Full Automatic Patching Line

Introducción
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Line construction
Working principle

- After VDA scanning veneer sheets are mechanically squared in fixed position before patching (constant zero for origo)
- Defects are positioned by xyz – cartesian robot by moving the veneer
- Patching heads are mounted in solid fixed frame
- Each patching head has its own strip magazine
New Features

• all machine adjustments are carried out by electrically
  – patch height position in veneer with 1/100mm accuracy
  – optimization of the functions for higher patching capacity
    • Top die lowered top position in patching vs. receiving the new veneer
    • x–direction slowered acceleration when veneer has a split. No compromise with solid veneer which will be moved with full speed
  – Controlling the veneer gripper gripping position depending the veneer size
• Separate running recipes
  – Fastest patching route depending veneer sizes
  – Veneer flow for patching as a one mat, minimum gap between sheets
• Totally new patching heads
  – planetary roller screw actuators (Exlar), 2each/patch head (ea. Novator 3 patching levels 6 patching heads and 12 each Exlars)
  – no more polyurethane patching anvil
  – solid tool steel dies
  – sharpening is just a simple flat grinding (lathe knife grinder may be used)
Veneer sizes

- Veneer squaring and gripper positioning
  - Squaring plate movement 160mm

![Diagram showing veneer sizes and components](https://via.placeholder.com/150)
Die movements
Die Sharpening

- Die includes two parts, Foot and Die.
- Sharpening is carried out while the foot is mounted to the die. This will ensure the flushness of the die and mounting surface.
- After die has worn out, the new die will be mounted to the existing foot.

Sharpening length 5mm (1/5”)
One sharpening takes 0.1mm
50 sharpening
Sharpening span 1-2milj. patch
Die live span 50-100milj. patch
Die calibration

• After die grinding the die position must be calibrated
  • Head 1 or 2
  • Calibration plate thickness
  • Calibration plate
  • Start button
### Die adjustment

- Patch height on veneer surface
- Patch is compressed in patch placing position
- Dies fine tuned position in defect placement into strip
- Dies fine tuned position in strip feeding

<table>
<thead>
<tr>
<th></th>
<th>Offset “compression”</th>
<th>Patch depth offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>+0.04</td>
<td>+0.25</td>
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<tr>
<td>F2</td>
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<td>F3</td>
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<td>F4</td>
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<td>F5</td>
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**Parameters:**

- **Patch depth offset**
- **Offset “compression”**
- **Upper die: defect cut position offset**
- **Lower die: defect cut position offset**
- **Upper die: strip feeding position offset**
- **Lower die: strip feeding position offset**

**Patching Line**

[Image of Patching Line interface with adjustments highlighted]
2mm stainless steel
Cut half way with no die damages

17mm birch plywood (13ply)
Cut all the way through with no die damages
Cartecian Robots for Veneer Moving

- Vendor Festo supplied unit
- Available models depending veneer sizes
  - Y -direction 5, 8 and 10ft (along the line)
  - X -direction 5 and 8ft (across the line)
- Motors can be selected according to market area
- Motor cables has connectors for easy change of cat track part of the cable (this part of cable is wear part).
Veneer gripper

- Frame of gripper is aluminium profile
- 4+5 suction cup pairs, divided for two separate suction areas which can be controlled by running recipe

- 3-position vertical movement
  - low, gripping position, 0
  - middle, move position, +20mm
  - top, return movement, +100mm
  - two vertical linear bearings

- Valve terminal
  - Festo
  - ethernet connection
Strip Magazine

- Stores and supplies the fresh strip for the patching head
- One full dose enough for 8h, very small waist of strip
- Can be loaded on "fly"
- Good quality of strips has major affect for line up-time
- Strips are loaded with tight face up (same as patched veneer)
- Strips can be over dried in separate storage boxes
Removing cutting waste

- With vacuum from collecting box
- Duct channel from collector directly to the hog etc.
- Patch head has separate cutter which cuts the waist in small pieces
- Separate device to remove strip end waist part
- VDA and PLC communication with Ethernet
- Line PLC receives patching coordinates from VDA
- Line PLC will distribute the veneers to separate patching levels which all have independent Level PLC
- After veneer is patched Level PLC will send a bin request to Line PLC which will take the veneer in stacker to proper bin

\[
\begin{array}{c}
\text{LINE PLC} \\
\text{LEVEL 1 PLC} \\
\text{LEVEL 2 PLC} \\
\text{LEVEL 3 PLC}
\end{array}
\]
• VDA –F stands for fluorescence illumination of the veneer
• With fluorescence illumination all splits, overlapped splits, and blond knots are detected much better than previous camera systems on the market
• Exact split information, its length and location is used to adapt correct or maximum moving speed of veneer with split.
VDA – F scanning procedure

- Picture is formed next to each other scanned and combined lines
- The scanning line width is typically 0.5 - 0.7mm (resolution)
- $1\mu s = 1$ millionth of a second
- Two images, surface image and fluorescence image
- Both images are separately analyzed

100 μs
Top lights on
Line scanning
Surface image

10 μs
Pause

100 μs
Bottom light on
Line scanning
Fluorescence image

Back to start
Maintenance

- Lubrication once in week
  - Cartesian robot linear bearings
  - Strip cutter linear bearings
  - Normal conveyor bearings etc.
- Automatic lubrication available
- Calibrations when necessary
  - After die has grinded it will be calibrated automatically with calibration plate
  - Cartesian robot homing calibration
  - Strip feeder homing calibration
Spare parts

- Mostly vendor components
  - Electrical components
    - Exlars, photo eyes, sensors, cables, motors, inverters
  - Mechanical components
    - Air cylinders/accessories, belts, rails, bearing units
- Self made parts, most important is dies and cutters
- Recommended minimum spare parts
  - Critical spareparts, dies
  - Wear spareparts, vacuum suction cups
8x4 Line Lay-Out

- Three patching level with 6 patch heads and strip magazines
- Stack carriages simple wheel carriages, needs bottom plates
- Infeeder is box feeder with belts, directly to scanning conveyor
- No line-up conveyor stack squareness at infeed ab. ± 1/3ft
- No by-pass conveyor
- 5 bins in stacker
5x5-10 Lay-Out

- Three patching levels with 6 patchheads and strip magazines
- No by-pass conveyor
- Stacker has 2 each 5x10 or 4 each 5x5 bins
- Infeed with crossing station with rising belts, 5x10 veneer one at the time and 5x5 veneer two at the time max. 15 feed/min
Capacity

- One level short time patching capacity is about 3000-3200 patch/hour when average patch count is 20 patches/veneer.
- Initial information for average patch count is likely to drop some 10-15%. This is because the human operator will always do "over quality" vs. accurate camera decision.
- At the moment 1-3 (4) patching levels can be in top of each other.
- Non–patched veneer can be easily 20-30% from veneer flow.
- Line is recommended to equipped with by-pass conveyor.
- Hot melt spray guns recommended wit APA Boat patches, capacity will lower some 10%.
Capacity calculation

- Calculate each patching level patch/min, which can be calculated together P1+P2+P3. **Patches/Effective Patching time.** This value is used to compare contract
- Calculate each patching level patched veneer/min, which can be calculated together P1+P2+P3. **Patched veneer/Effective patching time.** This value is used to compare contract
- Capacity is declared accepted which ever comes first. number of patches or number of veneer
Patching vs. Composing

- Significant raw material savings with patch size defects
- Material waste ratio 1:30
- Compocer production 3km/8h
- Annual raw material saving 80 000 – 200 000 eur/composer
Reduce need of polypatch

Patching the veneer with wood is always more efficient way to repair the product than polypatching plywood. Especially knots, knot holes and pitch pockets should be patched. Splits and other long defects to be repaired by polypatch.
Protection and Cat Walks

• Line is recommended to get that sales price includes:
  – patching unit fence protection
  – electronic safety doors (programs are ready)
  – cat walks around the patching levels for good visibility and ergonomic
• Line installation is easier and much faster with already tested cat walks, electric cabins ready made cabins etc..
  - flexible cables
  - engineered cable routes
  - ready length and tested cables
  - electric installation can be started 1-2 weeks earlier than home made cat walks