

Ways of embedding ETTLIN/lux® in laminated glass

The ETTLIN/lux® fabrics can be laminated in glass. The different procedures and possibilities which have been tested so far are presented in this document.

Types of glass

So far, the ETTLIN/lux®-laminated glass has been successfully produced from the following types of glass:

- Toughened glass
- Float glass
- Heat-strengthened glass

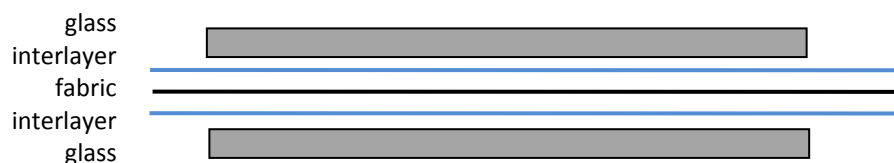
Types of processing

The lamination of ETTLIN/lux® fabrics in glass has been successfully accomplished by the vacuum bag process.

The pre-laminate process indeed is possible, but up to now the process couldn't be established securely.

The structure of the laminated glass

The fabric is always embedded in the same kind of structure. This structure is presented in the following outline:



The lamination of the fabric obtains the same rules as all other embeddings. The thicker the interlayer, the better is the surrounding and the adhesion.

Four different types of interlayer have already been successfully tested:

- PVB
- EVA
- Evasafe
- TPU

The use of two interlayer with a thickness of 0.76 mm each has been established. This thickness is leaving to a stable compound.

Ways of embedding ETTLIN/lux® in laminated glass

Pre-shrinkage

The ETTLIN/lux® fabric consists of thermoplastic materials, which are shrinking by thermal treatment.

If the fabric is pre-shrunk before lamination, this should happen under the same process-related parameters that will later be adjusted for the embedding. The consequences of pre-shrinking to the appearance of the laminated glass, as well as to the texture of the edges, will be presented in the passage below "Types of laminated glass".

The maximum results of shrinkage by a thermal treatment of 130° C are presented in the table below. The results are approximated.

Type of fabric	Direction of fabric	max. shrinkage (approximately)
ETTLIN/lux® 4252	Direction of effect (black rib)	2,5 %
	Orthogonally to the direction of effect	2,0 %
ETTLIN/lux® 4271	Direction of effect (black rib)	2,5 %
	Orthogonally to the direction of effect	2,0 %
ETTLIN/lux® 4368	Direction of effect (black rib)	2,5 %
	Orthogonally to the direction of effect	6,0 %

Depending on the type of fabric the maximum result of shrinkage is achieved after 30-60 minutes.

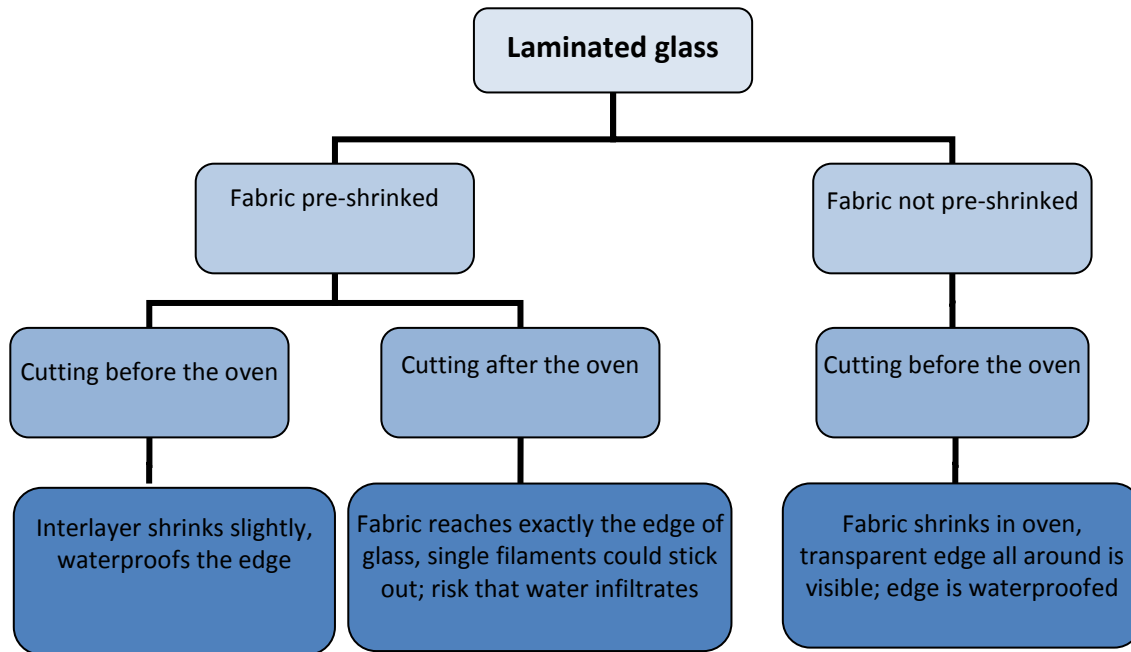
Ways of embedding ETTLIN/lux® in laminated glass

Types of laminated glass

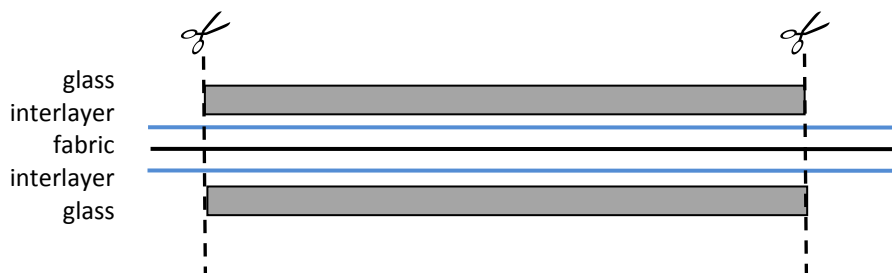
The appearance of the laminated glass, as well as the texture of the edges is depending on the following factors:

- Usage of pre-shrunk or non pre-shrunk fabric
- Cutting of the fabric before or after the oven

There are three types:



The second aspect „Cutting before or after the oven“ means the cut, that cuts back the overhanging fabric and interlayer to the edge of the glass. This is shown in the outline below:



With the laminated glass type of „Fabric pre-shrunk - Cutting after the oven“ four tests have been accomplished, which are necessary for admission of the glass as laminated safety glass:

- Aging test
- Boiling test
- Pummel test
- Pendulum impact test

All tests have been passed.