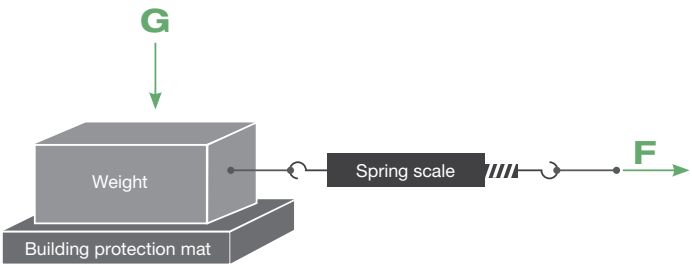
REPORT

STATIC COEFFICIENT OF FRICTION / COEFFICIENT OF FRICTION

The stability of a non-penetrating installation system is achieved through its own weight, the weight of the modules and additional ballast. A prerequisite for installation is therefore that the building has sufficient load-bearing capacity and that the roof structure is suitable for this purpose. A key factor influencing the structural stability of this design is the interaction between the roof membrane and the building protection mat of the installation system, which is described by the coefficient of friction. The coefficient of friction is incorporated directly into the structural analysis. It is therefore necessary to determine or verify the coefficient of friction on site!

DETERMINING THE COEFFICIENT OF FRICTION

The coefficient of friction (symbol μ) is a dimensionless measure of the frictional force relative to the normal force between two bodies.



Coefficient of friction μ = F : G
F = [kg]
G = [kg]

EXAMPLE
The test weight weighs 1.0 kg. The spring balance reads 0.6 kg before the weight moves.

F : G = μ
0,6 kg : 1,0 kg = 0,6
μ = 0,6

YOU WILL NEED THE FOLLOWING:

+ Test weight with a protective mat on the underside fixed in place)
+ Spring scale

EXAMINATION:

+ Prepare the roof surface, i.e. get it ready for the installation to take place later: clean it if necessary or apply water
+ Place the test weight on the roof surface and leave it for 10 seconds
+ Pull the spring balance across the slope of the roof
+ Read the weight as soon as the test weight starts to slip
+ Measure the area to be covered at several points, both on dry and wet roof surfaces
+ Measure the highest and lowest points, as well as the corners, edges and centre of the surface

Ensure that the unloaded scale is set to zero before each measurement. Use the designated protective mat during the test. The protective mat and the block must together weigh 1 kg. The weight can be adjusted by adding additional weights.

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ROOF PLAN

Please mark at least five measurement points!

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TEST REPORT

STARTING POINT			
Roofing manufacturer	Roofing type	Age of the roofing	Weight (g) Test specimen (kg)

MEASURED VALUES*	PULLING FORCE (F) IN KG
Measurement point 1 (dry)	
Measurement point 1 (wet)	
Measurement point 2 (dry)	
Measurement point 2 (wet)	
Measurement point 3 (dry)	
Measurement point 3 (wet)	
Measurement point 4 (dry)	
Measurement point 4 (wet)	
Measurement point 5 (dry)	
Measurement point 5 (wet)	

* Mark the measurement points on your roof covering or roof plan! For larger roof areas,
we recommend increasing the number of measurement points!
Then take the lowest value of all the measurement points and divide it by the weight of the test specimen:

RESULT μ :

WE RECOMMEND USING A TEST SPECIMEN WEIGHING BETWEEN 1 KG AND 10 KG.

Customer:	Commission:
Datum:	Examiner (name):

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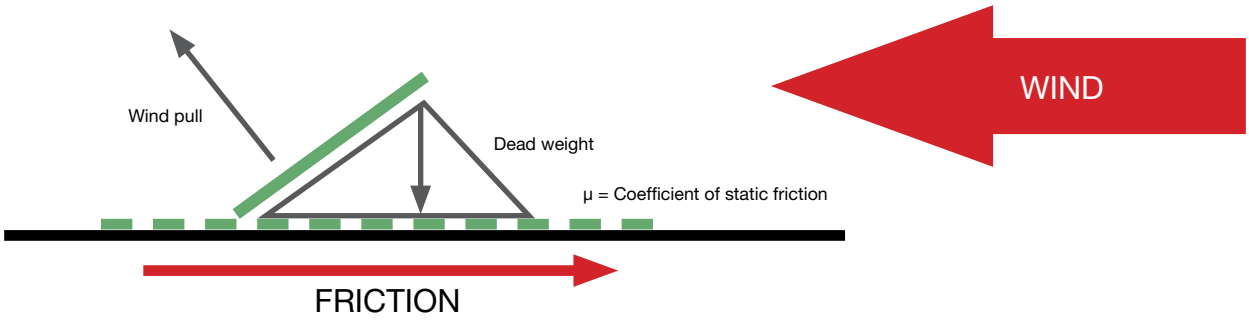
RECOMMENDATION

For the static friction coefficients to be used in ballasted solar installations

WHAT IS IT ABOUT:

As part of the stability analysis, in addition to component analyses, analyses of positional stability must also be carried out. The systems must be adequately secured against both lifting and displacement. A key factor influencing the positional stability analyses is the coefficient of static friction μ between the solar system and the roof.



The coefficient of static friction depends on the building materials used, the surface condition (rough, smooth, wet, dry, weathered), the temperature, the age and the general condition of the roof waterproofing. These factors must all be taken into account when determining the coefficient of static friction and may, where appropriate, result in reductions.

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RECOMMENDED STATIC FRICTION COEFFICIENTS:

This table provides recommendations regarding the coefficients of static friction that can be applied for various combinations of the building protection mats used in the installation system and the roof waterproofing. These recommendations are based on studies conducted by the various manufacturers and suppliers.

µh dry / wet waterproofing	Non-woven fabric * (Polyester)	Building protection mat (rubber-based)	Building protection mat (aluminium-coated)
PVC-P	0,2	0,5**	0,5
FPO (made from PE or PP)			
EVA			
Polypropylene			0,3
Bitumen elastomer / Polymer-modified bitumen	0,6	0,6	0,2
EPDM	0,6	0,6	0,7

Table 1: Coefficients of static friction

* Fleece is only recommended to a limited extent due to the risk of rotting

** Only if the manufacturer of the roof waterproofing has approved it for chemical compatibility (migration of plasticisers)

Important note: The values given in the table are for preliminary planning purposes only! It is not possible to determine the actual coefficient of static friction required for verifying stability without an on-site inspection.

The installer of a solar power system must therefore determine and ensure on site that the coefficient of static friction specified in the structural analysis is adhered to.

ON-SITE INSPECTION:

The static friction coefficients listed above are recommendations for standard cases. Depending on the specific project requirements, on-site investigations are also recommended. These should be carried out in particular where there is no information available regarding the waterproofing system used. The procedure for conducting the tests is detailed in the test report “Alumero Static Coefficient of Friction Report” and should be understood as a recommendation from Alumero.

The tests are carried out in accordance with DIN EN ISO 8295 Plastics – Films and sheets – Determination of coefficients of friction, October 2004 edition. To ensure that the test results are valid, the roof surface at the measurement points must be cleaned in the same way as is intended for the overall installation of the solar system.

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