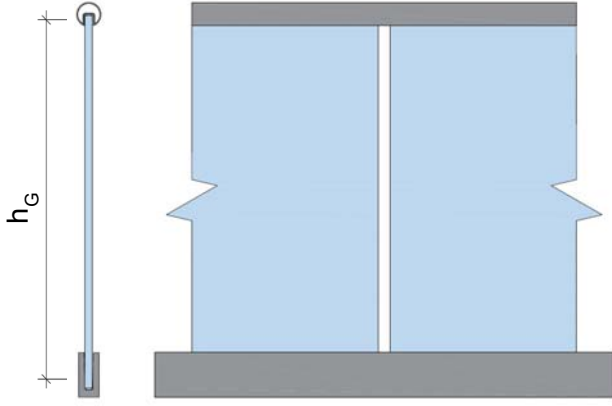
The subject of this report is exclusively the evaluation of the fall protection of the glass guardrail under impact loads. The verification of the glazing under static loads must be performed separately.

**The Bohle AG parapet system VetroMount Side profile Y was evaluated in regard to its fall protection properties by pendulum impact tests and can be classified as safety barrier in accordance with category B of DIN 18008-4.**

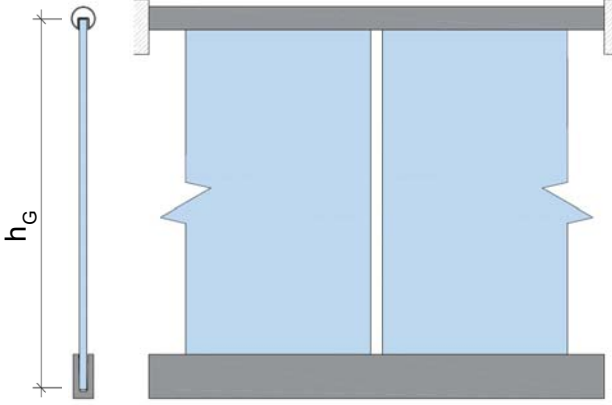
**Table 4** Summary of the impact test results valid for VetroMount Side profile Y variant  $\alpha$

<b>Execution possibility:</b> ■ without a load bearing handrail (but with edge protection) (acc. to chapter 5.4 system $\alpha$ )	Glass width B [mm]		Glass height $h_G$ [mm]		Glass assembly: VSG consisting of ...
	min.	max.	min.	max.	
	500	$\infty$	400	1300	10 mm TVG 0,76 mm PVB 10 mm TVG
	500	$\infty$	400	1300	8 mm ESG 0,76 mm PVB 8 mm ESG
	300	$\infty$	400	1300	10 mm ESG 0,76 PVB 10 mm ESG

**Table 5** Summary of the impact test results valid for Vetromount Side profile Y variant  $\beta$ 

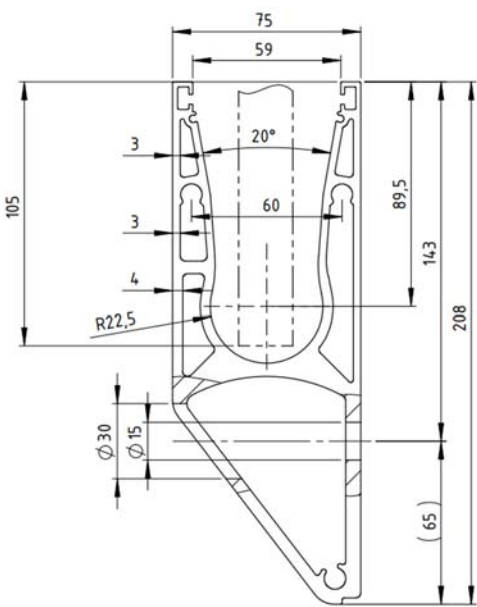
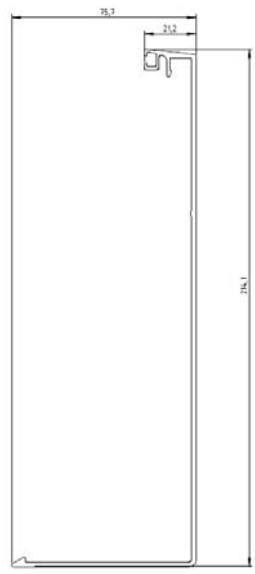
<b>Execution possibility:</b> <ul style="list-style-type: none"> <li>The glass panes are connected to the neighbouring glass panes by a continuous handrail (acc. to chapter 5.4 system <math>\beta</math>)</li> <li><b>Always connect at least two panes.</b></li> </ul>	Glass width B [mm]		Glass height $h_G$ [mm]		Glass assembly: VSG consisting of ...
	min.	max.	min.	max.	
	500	$\infty$	1000	1300	8 mm TVG 0,76 mm PVB 8 mm TVG
	500	$\infty$	400	1300	10 mm TVG 0,76 mm PVB 10 mm TVG
	300	$\infty$	400	1300	8 mm ESG 0,76 mm PVB 8 mm ESG
	300	$\infty$	400	1300	10 mm ESG 0,76 mm PVB 10 mm ESG

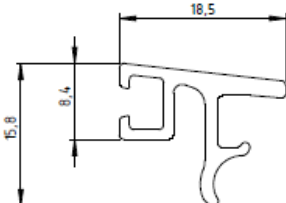
**Table 6** Summary of the impact test results valid for Vetromount Side profile Y variant  $\gamma$ 

<b>Execution possibility:</b> <ul style="list-style-type: none"> <li>The glass panes are connected to the neighbouring glass panes by a continuous handrail and connected by a post-corner connection (acc. to chapter 5.4 system <math>\gamma</math>)</li> </ul>	Glass width B [mm]		Glass height $h_G$ [mm]		Glass assembly: VSG consisting of ...
	min.	max.	min.	max.	
	500	$\infty$	1000	1300	8 mm TVG 0,76 mm PVB 8 mm TVG
	500	$\infty$	400	1300	10 mm TVG 0,76 mm PVB 10 mm TVG
	500	$\infty$	1000	1300	6 mm ESG 0,76 mm PVB 6 mm ESG
	300	$\infty$	400	1300	8 mm ESG 0,76 mm PVB 8 mm ESG
	300	$\infty$	400	1300	10 mm ESG 0,76 mm PVB 10 mm ESG

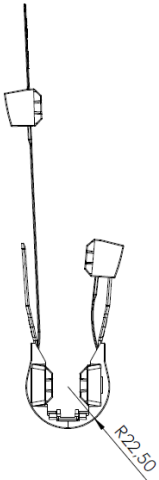
## Annex A Item Numbers

### A.1 Profiles

Name	Section	Material	Length	Article number (Surface)
Vetromount Side profile Y		Aluminium EN AW 6063 T66	2500 mm	BO 5403120 (E6/CO)
			5000 mm	BO 5403121 (E6/CO)
Y-Cover		Aluminium	2500 mm	BO 5403122 (E4+E6/CO)
				BO 5403124 (E4/C31)
			5000 mm	BO 5403123 (E4+E6/CO)
				BO 5403125 (E4/C31)

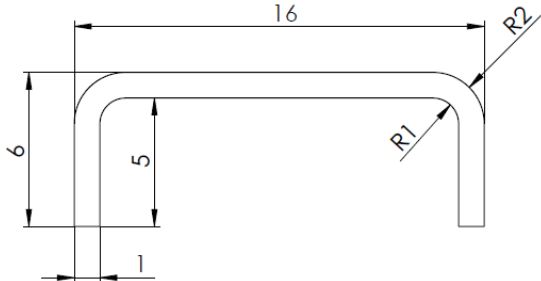
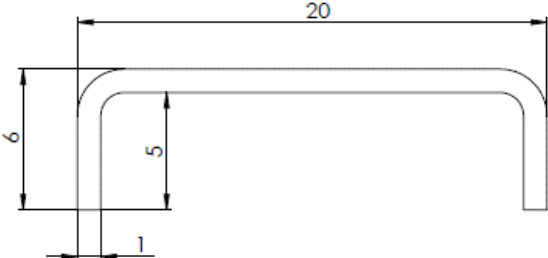
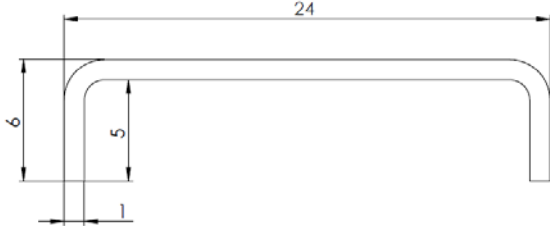
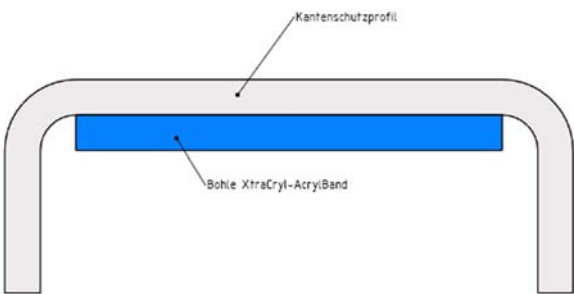
Name	Section	Material	Length	Article number (Surface)
Top cover		Aluminium	2500 m	BO 5403016 (E6/CO)
				BO 5403017 (E4/C31)
			5000 m	BO 5403018 (E6/CO)
				BO 5403019 (E4/C31)

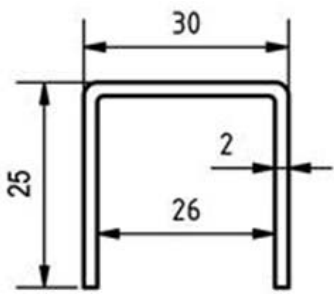
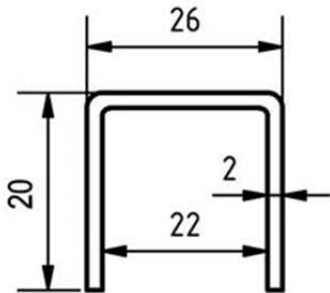
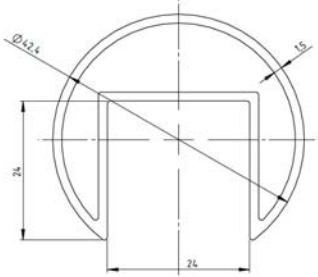
## A.2 Glass bearings

Name	Section	Glassthickness	Item number
Glass bearing		12,76 mm	BO 5403060
		13,52 mm	BO 5403061
		16,76 mm	BO 5403063
		17,52 mm	BO 5403064
		20,76 mm	BO 5403066
		21,52 mm	BO 5403067



## A.3 Handrails and edge protection

Section of the edge protection/ handrail	Material	Valid for the glass thickness	Item number
	stainless steel	Glass edge protection profile for 12-13,5 mm glass thickness	BO 5403001
	stainless steel	Glass edge protection profile for 15-17,5 mm glass thickness	BO 5403002
	stainless steel	Glass edge protection profile for 19-21,5 mm glass thickness	BO 5403003
	Acryl	Bohle XtraCryl-AcrylBand for the glass thickness:	
		12,76 - 13,52mm	BO 5207742
		16,76 - 17,52mm	BO 5207743
		20,76 - 21,52mm	BO5207744

Section of the edge protection/ handrail	Material	Valid for the glass thickness	Item number
	stainless steel	Glass edge protection profile for 12-21,5 mm glass thickness	BO 5215253
	stainless steel	Glass edge protection profile for 12-21,5 mm glass thickness	BO 5215293
	stainless steel	Handrail profile for 12-21,5 mm glass thickness	BO 5215248 (V2A) BO 5215249 (V4A)