

# Rockfall protection system

## Overview



### General:

TRUMER rockfall catchment fences were developed to protect infrastructure, utilities, buildings and lives from falling debris. Typical catchment fences are installed in run-out or deposition zones, close to the elements at risk that they protect. For this purpose TRUMER offers a wide range of tested systems that differ in the maximum energy level and the approved heights. Fixed rotations systems, as well as systems with retaining ropes are available. All systems are tested in accordance with either ETAG 27 or Austrian WLV guideline.

#### ETAG 27

ETAG 27 is the guideline from the European Organisation for Technical Approvals entitled "Guideline for European Technical Approval of Falling Rock Protection Kits", was published in 2008 and is the basis for the CE marking.

#### WLV

The WLV guideline from the Austrian Service of Torrent and Avalanche Control, the national authority responsible for natural hazard prevention and mitigation, entitled "WLV-Richtlinie für den Eignungsnachweis von Steinschlagschutznetzen" was published in 2005.

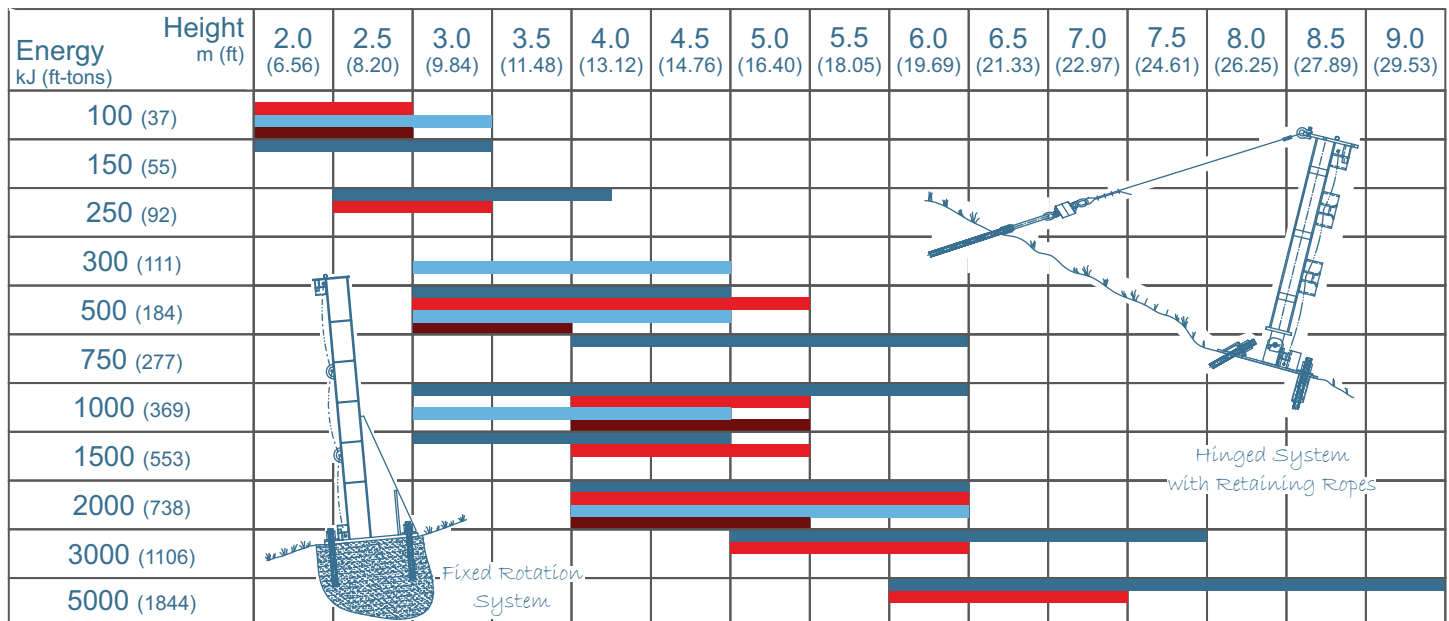
#### Hinged post-base plate

This type of system has an independent post and base plate that are connected with a steel pin to form a hinge, allowing the post to rotate in a direction perpendicular to the fence line. The system requires retaining ropes from the post head which are anchored uphill.

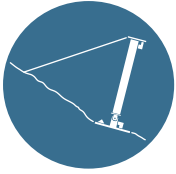
#### Fixed rotation

A fixed rotation system has a post with an integrated base plate. The connection between post and base plate is rigid and welded. The system is free standing and do not require retaining ropes at the head of the post.

## Energy / Height Matrix



Hinged System (Acc. to WLV) 
 Hinged System (ETAG 27 Certified) 
 Fixed Rotation System (Acc. to WLV) 
 Fixed Rotation System (ETAG 27 Certified) 



## HINGED SYSTEM - Acc. to WLV

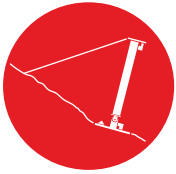
Model	TS-150-ZD	TS-250-ZD	TS-500-ZD	TS-750-ZD	TS-1000-ZD 04	TS-1000-ZD 07	TS-1500-ZD	TS-2000-ZD	TS-3000-ZD	TS-5000-ZD
Style	Hinged System									
Energy Class	0	1	2		3		4	5	6	8
MEL [kJ]	150	250	500	750	1000		1500	2000	3000	5000
SEL [kJ]	N/A									1660
Approved Height [m]	2.0 - 3.0	2.5 - 3.75	3.0 - 4.5	4.0 - 6.0		3.0 - 4.5		4.0 - 6.0	5.0 - 7.5	6.0 - 9.0
Verification	Full Scale Tested									
Certification	Tested by Montanuniversität Leoben according to WLV Guideline									
Report Number	0204	0108	0307	0202	0104	0607	0306	0206	0207	0308
Test Height [m]	2.0	2.5	3.0	4.0		3.0		4.0	5.0	6.0
Max. Elongation [m]	2.64	4.44	5.98	5.76	6.29	5.50	6.18	7.57	7.93	9.95
Residual Height Cat.	A (≥ 50 %)									
Net Type	HPN 50/50/4.6	Omega-Net 6.0/135	Omega-Net 7.5/135		Omega-Net 9.0/185				Omega-Net 10.5/180	
Corrosion Protection	ZnAl, Cl. A	Zn or ZnAl, Class A							ZnAl, Class A	
Connection	Rope	Shackled (Panel to Panel), Threaded (Bearing Rope)								
Tested Post Type	HEA 100		HEA 120	HEA 140	HEA 180	HEA 160	HEA 200	HEA 220	HEA 300	HEB 400
Connection	Tongue and Pin (Post with Base Plate)									
No. of Anchors*	2									
Bearing [mm] / Pcs.**	16 / 2		20 / 2	24 / 2	20 / 2		22 / 2		24 / 2	24 / 4
Middle [mm] / Pcs.**	N/A				16 / 2	18 / 2	20 / 2		22 / 4	24 / 4
Retaining [mm] / Pcs.*	12 / 2		16 / 2	18 / 2	16 / 2		22 / 2		24 / 2	24 / 4
Bearing / Pcs.***	AVT phx / 2									
Middle / Pcs.***	N/A				AVT phx / 2			AVT phx / 4		
Retaining / Pcs.***	N/A				AVT phx / 1					
Lateral Anchor [kN]	112	216	231	246	149	170	236	249	245	307
Retaining Anchor [kN]	49	74	187	277	134	202	262	279	293	299
Base Plate [kN]****	42	97	123	232	149	149	201	221	270	343

\* Quantity per post

\*\* Quantity per fence segment

\*\*\* Quantity per rope

\*\*\*\* Slope parallel force at Base Plate



## HINGED SYSTEM - ETAG 27 Certified

Model	TSC-100-ZD	TSC-250-ZD	TSC-500-ZD	TSC-500-ZD H4	TSC-1000-ZD	TSC-1500-ZD	TSC-2000-ZD	TSV-2000-ZD H4	TSC-3000-ZD	TS-5000-ZD
Style	Hinged System									
Energy Class	0	1	2		3	4	5		6	8
MEL [kJ]	100	250	500		1000	1500	2000		3000	5000
SEL [kJ]	N/A	85	170		330	500	660	in process	1000	1660
Approved Height [m]	2.0 - 2.5	2.5 - 3.0	3.0 - 3.5	4.0 - 5.0			5.0 - 6.0	4.0 - 5.0	5.0 - 6.0	6.0 - 7.0
Verification	Full Scale Tested									
Certification	ETAG 27 Certified									
ETA Number	ETA-12/0156	ETA-12/0204	ETA-12/0117	ETA-12/0116	ETA-11/0226	ETA-11/0225	ETA-11/0228	in process	ETA-11/0227	ETA-10/0202
Test Height [m]	2.0	2.5	3.0	4.0			5.0	in process	5.0	6.0
Max. Elongation [m]	3.03	3.86	4.59	5.02	4.87	5.78	7.19	in process	7.22	8.62
Residual Height Cat.	A (≥ 50 %)							in process	A (≥ 50 %)	
Net Type	Omega-Net 6.0/135		Omega-Net 7.5/135			Omega-Net 9.0/185				Omega-Net 10.5/180
Corrosion Protection	Zn or ZnAl, Class A									ZnAl, Cl. A
Connection	Shackled (Panel to Panel), Threaded (Bearing Rope)									
Tested Post Type	HEA 100		HEA 120	HEA 140	HEA 180	HEA 200	HEA 220	in process	HEA 300	HEB 400
Connection	Tongue and Pin (Post with Base Plate)									
No. of Anchors*	2									
Bearing [mm] / Pcs.**	16 / 2		20 / 2			22 / 2		in process	24 / 2	24 / 4
Middle [mm] / Pcs.**	N/A				18 / 2	20 / 2		in process	24 / 4	
Retaining [mm] / Pcs.*	12 / 2		16 / 2			22 / 2		in process	24 / 2	24 / 4
Bearing / Pcs.***	AVT phx / 2							in process	AVT phx / 2	
Middle / Pcs.***	N/A				AVT phx / 2	AVT phx / 4		in process	AVT phx / 4	
Retaining / Pcs.***	N/A				AVT phx / 1			in process	AVT phx / 1	
Lateral Anchor [kN]	110	193	228	183	194	252	236	in process	229	307
Retaining Anchor [kN]	37	88	104	171	181	293	369	in process	296	299
Base Plate [kN]****	57	98	116	88	198	251	222	in process	302	343

\* Quantity per post

\*\* Quantity per fence segment

\*\*\* Quantity per rope

\*\*\*\* Slope parallel force at Base Plate



## FIXED ROTATION SYSTEM - Acc. to WLV

	TS-100-oA	TS-300-oA	TS-500-oA	TS-1000-oA	TS-2000-oA	
<b>Classification</b>	Fixed Rotation System					
Energy Class	0	1	2	3	5	
MEL [kJ]	100	300	500	1000	2000	
SEL [kJ]	N/A					
Approved Height [m]	2.0 - 3.0	3.0 - 4.5		4.0 - 6.0		
Verification	Full Scale Tested					
Certification	Tested by Montanuniversität Leoben according to WLV Guideline					
Report/ETA Number	0103	0603	0203	0407	0208	
Test Height [m]	2.0	3.0		4.0		
Max. Elongation [m]	2.22	3.75	4.42	6.03	7.10	
Residual Height Cat.	A ( $\geq 50\%$ )					
<b>Net</b>	HPN 50/50/4.6	Omega-Net 6.0/135	Omega-Net 7.5/135		Omega-Net 9.0/185	
Corrosion Protection	ZnAl, Cl. A	Zn or ZnAl, Class A				
Connection	Rope	Shackled (Panel to Panel), Threaded (Bearing Rope)				
<b>Structure</b>	HEA 140	HEB 160	HEB 200	HEB 240	HEB 280	
Connection	Fixed (Post with Base Plate)					
No. of Anchors*	3					
<b>Ropes</b>	Bearing [mm] / Pcs.**		20 / 2		24 / 2	
Middle [mm] / Pcs.**	N/A	16 / 2		18 / 2	24 / 2	
Bearing / Pcs.***	N/A	AVT phx / 2				
Middle / Pcs.***	N/A	AVT phx / 2			AVT phx / 4	
<b>Forces</b>	Lateral Anchor [kN]	201	96	113	231	324
Base plate [kN]****	186	170	205	378	505	
Bending Moment at foot of post [kNm]*****	198	249	289	671	773	

- \* Quantity per post
- \*\* Quantity per fence segment
- \*\*\* Quantity per rope
- \*\*\*\* Slope parallel force at base plate
- \*\*\*\*\* Bending moment for tested height



## FIXED ROTATION SYSTEM - ETAG 27 Certified

TSC-100-oA	TSV-500-oA	TSV-1000-oA	TSV-2000-oA
Fixed Rotation System			
0	2	3	5
100	500	1000	2000
in process		330	in process
2.0 - 2.5	3.0 - 3.5	4.0 - 5.0	
Full Scale Tested			
ETAG 27 Certified			
in process		ETA-13/0690	in process
in process		4.0	in process
in process		4.93	in process
in process		A ( $\geq 50\%$ )	in process
in process		Omega-Net 7.5/135	in process
Zn or ZnAl, Class A			
Shackled (Panel to Panel), Threaded (Bearing Rope)			
in process		HEA 240	in process
Fixed (Post with Base Plate)			
in process		3	in process
in process		20 / 2	in process
in process		18 / 2	in process
in process		GDVI / 1	in process
in process		GDVI / 1	in process
in process		206	in process
in process		307	in process
in process		614	in process