

MACHINE SAFETY WINDOWS

Safety glass is a restraining protective device on machining centres. It prevents tools, machined parts and broken particles from being ejected out of the machine's working space and protects people from injuries.

Industrial accident statistics show that workers are still the frequent victims of flying objects ejected by machine tools. Viewing panes in machining centres, ideally combined with a spin window system, provide a good view for the operator and transparency of the manufacturing process.

Viewing panes within the trajectory path of parts must exhibit adequate strength. According to the latest empirical tests polycarbonate is the material best suited for safety glass owing to its high energy absorption.

The restraining capacity of a polycarbonate pane of 8 mm thickness is about the same as of a 3 mm St 12.03 sheet.

Application	Protection against
Turning	<ul style="list-style-type: none"> broken chuck components broken tools machine parts
Milling	<ul style="list-style-type: none"> hot chips broken tools machine parts
Grinding	<ul style="list-style-type: none"> Pieces of broken grinding disks

Application areas of safety windows

A disadvantage of polycarbonate is its sensitivity to scratching and it will be damaged by the impact of hot chips and sparks.

Furthermore it has low resistance to the effects of coolants, grease and oil and will embrittle as a result. This can reduce the restraining capacity within just a few years.

The safety glass provided by HEMA is encapsulated and sealed for permanent and efficient protection against these external influences.

Any safety glass showing damage from external mechanical impact, for example cracks, deep scratches or deterioration resulting from exposure to chemicals, must be replaced if it is to continue functioning properly.

At present there are three technical standards for metal cutting tools: DIN EN 12415 (for lathes), DIN EN 13128 and DIN EN 12417 (for milling machines and machining centres). These standards form the basis of our safety glass and spin window systems. You may determine the relevant safety classification and the corresponding minimum thickness of the polycarbonate from the tables on the following pages. The influential factors are the mass of the tool and of the machined part and the speed of rotation.



Machine safety window with stainless steel frame, including mounted VISIPORT® with »Golden Eye« spin disk

The restraining capacity of safety glass depends not only on the thickness of the polycarbonate but also on the sheet metal design of its enclosure. Clamps or bonding or an adequate frame is the best solution for the mounting.

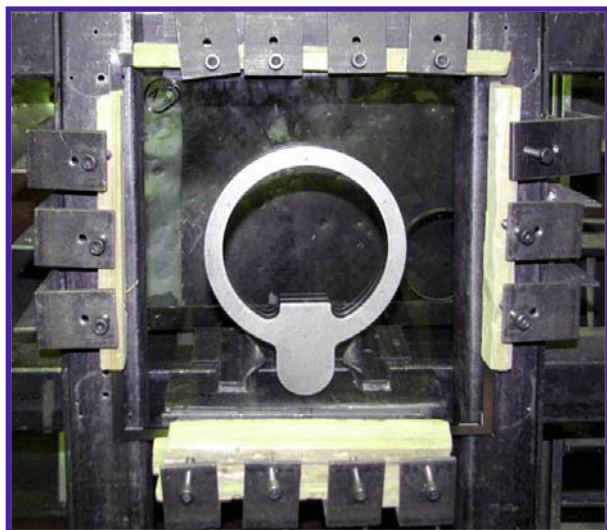
The joints should be well covered to prevent the screen from being pushed through the frame when impacted by parts.



Machine safety window, standard design

IMPACT TEST

Safety glass is a restraining protective device on machining centres. As part of tests on their restraining ability a range of HEMA polycarbonate panes with and without integrated VISIPOINT® mounting plate were tested at the IWF of TU Berlin.



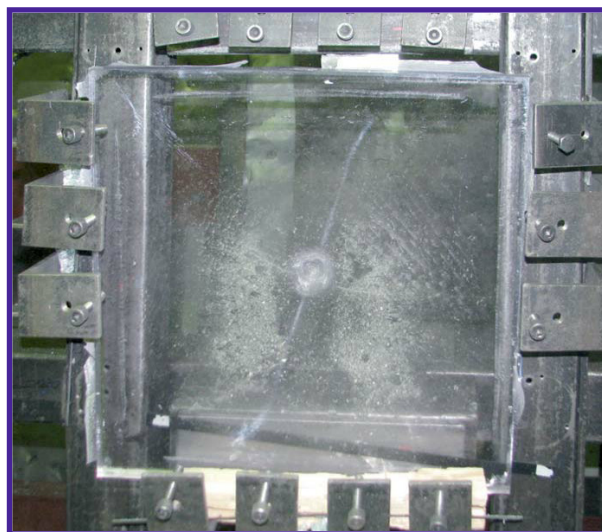
Fixing of pane

For the impact test according to DIN EN 12415, resistance class C3, for example, panes with 10 mm tempered safety glass and 15 mm polycarbonate were tested with and without supporting mounting plate for VISIPOINT®.

Testing

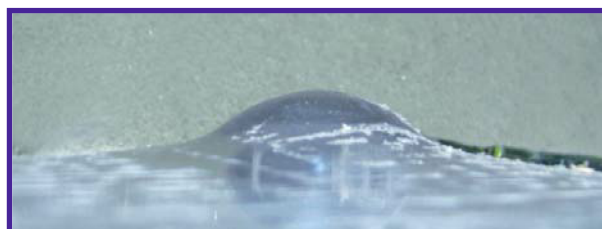
Polycarbonate panes are fixed within a frame and impacted with a 2.5 kg projectile.

The speed of the projectile is adjusted at the cannon's pressure, the speed is measured with a double laser light barrier.



Fixed polycarbonate pane after impact test

Test No	Test object	Projectile speed v [m/s]	Projectile energy E [Nm]	Result, note
1	4e	80	8000	passed
2	4b	80	8000	passed
3	4c	80	8000	passed
4	4f	80	8000	passed



Ident of polycarbonate pane after impact test



Panorama view of test laboratory at the IWF of TU Berlin. In the foreground acceleration pipe with projectile (enlarged).

Quelle: IWF

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Material / classification	A1	A2	A3	B1	B2	B3	C1	C2	C3
Mass of projectile in kg	0.625	0.625	0.625	1.25	1.25	1.25	2.50	2.50	2,50
Kinetic energy in joule	320	781	2000	1562	2480	4000	3124	4960	8000
PC 6 mm	■			■					
PC 8 mm	■	■		■	■		■		
PC 10 mm	■	■	■	■	■		■	■	
PC 12 mm	■	■	■	■	■	■	■	■	
PC 15 mm	■	■	■	■	■	■	■	■	■
PC 19 mm laminated	■	■	■	■	■	■	■	■	■

Impact tests according to DIN EN 12415 at test pattern 500 x 500 mm

■ Available combination (without guarantee)

Parameter for calculation of safety classification and thickness of polycarbonate panes for turning centres according DIN EN 12415

Diameter of rotation	Maximum outer diameter of the clamping jaw at the machine
Rotational speed of the spindle	Maximum speed of the machine according to the manufacturer
Mass of clamping jaw	Mass of one clamping jaw (classification according to proposed standard)

max. diameter of clamping jaw (mm)	circumferential speed v (m/s)	Projectile dim. D x a (mm x mm)	Projectile mass m (kg)	Impact speed v (m/s), up to	Impact energy (Nm), up to	safety classification*	Minimum thickness of PC (mm)
up to 130	25	30 x 19	0.625	32	320	A1	6
	40			50	781	A2	6
	63			80	2.000	A3	8
130 to 250	40	40 x 25	1.250	50	1,562	B1	6
	50			63	2,480	B2	8
	63			80	4,000	B3	12
> 250	40	50 x 30	2.500	50	3,124	C1	8
	50			63	4,960	C2	10
	63			80	8,000	C3	15
> 500			2.500	89	10,000	PK 1	15
			5.000	63	10,000	PK 2	15
			8.000	69	12,000	PK 3	19
				55	12,000	PK 4	19
				59	14,000	PK 5	19

*A1 to C3 = Classification according DIN EN 12415; PK 1 to 5 = classification according to VDW

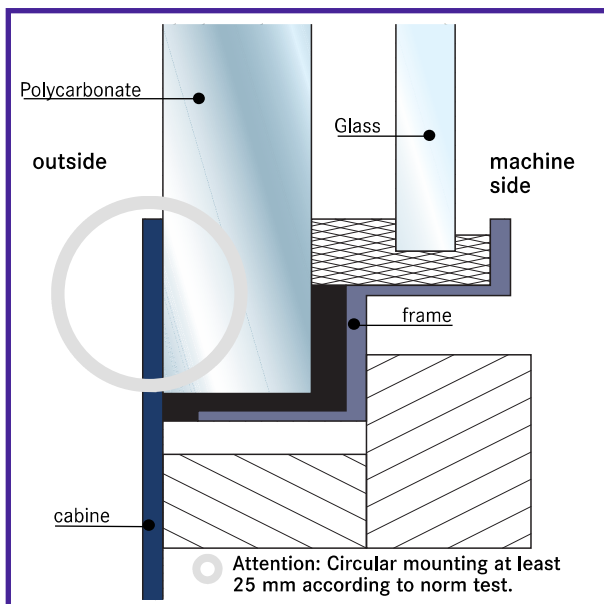
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Calculation of safety classification and required polycarbonate thickness for milling machines DIN EN 12417

Diameter of rotation	maximum outer diameter of the cutting tool unit at the machine concerned
Rotation speed of spindle	maximum speed of the machine according to the manufacturer
Mass of cutting tool	mass of cutting tool, defined for 100 g according to proposed standard

Required Data for calculation of impact energy and impact speed

Projectile mass m (kg) m (kg)	impact speed vt (m/s), up to	impact energy (Nm), up to	Minimal thickness of Polycarbonate (mm)
0.100	85	361	4
0.100	100	500	6
0.100	120	720	8
0.100	145	1.063	10
0.100	150	1.125	12
0.100	170	1.445	15
0.100	>170	>1.445	19



Design of safety glass window

Polycarbonate panes only with safety foil

When exposed these polycarbonate panes may lose their safety restraining properties partly or completely after only a few months of use.

This was impressively demonstrated by tests at the BIA Institute. Systematic research showed that polycarbonate panes splashed with coolant possess a retaining potential of only 60% after nine months of exposure.

According to our definition safety glass may be considered exposed as long as it is not completely encapsulated by an additional glass layer or a special foil. This encapsulation and sealing can be verified only by specialised companies.

In spite of the lower safety classification requirements of milling/drilling machine manufacturers and polycarbonate pane thicknesses less than 6 mm customers still use these panes.

Although the pane thickness corresponds to the machine's safety classification these panes are unprotected, i.e. not encapsulated or sealed.

Polycarbonate panes for machines should be protected against chemical attacks if they are to provide reliable protection over the long term.

A special focus of attention is the safety risks posed by safety windows that has found testimony over recent years.

The replacement of unprotected polycarbonate panes is recommended by VDMA (association of German machine and plant manufacturers) after only two years of use.

The safety glass fulfils the applicable recommendations of VDMA for an assured A1 to C3 safety classification. It is non-aging and resistant to oil, coolants, and heavy impacts.

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The increasing imports of machining centres from low-cost countries always mean a safety risk, and the legal requirements are not always being met by these products.

Safe operation can be achieved though when these low cost machines are retrofitted in accordance with the required European safety standards.

Recommendation for replacement of panes

According to the recommendations of the German Berufsgenossenschaft BIA (Accident Prevention & Insurance Association), the Werkzeugmaschinenverband VDW, and the IWF/TU Berlin, Fachgebiet Werkzeugmaschinen und Fertigungstechnik, we recommend that protective panes are replaced after 5 years of use.

All buyers of new or second-hand machine tools must be informed of polycarbonate deterioration (e.g. in the manual). It is also recommended to mark the installation date of the polycarbonate pane on the pane itself. Replacing and servicing protection panes must observe all of the instructions from the manufacturer.

We recommend replacing the pane immediately when there is:

- deformation and/or cracks from impacts
- damage to the sealing
- infiltration of cooling fluid
- damage or destruction to the protection pane (or the scratch-resistant protection film) on the operator or machine side

HEMA safety windows

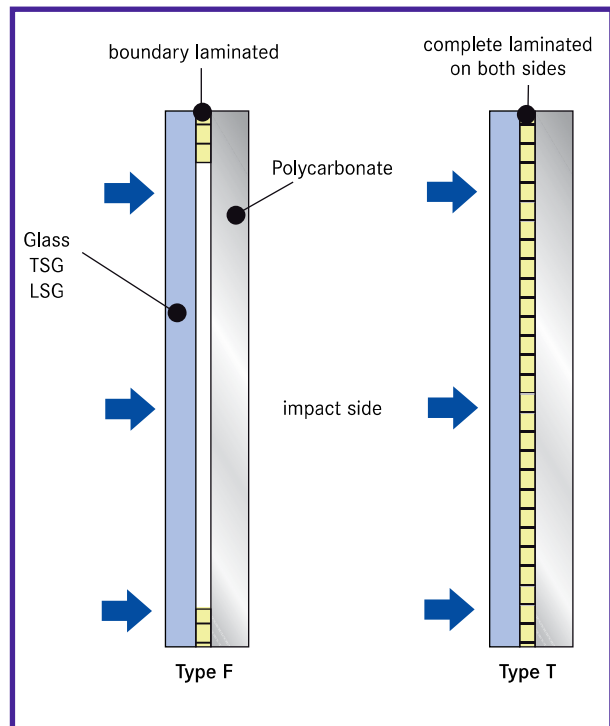
- Only certified quality panes of polycarbonate are used with an efficient surface coating providing protection against chemicals, abrasion and scratching
- Polycarbonate panes from renowned manufactures
- Polycarbonate panes can be provided with any of the usual thicknesses. The basic versions range from 4 to 15 mm in thickness.
- PC panes are protected on the machine side by an additional single or multiple layer safety glass pane.
- The design may consist of polycarbonate, foils and glass depending on customer requirements.
- As standard we use splinter proof laminated glass with a low risk of injury and for shorter cleaning and machine downtimes.
- The edges of the panes are completely sealed and resistant to coolants. In addition they can be fitted with an aluminium or stainless steel frame for optimal mounting.
- The panes and their components are tested by the IWF institute in Berlin according to DIN EN 12415, restraint categories A1 to C3, and to safety standards CEN/TC 143/WG3
- The customer receives a 5-year warranty on the encapsulated and sealed safety pane (according to our warranty conditions).

- The integration of modern spin window solutions such as VISIPOINT® is possible without any safety risk or additional mounting work.

Design of machine safety windows

To meet the different requirements the following layouts of polycarbonate panes are available:

- **Type F:** Cost-effective alternative suitable for most applications, recommended less for larger panes and higher impact, available with short delivery times
- **Type T:** Advanced version of type F, polycarbonate and glass entirely bonded. Advantages: high stability, no condensation or cooling fluid can enter between polycarbonate and glass



Types of polycarbonate/glass composites

Both types can be produced with optional graduation, protection films, and aluminium or steel frames. The thickness of polycarbonate and the design of the multi-layer machine safety window is based on the individual requirements and safety classifications.