

**Dooria Ardal AS**

**0-600-46-2492**

# Door Plant

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## 2 Foreword

This project description is intended to optimize cooperation between the customer and the plant supplier.

The plant supplier will in turn forward this project description to the concerned in-house functions. In the event of changes, add-ons or other additions, these must be communicated to the project management. Only stipulations documented here in writing are applicable as binding.

**Verbal ancillary agreements have no validity.**

A distribution list will be submitted, please refer to Contacts at/Distribution list.

Each edition of the target specification will be issued with a new version number.

Every change will be optically highlighted, with a view to improving legibility for individuals in respect of any changes in the text.

With the issue of a new version number, the previous changes will be adopted as accepted into the text.

The project description will be distributed in PDF format.

### 3 Definition of terms

The following terms will be used in the target specification:

Frame timber	The frame timber is the generic term given to the frame around the central core. This can be made of different materials.
Upright frame timber	These are the upright timbers running lengthways along the edge of the door.
Transverse frame timber	These are the transverse timbers running at right angles to the upright frame timbers at the top and bottom of the door. Two timbers can also be used at the bottom.
Central core	This term describes the core layer in the centre of the door manufactured using different panel materials. (The frame timbers are laid around this core.)
Tubular chipboard	A filler board with defined tubular cavities running transversely to the door (width)
PUR hard foam	A foamed panel made of plastic
Barrier panels	Panels laid symmetrically on both sides of the central core. Materials which can be used are thin chipboard, MDF or hard fibreboard panels.
Cover layer	The visible surface of the door leaf. This can comprise a variety of materials. (veneer – HPL – lacquer)
CPL	<b>C</b> ontinuous- <b>P</b> ressed- <b>L</b> aminate
HPL	<b>H</b> igh- <b>P</b> ressure- <b>L</b> aminate
Vapour barrier	This is generally placed between the central core and the barrier panel. Its function is to prevent the absorption of moisture in the door.
Head side	The upper transverse edge of the door leaf.
Threshold side	The lower transverse edge of the door leaf.
Lock case	This is the trimmed recess on the upright door edge to accommodate the lock.
Overhang	The dimensional difference (length - width) of different layers of the door leaf positioned one on top of the other.
EPI adhesive	EPI adhesive is a glue which permits aluminium to be stuck onto wood-based materials.
MUF adhesive	<b>M</b> odified <b>U</b> rea <b>f</b> ormaldehyde <b>g</b> lue
UF adhesive	Urea formaldehyde glue
BOF	Routing centre
KFR	Sizing and edge banding machine

## 4 Framework conditions

### 4.1 Working hours

The company works in both single and multiple-shift operation. When and where it switches to multiple shift operation depends on the order situation and plant capacity.

- We have calculated on the basis of 220 working days a year
- Work periods are set at 7.5 hours per shift.
- We have based the calculation of output on 75% utilization of the available working time (capacity utilization).
- Technical availability according to VDMA, complex interlinking 85%
- Mean degree of utilization 75%
- **Technical availability of press line: complex interlinking 85%**
- **Technical availability of edging line: complex standalone machine 85%**
- **Technical availability of lock and hinge line: complex standalone machine 90%**
- **Technical availability of BOF 722: complex standalone machine 90%**

#### Technical availability according to VDMA

Standalone machine	90 - 95%
Complex standalone machine/simple interlinking	85 - 90%
Complex interlinking	83 - 88%
Multiple shift operation with two shifts	2 %
Multiple shift operation with three shifts	5 %

#### Note:

The production output is batch size and workpiece dependent.

The set-up input is dependent upon the product spectrum and organization.

The end customer is responsible for the processing materials.

#### 4.1.1 At the BOF 722

##### **1-shift**

Number of working days	Days	220
Number of shifts per day	Shifts	1
Hours per shift	Hours	7.5
Mean degree of utilization	%	75
Usable shift duration	Minutes/shift	338
Hours per year and shift	Hours/year	1.238
Minutes per year and shift	Minutes/year	74,250
Minutes per year in total	Minutes/year	148,500

##### **2-shift**

Number of working days	Days	220
Number of shifts per day	Shifts	2
Hours per shift	Hours	7,3
Mean degree of utilization	%	75
Usable shift duration	Minutes/shift	328
Hours per year <b>2-shift</b>	Hours/year	2.409
Minutes per year and shift	Minutes/year	72.220
Minutes per year total	Minutes/year	144.540

#### 4.1.2 In the remaining operations

Number of shifts per day	Shifts	1
Hours per shift	Hours	7.5
Mean degree of utilization	%	75
Usable shift duration	Minutes/shift	338
Hours per year	Hours/year	1.238
Minutes per year	Minutes/year	74,250

## 4.2 Product designations, quantities and dimensions

### 4.2.1 Product designation

We use the following designations for the following product definition:

- External doors standard with decor recesses "A"
- Institution doors "B"
- External door with standard core "C"

### 4.2.2 Quantities

Doors with the following designation will be produced in single-shift operation per annum:

#### 4.2.2.1 In single-shift operation

Remark:

The values specified below in table 1 relate to manufacture of the door leaf.

Table 1

Type of door:	Total	Pcs./h
External doors <b>thickness up to 60 mm</b>	70.000	56,57
Internal doors <b>thickness up to 41 mm</b>	40.000	32,32
Internal doors <b>thickness up to 60 mm</b>	10.000	8,08
<b>Total per year</b>	<b>120,000</b>	<b>96,97</b>

The quantities specified above contain the work steps hinge and lock trimming for all the doors, whereby half of each of the doors (50:50) entail 2 or 3 hinge trimming processes.

This corresponds to an output of:

1.62 doors/minute or  
0.62 minutes/door (= 37.12 seconds/door)

#### 4.2.2.2 In two-shift operation

The quantities specified in table 2 are derived from table 1 and are divided per year into 2 shifts for NC processing BOF 722 as follows:

Table 2

External doors:	Total	Pcs./h
With glass	58,500	23,64
With grooves on one side	51,000	20,61
With grooves on two sides	18,000	7,27
Internal doors:		
With glass 40 mm	8,000	3,23
With glass 56 mm	1,000	0.40

As a computational mean value, it is safe to assume 78,000 doors in 2-shift operation

31.52 doors/hour, or  
0.53 doors/minute, or  
1.9 minutes/door, (= 114.21 seconds/door).

#### 4.2.2.3 Performance of press LAS 230 E

The press has a possible cycle of 330 seconds. This time includes the loading and unloading of 10 daylight.

10-daylight: Door thickness up to 50 mm

9-daylight: Door thickness up to 55 mm

8-daylight: Door thickness up to 60 mm

7-daylight: Door thickness up to 65 mm

Consequently, a door spends at least 330 seconds in the press. Depending on the requirements of the adhesive, this dwell period can be increased or reduced at will.

Note: Use of MUF and UF adhesive. Adhesive manufacturer: Casco Nobel, (Sven Gjerset)

Press temperature 95 degrees Celsius, pressing time: 3.5 min.

#### Performance relative to the number of opened press daylight:

- 10 daylights appr. 2 doors/min
- 9 daylights appr. 1.65 doors/min
- 8 daylights appr. 1.46 doors/min
- 7 daylights appr. 1.28 doors/min

Depending on the adhesive and material used, and the set temperature, the dwell period can change and consequently also the press output.

## 4.3 Dimensions and weights

### 4.3.1 The door leaf

The doors have the following dimensions:

- Minimum Length of 1640 mm
- Maximum Length of 2500 mm
- Minimum Width 600 mm in single track operation
- Minimum Width 280 mm in double track operation (press).
- Maximum Width 1250 mm
- Minimum Door thickness 30 mm
- Maximum Door thickness 65 mm
  - Door weight max. 80 KG.

Note: The length or width differences in a loaded press should not exceed 300 mm, relative to 10-daylight loading.

### 4.3.2 General

- The stacks in production have a maximum height of 1900 mm from the upper edge of the floor. Stack roller conveyor height 300 mm
- For the lifting platforms, a reduced stack height must be taken into consideration corresponding to the load capacity of the lifting platform.
- Equally when using pitless lifting platforms, the maximum stack height must be adjusted to the push-off height (working height).
- The stacks of raw material are aligned vertically and are free of packaging material.
- The dummy boards within production all have the same outside dimensions and thicknesses.
- The aluminium (thickness min. 0.3 mm) has an intrinsic rigidity which allows its sideways alignment using fences. and transporting. Aluminium thickness at Fa. Dooria 0,3-0,5 mm, as discussed at 6.10.06 at Homag.

## 5 Product range

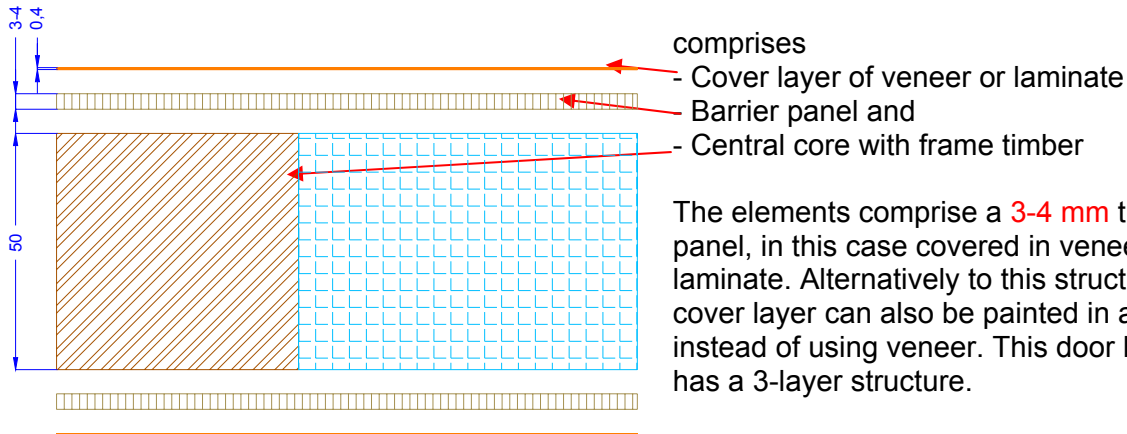
### Door cuts

There are 2 essential differences in the door leaves. External and internal doors are produced. The external doors have a thickness of **max. 65 mm** and are fitted with an integrated vapour barrier.

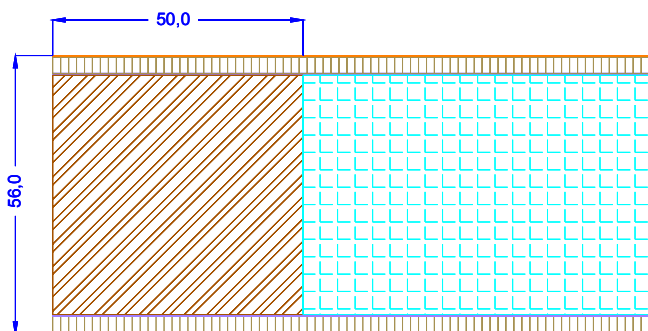
### Internal doors

Internal doors are always made of 5-layer elements. 3-layer doors are also possible.

#### The 5-layer internal door



The elements comprise a **3-4 mm** thick barrier panel, in this case covered in veneer or laminate. Alternatively to this structure, the cover layer can also be painted in a colour instead of using veneer. This door leaf then has a 3-layer structure.



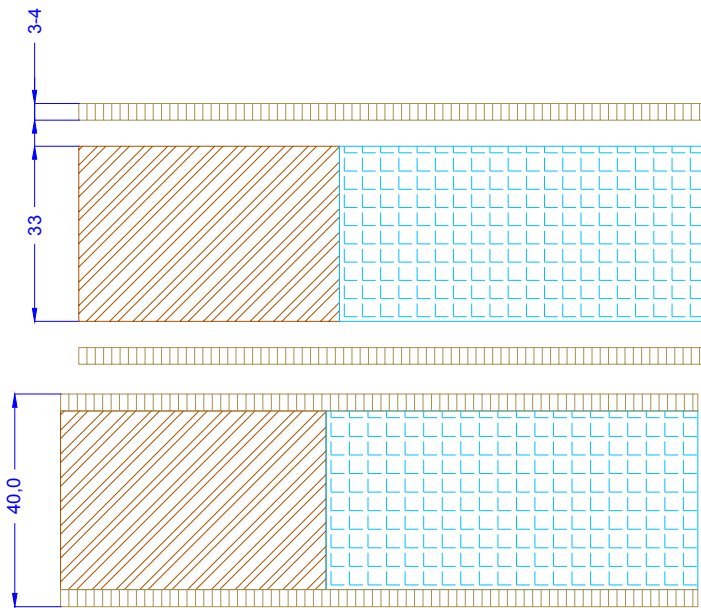
The barrier panel (=layer under the outer coat) comprises a eucalyptus **MDF, HDF or chipboard panel**.

The rails, vertical and transverse, are made of solid wood.

Various materials are used as a central core. These can be for instance PUR hard foam, tubular chipboard, flax board, filler board, combined filler boards for noise protection or also other plastic panels.

## The 3-layer internal door

This comprises a barrier panel at the top and bottom and a central core.

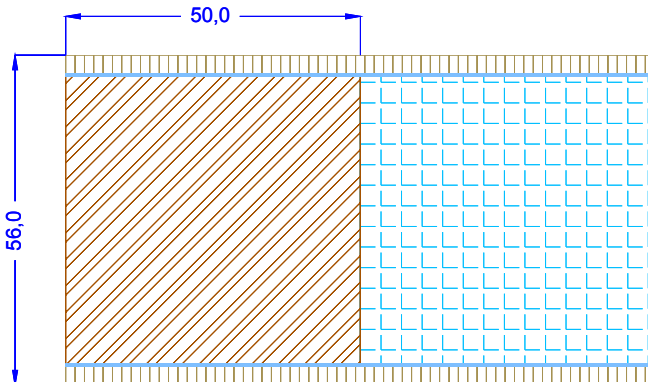


The rails positioned one above the other and the central core are joined in such a way that they form a compact unit. This door blank must not be permitted to come apart or become disassembled into its individual components during the production process. **This refers predominantly to situations in which glue with insufficient adhesive properties and elasticity is used.**

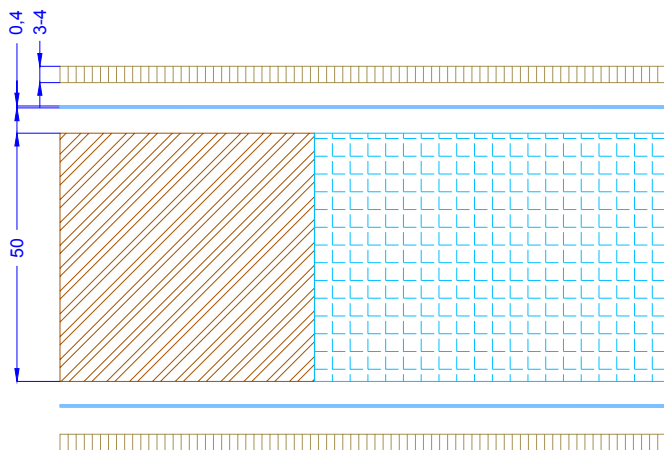
## External door

The 5-layer door

Here, the product spectrum is made up exclusively of 5-layer doors



A 0.3 mm aluminium plate is used as a vapour barrier. This is then always mounted directly on the central core.

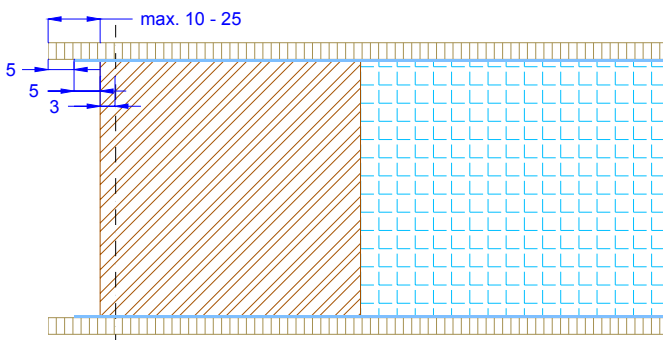


Barrier panel  
Vapour barrier

Core

Vapour barrier  
Barrier panel

## Dimensional allowances



Dimensional allowances are required to permit production.

The finished dimension of the door is the starting dimension. The central core with the outside dimension of the frame is 3 mm larger on each side than the finished door dimension.

The vapour barrier must then be cut 5 mm larger on each side.

The barrier panel must then be cut 5 mm larger than this dimension on each side.

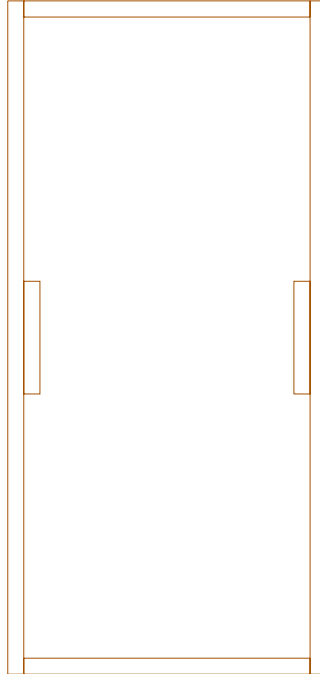
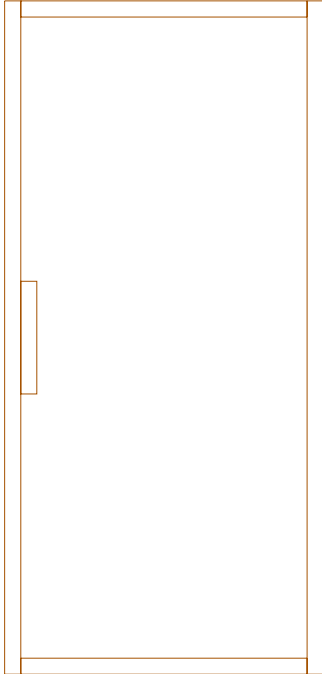
The cover layer material has an allowance of 10-25 mm relative to the rail construction on each of the four sides.

These dimensions and rules must be adhered to, as they form the basis for the reference and processing lines.

### Door views

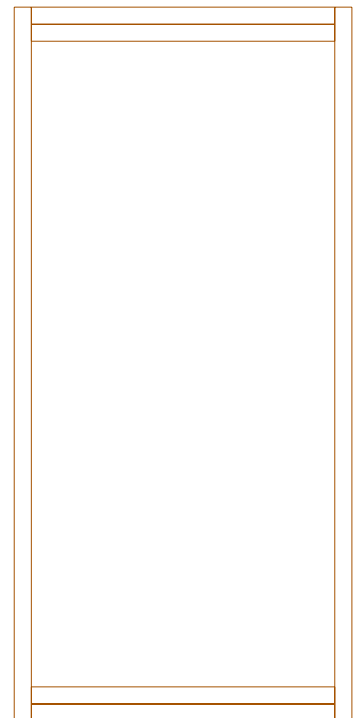
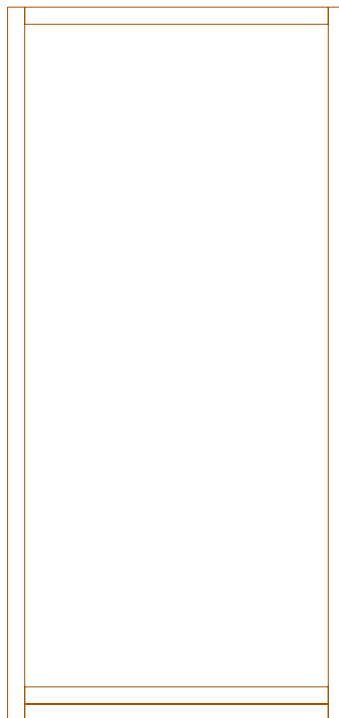
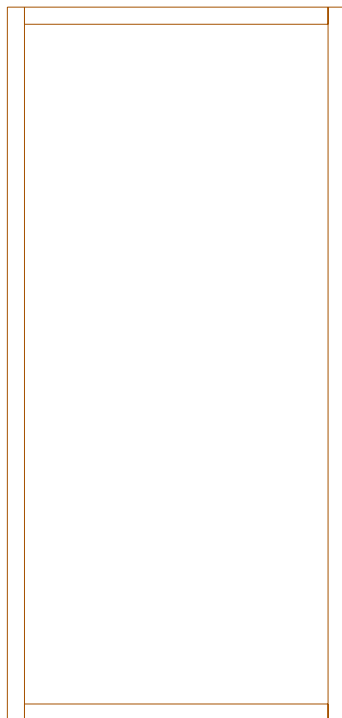
External doors "A" and "C" have the following appearance:

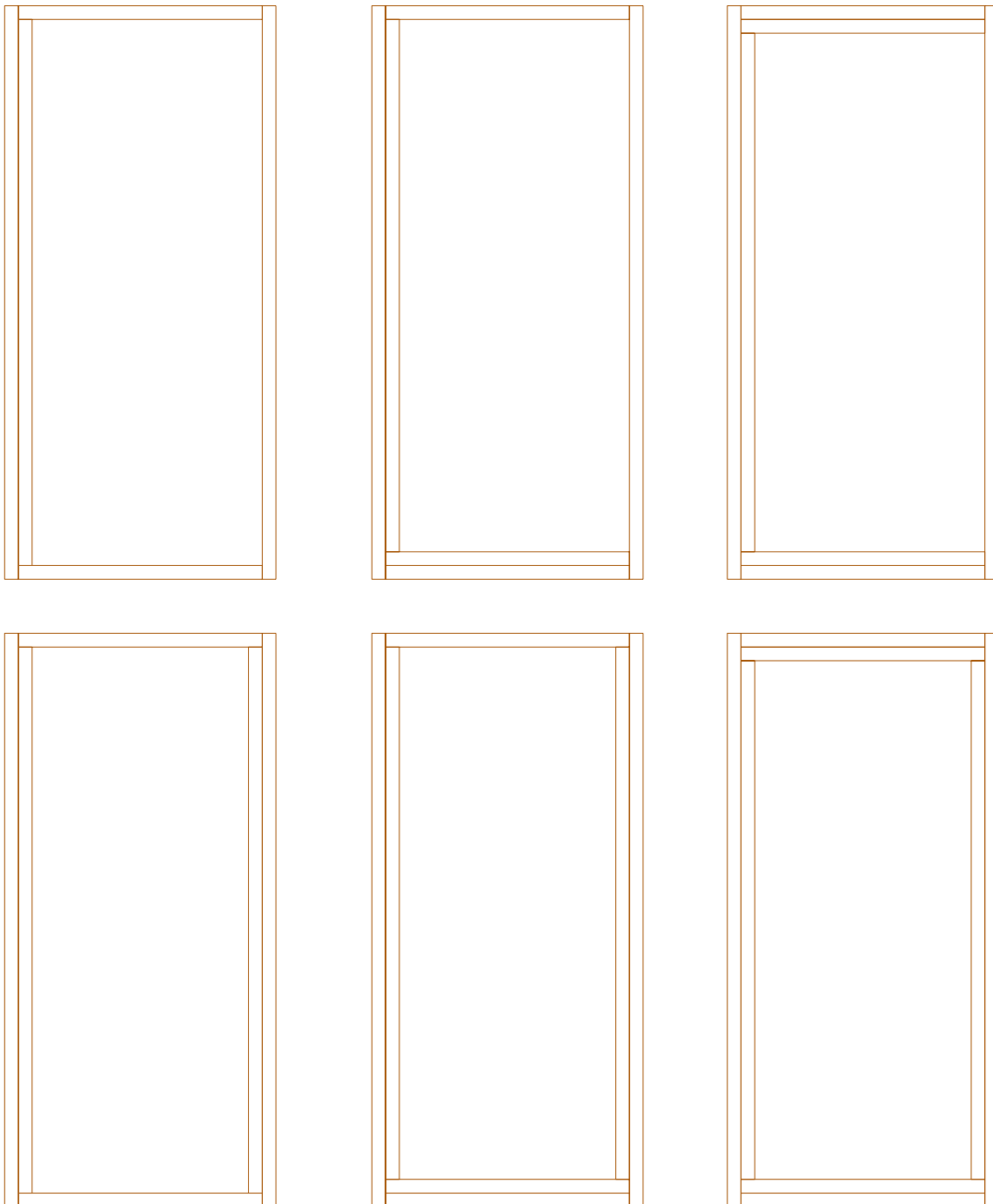
- Standard external doors with decor recesses "A"
- External door with standard core "C"



In detail, the central core comprises the two upright frame timbers (single or double rail) and the two transverse rails. The lock reinforcements are inserted on both sides.

The central core comprises a continuous panel with the relevant recesses for the lock reinforcements.





When producing rails, maximum processing precision must be ensured. Longitudinal warp may not exceed 3 mm over 2000 mm. When assembling, rails must be selected so that any concave warp is on the outside.

Remark:

If warp is greater than 3 mm over 2000 mm, the glue joint at the rail corners is placed under greater strain. This can result in a situation where the corners become detached prior to pressing and rejects are produced.

### **Central cores**

As previously described, the central cores can comprise different materials. These can be:

- Hard foam panels
- Flax boards
- Tubular chipboard panels
- Compact filler panels
- Multiple-layer filler panels for noise protection

The central cores must be supplied to the production process cleaned of dust and sharp edged. Dimensional accuracy must be guaranteed. Overdimensioned panels will result in gaps at the contact edges along the upright and horizontal rails. Overdimensioning also results in faulty connection of the individual components and results in splits in the core which may be visible on the surface. The thickness tolerance between the rails and central core must be kept to a minimum. Otherwise, production will result in markings on the surface and open joints.

## 6 Workpiece parameters

<b>Door dimensions:</b>				
	Length [mm]	Width [mm]	Thickness [mm]	Weight / workpiece [kg]
min.	1640	600 (280)	30	
max.	2500	1250	65	80
Frieze min.	120			

Note: min. width 600 mm in single-track operation (press),  
min. 280 mm in double-track operation. Light recess doors will not be produced until the BOF 722.  
In the press line, edging line and lock/hinge line, no light recess doors will be produced.

<b>Rebate dimensions, single rebate:</b>				
	Rebate height [mm]	Rebate depth [mm]		
min.	14	12 (8mm, only with thin edges, not with thick edges)		
max.	52	18		

No counter rebate doors, no double rebate

<b>Workpiece characteristics:</b>					
Barrier panel material:	MDF, HDF, Eucalyptus panels Chipboard See also door structure, chapter 5				
Coating material:	Melamine, Veneer, Laminate 0,3-3mm				
Surface characteristics:	raw, smooth, tidy, capable of separation, absorbent				
Cover layer overhang after pressing:		left [mm]	right [mm]	front [mm]	back [mm]
	Above max.:	15-25	15-25	25	25
	Below max.:	15-25	15-25	25	25
	Thickness dependent max. 15 mm with door thicknesses 30-40 mm				
	Material:	See barrier panel material			
Distribution	<ul style="list-style-type: none"> <li>- max. 0.2 % on the diagonal, but no more than 2 mm</li> <li>- max. 1mm in width</li> <li>- max. 5 mm in length</li> </ul>				
Processing allowance of rail in edge banding machine	<ul style="list-style-type: none"> <li>- Longitudinal rail 0.4 mm</li> <li>- Transverse rail 0.4 mm</li> </ul>				

## 7 Production parameters

<b>M.00 - M.16 Door blank manufacture</b>	
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	450 / 1200 mm
Max. stack height	Aluminium: 450 mm incl. underlay, max. 2000 kg, Decks: 1400 mm incl. underlay
Pits:	None

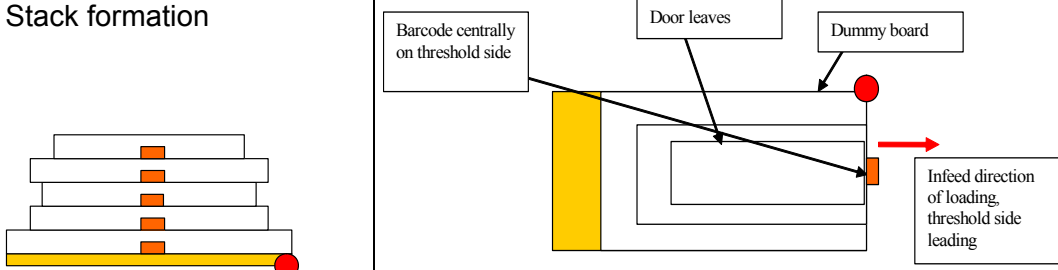
<b>M.30 Door press + Robopress</b>	
Press layout	>600mm in one row, 280-600 mm in two adjacent rows
Shortest pressing cycle:	330 sec.
Working height:	1200 mm

<b>M.32 Dummy board loading + separation</b>	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm
Stacking locations:	2, stack roller conveyor on the left in the throughfeed direction is planned as an intermediate storage buffer.
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Dummy boards:	With steel panel let into the centre of the dummy board at the top and bottom. Detection by metal sensors.
Stack change	Manual, manual dummy board stack feed, upstream stack roller conveyor supplied by the customer
Reference edge:	Central
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 1200 mm

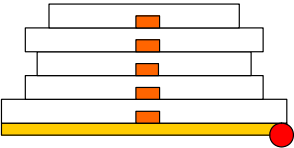
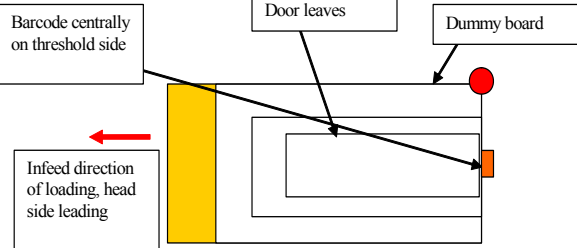
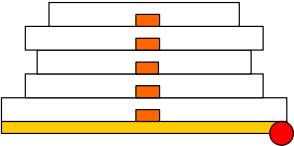
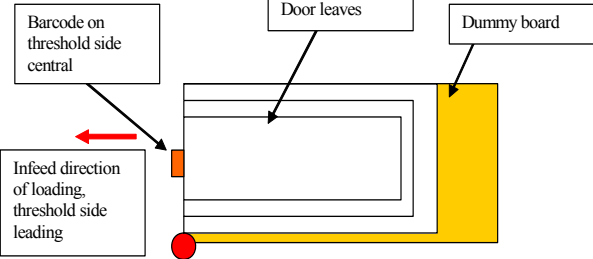
<b>M.34 Cooling turnover device + rotary stations</b>	
Working height:	1200 mm / 1050 mm

<b>M.43 - M.45 Format BOF + infeed and outfeed roller conveyors</b>	
Reference edge:	Right (front)
Feed rate roller conveyors:	5-30 m/min
Dummy boards:	Dummy boards are fed through the BOF. By means of metal detector, the metal plate let into the dummy board is recognized, so that the dummy board travels through the BOF without any processing steps.
Door leaf processing:	Sizing flush, Special rebate transversely at the head and threshold side: Rebate depth: 4 mm Rebate height: 14 - 52 mm

	<p>Rebate with sealing groove as a tool set for external doors, with reduced feed rate for finishing quality (appr. 15 m/min) (assumed cycle time appr. 45 sec.)</p> <p>According to profile drawing</p> <p>Where additional processes are performed, the processing time is increased accordingly this has an effect on processing time. This affects output.</p>
Processing allowance at the rail:	min. 3 mm per side
Cover layer overhang:	max. 15-25 mm on all sides
Working height:	1050 mm

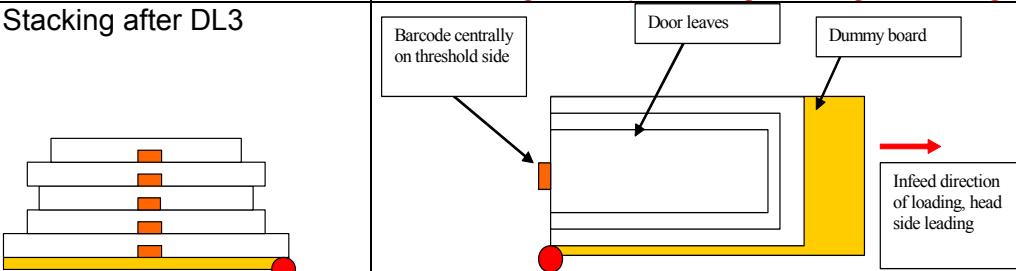
<b>M.47-M.4704 Stacking + traversing slide with thermal transfer printer and chamfer trimming unit</b>	
The label needs to be placed either inside the rebate or on the rebate depending on the threshold side profile of the door, or at the flush bottom side of the door.	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm incl. dummy board
Stacking locations:	2
Dummy board feed:	By dummy board stacker M.32
Stack formation	
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Stack change	Automatic
Reference edge:	From fixed edge right to fixed edge central
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 1050 mm

<b>M.50 Loading edge line</b>	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm incl. dummy board
Stacking locations:	2 Stack feed from the roller conveyor via buffer roller conveyor, stack return via return roller conveyors
Dummy boards infeed:	Dummy boards are transported through the line, workpiece overhang offset, clocked fence from above

<p>Stack feed with DL1</p> 	 <p>Barcode centrally on threshold side</p> <p>Door leaves</p> <p>Dummy board</p> <p>Infeed direction of loading, head side leading</p>
Loading with DL1	90° left-hand rotation (Sequence of sides to produce an the rotation is given by the ERP system.)
Loading with DL2	0° rotation
Loading with DL3	180° rotation
Rebate doors:	<p>There are rebate doors with edging on three sides and rebate doors and flush doors with edging on 4 sides.</p> <p>In the case of rebate doors with edging on 4 sides, the sequence is as follows.</p> <ol style="list-style-type: none"> <li>1. Transverse processing head side</li> <li>2. Transverse processing threshold side</li> <li>3. Longitudinal processing 1st longitudinal edge</li> <li>4. Longitudinal processing 2nd longitudinal edge</li> </ol>
<p>Stack feed with DL2 and DL3</p> 	 <p>Barcode on threshold side central</p> <p>Door leaves</p> <p>Dummy board</p> <p>Infeed direction of loading, threshold side leading</p>
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Stack change	Automatic
Reference edge:	From fixed edge right to fixed edge central
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 950 mm

<b>M.51 - M.5101 Rebate edge machine + thermal transfer printer</b>	
Reference edge:	Right
Feed rate:	15-22 m/min
Workpiece overhang:	80 mm / 0 mm
Dummy boards:	Dummy boards are transported through the line with 0 mm workpiece overhang.
Minimum gap:	1000 mm
Door leaf processing:	<p>Flush doors: Straight, with thin edge, thick edge and flush doors with radius profile above / below</p> <p>Rebate processing and rebate edge gluing, straight door overlay radius profile at door overlay and at rebate run-out,</p> <p>Thick edge at the door overlay.</p> <p>According to profile drawing</p>
Processing allowance:	0.4 mm per side

Place for label	Labels need to be placed a fix distance from the top side, (following the machine top pressure beam). This due to possible rebate on bottom edge of the door.
Edging material rebate edge:	Melamine edge 0.3-0.4 mm Veneer edge, fleece laminated and sanded 0.4 mm The edging material must be suitable for rebate gluing.
Working height:	950 mm

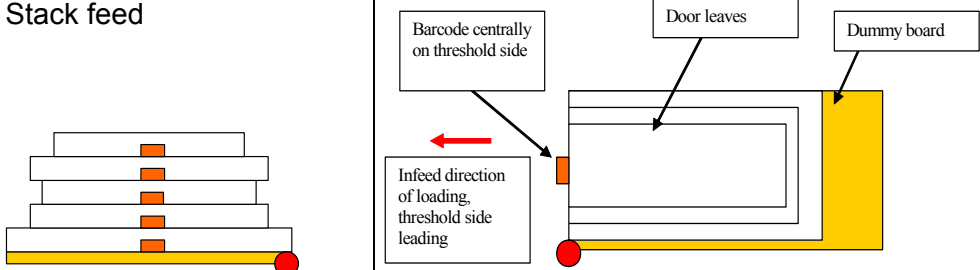
<b>M.52 - M.5201 Stacking edging line + Dummy board magazine</b>	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm incl. dummy board
Stacking locations:	2 Stack feed from the roller conveyor via buffer roller conveyors, stack return feed via return feed roller conveyors
Dummy board infeed:	The 1 <sup>st</sup> dummy board is fed via the transverse conveyor to the two stacking locations. The following dummy boards are conveyed through the line and fed towards the stacking station.
Dummy board magazine:	stack height max. 300 mm
Stacking after DL1	90° left-hand rotation (Sequence of sides to produce an the rotation is given by the ERP system.)
Stacking after DL2	0° rotation
Stacking after DL3	180° rotation
Rebate doors:	There are rebate doors with edging on three sides and rebate doors and flush doors with edging on 4 sides. In the case of rebate doors with edging on 4 sides, the sequence is as follows 5. Transverse processing head side 6. Transverse processing threshold side 7. Longitudinal processing 1st longitudinal edge 8. Longitudinal processing 2nd longitudinal edge
Stacking after DL3	
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Stack change	Automatic
Reference edge:	From fixed edge right to fixed edge centre
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 950 mm

<b>M.60 Stack roller conveyors</b>	
Fixed edge:	left
Feed rate:	12 m/min
Roller conveyors:	sectioned

## 7.1

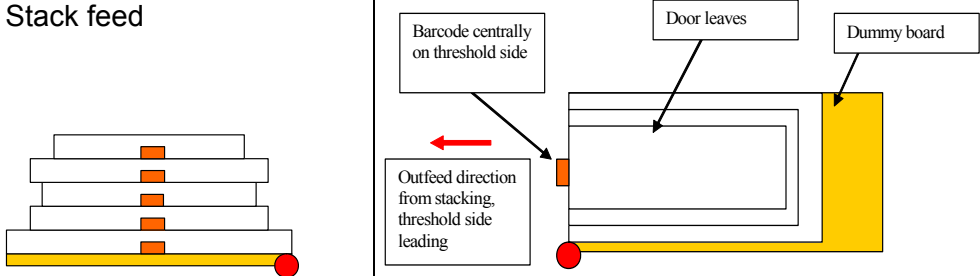
<b>M.61 Crane gantry for BOF722 + alignment station, turnover station and stack roller conveyors</b>	
Reference edge:	From middle centred stack, alignment with zero point left front
Feed rate stack roller conveyors:	12 m/min
Dummy board handling:	Partially automated
Working height:	300 / 1020 mm

<b>M.63 - M.6301 Router BOF722</b>	
Reference edge:	left front
Workpiece overhang:	0 mm
Door leaf processing:	Surface trimmed recesses, cut-outs, Grooving according to profile drawing
Working height:	1020 mm

<b>M.80 - M.8002 Loading lock &amp; hinge processing machine + stack roller conveyors</b>	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm incl. dummy board
Stacking locations:	3
Stack feed	
Loading	0° or 180° rotation, depending on DIN left/right
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Stack change	Automatic
Reference edge:	From central to fixed left edge
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 1000 mm

<b>M.81 - M.8101 SBL520 Lock &amp; hinge processing machine</b>	
Reference edge:	left
Feed rate:	Stop & Go machine
Workpiece overhang:	Lock side 200 mm, hinge side 50 mm
Dummy boards:	Are conveyed through the line
Door leaf processing:	Lock processing, hinge processing, butt hinges and screw-in hinges

Min. door leaf width	500 mm, for door leaf widths smaller than 500 mm lock and hinge processing will be carried out on the BOF 722, Hinge processing as well +/- 3°
Working height:	1000 mm

<b>M.82 - M.8202 stacking lock &amp; hinge processing machine + stacking roller conveyors</b>	
Bottom edge of stack:	from floor 300 +/-20 mm
Top edge of stack:	from floor 1900 mm incl. dummy board
Stacking locations:	5
Stack feed	
Loading	0° or 180° rotation, depending on DIN left/right
Stack underlay:	Dummy boards, dimensions: 2440 x 1000 x 22 mm
Stack change	Automatic
Reference edge:	from fixed edge left to centre
Feed rate stack roller conveyor:	12 m/min
Feed rate depositing roller conveyor:	10 – 50 m/min
Working height:	300 / 1000 mm

<b>M.90 Stack roller conveyors</b>	
Fixed edge:	left
Feed rate:	12 m/min
Roller conveyors:	sectioned

<b>M.91 Stack roller conveyors</b>	
Fixed edge:	left
Feed rate:	12 m/min
Roller conveyors:	sectioned

<b>M.92 Stack roller conveyors</b>	
Fixed edge:	left
Feed rate:	12 m/min
Roller conveyors:	sectioned

## 8 Process description

The description is in alignment with the production sequence and starts with blank production

### 8.1 Blank production

- Barrier panels

- For larger quantities store on 4 stacking locations distributed centrally below gantry M.06.
- Position stack in infeed direction to front edge.
- The gantry carriage is positioned centrally above the stack.
- The height of the stack is determined by the gantry.
- The operator defines where which stack is deposited under the gantry.
- The operator registers completed loading and stacking location to the control system.
- During loading with a new stack, the gantry is completely stationary.
- **Manual line removal and stacking.**

- Gantry carriage

- After starting the production process, removal of material from the correct location, specified by the control system.
- The gantry carriage traverses over the selected stacking location and lifts off a barrier panel.
- The gantry carriage then traverses via the roller conveyor M.06/G.0022 and deposits the panel centrally on it. The next cycle begins.

- Roller conveyor M.05/G.0004

- Upstream from M 05, the roller conveyor is fed with vapour barriers by the fork lift. Here, too, stacking takes place centrally aligned.
- The pack is manually moved onto the roller conveyor of lifting platform M.05.
- The pack is positioned aligned at the leading edge.
- After acknowledging the loading process, the lifting platform traverses to the unloading position.
- Infeed starts, initiated by the line control system.
- The vapour barrier is traversed via roller conveyors M.06/G.0022 and M.08 towards the brushing machine M.09.

- The empty pallet is manually removed.

- Roller conveyor M.06/G.0022

- Engages the barrier panel / aluminium, and traverses to the stop position.

- Roller conveyor M.08

- After control release, the barrier panel travels as far as the end.
- The centering device aligns the barrier panel.
- The aluminium is not damaged during this process.

- Brushing machine M.09

- The brushing machine is previously set to the required thickness by the line control system.
- On release by the control system, the cleaning process is started and alignment takes place with the downstream roller M.10.
- The system stops immediately upstream from the glue application machine M.11.

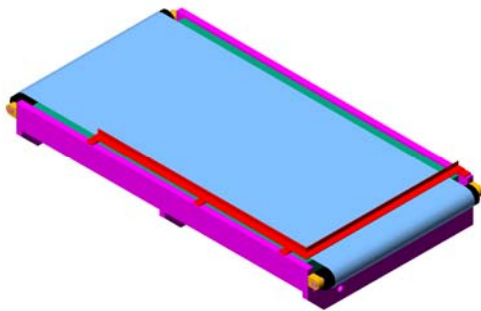
- Glue application machine M.11

- Initiated by the line control system, the glue application machine automatically adjusts to the thickness.
- Application is started by the control system.
- In the case of 5-layer doors, adhesive is applied to both sides.
- The adhesive quantity is manually preset and then automatically applied on alternate sides through preselection by the control system.
- In the case of 3-layer doors, the adhesive is applied on one side from below onto the barrier panels.
- During the normal sequence, it is possible to change over from 3 to 5 layer doors.
- When changing from 5 to 3-layer doors, the production line must be stopped and the glue application machine cleaned.
- At the outfeed, a defined stop of the barrier panel takes place in the longitudinal direction.

- Turnover device M.12
    - Sequence for 3-layer door
    - The turnover device from M.12/G.001 lifts the barrier panel from above and turns it in the direction of roller conveyor M.12/G.007. The suction arm of the turnover device, which is now underneath, releases the barrier panel.
    - The turnover device now remains in this position (idle position) until the next turnover process.
  
    - 5-layer door:
      - The turnover device has no function.
  
  - Plate roller conveyor M.15/G.0031
    - The barrier panel is aligned parallel to the left-hand longitudinal edge.
    - The barrier panel is fed out towards the depositing area of M.15/G.0025.
    - The barrier panel is now lying precisely aligned on the depositing conveyor M.15/G.0025.
  
  - Gantry M.15/G.00
    - In the case of 3-layer doors, the rake from gantry carriage “1” travels under the barrier panel.
    - This is placed in the depositing position on M.15/G.0025 on top of the previously positioned sandwich.
- The gantry carriage “2” is already in the depositing position.
  - As soon as gantry “1” is in position, gantry “2” lowers the stripper.
  - Gantry “1” travels back to the starting position.
  - In the case of 5-layer doors, first the unglued barrier panel is deposited on the alignment table M.15/G.0019.
  - Traversing carriage “3” engages the barrier panel and places it precisely aligned on the depositing conveyor M.15/G.0025.
  - The aluminium vapour barrier is traversed into the depositing position by carriage “1”.
  - Traversing carriage “2” is already in the depositing position and lowers the stripper.
  - Carriage “1” returns to the starting position and deposits the vapour barrier.
  - From the transfer tray, the central core is traversed to the push-on position.
  - Carriage “2” is in position and lowers the stripper.
  - The vapour barrier is transported by carriage “1” as described above and is deposited.
  - The barrier panel is transported by carriage “3” and is deposited.

## 8.2 Central core assembly

- On principle, the door blanks are produced and transported with the threshold side leading in the direction of transport (to the right in the drawing).
- The central cores are produced in parallel, for which the individual components to complete the orders in hand are located within reach of the M.02.
- Information regarding which door has to be produced is communicated to the operator by means of lists (prepared by the line manager).
- M.02 Assembly conveyor



- The assembly table M.02 is swivel mounted. While the central core is assembled, the table is swivelled upwards into the work position.
- The operator first deposits the lower upright rail horizontally in line with the fence.
- The operator accesses the relevant label from the label printer, and glues it centrally on the underneath edge of the threshold side.
- The central core is next. For this, a bead of hot melt glue is applied on the contact edge of the deposited rail. The central core is then positioned and pressed against the rail edge.
- The upper transverse rail (head edge) is then picked up, coated on the face edges with hot-melt assembly glue. It is then deposited against the fence and pressed onto the upright rail.
- The remaining rails are then also painted with hot melt glue and deposited for a precision fit against the core.
- Once the central core has been completed, the assembly table is swivelled back to the horizontal.

- The central core is conveyed out in the direction of M 03.
  - Conveyor belt M.03
    - Cycle for a 3-layer door
    - The conveyor belts convey the central core until it is below the push-off device M.04.
  - Push-off device M.04
    - The push-off device drops below the central core and pushes it as far as the end position onto the transfer tray. The central core is now precisely deposited in the longitudinal direction.
  - Transfer tray M.15/G.0022
    - The transfer tray now starts to move in the direction of the depositing belt M.15/G.0025.
    - After the transfer tray has reached the end position, the strippers of gantry "2" are lowered.
    - The transfer tray returns to the starting position. The central core is now lying precisely on the lower barrier panel / vapour barrier.
  - In the case of 5-layer doors
    - Here initially the barrier panel is engaged by lifting platform M.15/G.0016, aligned and deposited on conveyor belts M.15/G.0019.
    - After release by the operator, the barrier panels are transported away transversely, aligned at the fences and stopped.
    - Gantry carriage "3" lowers and engages the barrier panel by suction, lifts it and traverses to the still empty depositing belt. Here, the barrier panels are precisely deposited.
    - The work processes deposit bottom vapour barrier and central core are now performed as described previously.
    - Finally, the upper barrier panel is deposited.
  - Finish deposited sandwich
    - The finish deposited sandwich is transferred to the transverse shunting truck M.15/G.0013.

- Special feature
- The special feature to be noted here is that narrow doors (narrower than 600 mm) are transferred in parallel in pairs from the transverse shunting truck.
- For this purpose, the transverse shunting truck is steered to the relevant correct position and individually engages the centrally aligned doors. The transverse shunting truck then traverses to the transfer position into the process.
- Press M.30
- Here, first the door(s) are transferred to the loading tray, traversed in the longitudinal direction into position and stopped.
- At the press, the specific pressure and overall pressure have previously been manually set.
- As soon as the press is ready for loading, the loading tray traverses into the previously opened daylight and while doing so pushes out the door it is carrying.
- For sensitive surfaces, the Robopress is used for removal.
- During retraction of the loading tray, the door is deposited in the daylight.
- As soon as the loading tray has reached its end position, the press closes the daylight and builds up the set pressing pressure.
- The next cycle can begin.
- The finish pressed door blanks, which are ejected out of the back of the press, are placed on the roller conveyor, which transports the blanks through underneath the gantry.
- In the case of narrow doors, the doors are further transported singly by this roller conveyor.
- Gantry M.32
- Should a fault occur in the sequence, the press must be capable of being emptied under any circumstances.
- For this purpose, the blank is ejected. The door in question is removed from the line and deposited on the left-hand location (along the wall) on square timbers.
- After remedy of the fault, the stack is first worked through before restarting the normal sequence.
- It should be noted that the doors are now loaded back into the line in reverse sequence.
- On the right-hand roller conveyor (in front of the line), dummy boards are stored. These are accessed by the control system and fed into the line as required.
- The dummy boards have to be manually placed ready on the roller conveyor.
- Rotary station
- Subsequently, the blank reaches the rotary station M.34/N.02.
- Here, the blank is rotated by 90 degrees.
- Conveyor belts engage the transversely positioned blank and transport it to the forks of the cooling turnover device.
- The doors are cyclically clocked through the cooling turnover device and deposited turned the other way up.
- The door is then turned back again in rotary station M.34/N.04 and deposited on the roller conveyor.
- The door is then guided under the scanner on roller conveyor M.43, during which the barcode is read and communicated to the control system.
- The control system processes the information and transmits it to the processing centre M.44.
- Processing centre M.44
- On the processing centre, the door is processed all round to a defined dimension.
- At the outfeed, the door is centred via the roller conveyor M.45 and fed towards the stacker.
- Traversing carriage with labelling and chamfer trimming devices M.4701 and M.4704
- The door is precisely aligned at the fence and clamped in position.
- Using the trimming device integrated on the traversing carriage, the threshold side is chamfered above and below
- The control system transmits the relevant data.
- The current label is applied.
- The door is released and transferred to the stacker.
- Stacker M.47

- The door is stopped centred in alignment with the threshold side.
- The door is stacked with the threshold side leading.
- The control system defines how many doors are located on the stack.
- The full stacks are then automatically traversed out of the stacker onto the stack roller conveyor at the request of the production line control.

- The dummy boards are fed as required and called forward by the control system through the production path to the stacker. They are deposited on the empty accumulating roller conveyor.
- Each stack is recognized by the control system and its progress monitored during the subsequent production sequence.
- The control system governs operation of the transverse shunting truck and the automated accumulating roller conveyor.

### 8.3 Edge processing

- The material stacks are transferred to the roller conveyor M.90 via the transverse pushing device.
- At the end of this accumulating conveyor line, the stack is processed in sequence.
- Gantry M 50
  - Prior to the start of production, a check is performed on the stack roller conveyor to determine if an empty dummy board is in place or if there is a stack which needs to be filled with the remaining doors.
  - Gantry M.50 then traverses over the stack, engages the first door and lifts it.
  - In the stack, the bar code is scanned and transmitted to the control system.
  - Via the control system, the gantry is informed how the door has to be handled.
  - First of all, the door must be rotated by **90 degrees at first run only for 3 or more runs**, as the first work step is to process the head edge.
  - Stack return transport takes place on the conveyor back to the M50 gantry.
- Edge processing machine M.51
  - The door then travels through the edge processing machine and is processed in accordance with the program.
  - Once the third / fourth pass (=threshold side) has been completed, a new label is

printed on at the end of the edge processing machine.

- Gantry M.52
  - After the completion of processing, the gantry engages the door at the machine outfeed and turns it in a defined movement in the longitudinal direction so that the label is now positioned on the leading edge (threshold side) in the direction of transport, and then deposits it on the roller conveyor.
  - Stack return transport takes place on the conveyor back to the M.50 gantry.
  - The third and where applicable fourth pass take place according to the same principle.
  - The finished doors are turned in such a way that the label can be **read** at the trailing edge on the roller conveyor in the direction of transport.
  - The finished stack is transferred to the transverse pusher and forwarded to the roller conveyors.
  - The empty dummy boards are conveyed through the line in the same way as a door, but without being processed. **The first dummy board is drawn from a dummy board magazine under the roller conveyor. Until they are required, the dummy boards are kept in intermediate storage in a magazine under the roller conveyor.**

### 8.4 Lock and hinge processing

- Gantry M.80
  - The door stacks on the roller conveyors M.80/N.01 are conveyed under the gantry.

From here, the gantry carriage engages the first door and traverses over the depositing position.

- At the crossbeam, the scanner reads the barcode.
  - The control system informs the gantry carriage whether the door needs to be rotated or can be directly deposited. This depends on whether the hinging side is left or right.
  - The deposited door is aligned and is transported into the lock and hinge processing machine, which has now been set up correctly.
  - Lock and hinge processing M.81
    - The lock and hinge side are trimmed in accordance with the specifications provided by the control system.
    - The processed door is transported out of the machine and stopped at the end of the roller conveyor.
- Gantry M.82
    - The gantry carriage engages the door and stacks it on the roller conveyors under the gantry.
    - Depending on the position of the label, the door is previously turned in such a way that the label comes to rest on the leading side in the direction of transport (threshold side).
    - The finished stacks are engaged by the transverse pusher.
    - The production line control system informs the gantry of the stacking position.
    - The finished stacks are engaged by the ride-on transverse shunting truck.
    - The control system decides whether the stack is transferred direct for the next processing step "lacquering" on roller conveyors M.91 / M.92.
    - The transverse pusher also engages finish processed stacks from the roller conveyor M.91 and transfers them to M.92.

## 8.5 BOF722 trimming machine M.63

- Gantry M 61
- Stacks from the infeed roller conveyor are lifted by gantry M61.
- The gantry then travels to the alignment table.
- Here, initially the scanner reads the barcode.
- The data is transmitted to the control system.
- Processing centre M.63 is set up.
- In the meantime, the door has been deposited and aligned.
- The gantry engages the door and deposits it in a predetermined deposit position at the processing centre.
- The processing centre starts the work cycle.
- If necessary, the door is removed from this position and deposited on the turnover table. The door is turned over, realigned and deposited back on the processing machine.

- Once the door is finished, if necessary the door is turned back over and stacked on the outfeed roller conveyor.
- The empty dummy boards of the new stack are engaged by the gantry and deposited on the dummy board station. There is always a supply of dummy boards available on the dummy board station.
- The sequence of doors can change due to the varying duration of the different work cycles.

- Processing centre M.63
- The data is transmitted by the control system.
- Both tables work separately from each other.
- Waste from light cut-outs is automatically disposed of.

## 8.6 Assembly department

- The finished stacks with doors are engaged by the existing on-site transverse pusher.
- Depending on further processing, they are then deposited on the stack roller

conveyors in the assembly area or pushed off via the roller conveyors.

## 9 Control system

Control of the individual processing islands corresponds to customer's server.

All relevant data for the production of doors is made available to the host computer of the individual processing islands according to the shape and format still to be determined.

The following points may be taken as agreed:

- 1) For each door leaf, an independent data record will be generated.
- 2) Each data record encompasses all the necessary data for manufacture of the door.
- 3) The line control system does not calculate any data required for manufacture of the doors.
- 4) The doors to be produced will be collated by the customer to form production lists and sorted according to optimum production criteria. It should be noted that the production route also constitutes a criterion.
- 5) Changes to lists are limited to marking of items as doors which are not to be produced (mark data record). The

change can only be made from the production line host computer.

- 6) Doors which sustain damage during production must always be finished in the relevant section. A list must be drawn up by the host computer which indicates doors which have not been produced.
- 7) The logistical infrastructure for roller conveyor and transverse pusher transport systems must be provided by the customer in respect of interfaces to existing machines. A production order = list can only always contain the same production sequence.
- 8) Stacks in production are not broken down into different production routes. [After the Door Lock- & Hinge machine the stacks can be divided in different production routes.](#)

### 9.1 Data link

Data preparation	
Production line control:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Data transfer from customer's own ERP system:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Bar code control:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Printer link:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

The exchange of data is still to be defined together with the customer in a separate interface discussion to be held at Homag.

## 10 Project documentation / Project sequence

Documents			
	Available	Format	Drawing no.
Profile drawings	OK	PDF	5-900-03-0734
Hall layout	OK	DXF	5-400-06-3432
Foundation Layout	OK	DXF	5-400-06-4020
Sandwich Line	OK	DXF	5-300-58-0502
Press Linie	OK	DXF	5-600-02-6380
Edge Linie	OK	DXF	5-600-02-6390
Lock- & Hinge Line	OK	DXF	5-600-75-5474
Lock- & Hinge Foundation	OK	DXF	5-300-58-0521
BOF722 Line	OK	DXF	5-122-01-0200

If there is a changing in the Layout it will be marked with A, B, C ... or the last number will be changed.

### 10.1 Tolerances at the finished workpiece

Tolerances according to DIN

### 10.2 Installation

At the beginning of the installation process, all parts of the building must be fit for occupation and the environmental conditions adapted in line with the circumstances. The following work must have been completed:

- Foundation work
- Extraction systems
- Power supply
- Compressed air connection
- Energy supply from above (main connection)

### 10.3 Resources/test materials

The following must be supplied by the customer free of charge:

- Transport aids (crane, fork lift)
- Assistant personnel
- Test materials for run-in of the line

The following must be made available for running-in purposes by the customer by eight weeks prior to delivery:

- Original tools
- Run-in material including all extreme measurements, with cover layer overhang as shown in the profile drawing.
- Edging material
- Adhesive

### 10.4 Project management

- Compilation of the target specification
- Planning and layout
- Project management
- Machine acceptance in supplier plants and on end customer's premises

### 10.5 Cable routing

- Cables to be routed over the ceiling, height 3500 mm
- The switch cabinets are located on the floor