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TECHNICAL BULLETIN 100-02

Simply Specifying 5-Ply Doors No Longer Provides Quality Assurances

For years there has been an on going discussion regarding the merits of 5-ply vs. 7-ply. The real issue isn't and never has been, the number of plies used. Referencing plies has only been a method to define the production methodology and quality level preferred by the Specifier. Five-ply doors have historically been and continue to be specified by Architects for use in Hospitals, Schools, Executive Office Buildings and other facilities requiring the highest levels of aesthetics and durability.

The question is why do many Architects, Specifiers and End Users prefer 5-ply doors over 7-ply. The first flush doors were 3-ply, consisting of a bonded and sanded core with a 1/8" thick piece of sliced lumber hot pressed to each side. The 1/8" decorative facing was highly subject to dimensional changes and had problems with checking and cracking due to its thickness. The process was improved on by making the door 5-ply. The 1/8" decorative face became veneer ranging in thickness from 1/28" to 1/42" depending on species and cut. A 1/16" crossband was added with the grain running at right angles to the face and from edge to edge of the door. This insured the stability of the face veneer and virtually precluded cracking of the face while still preventing telegraphing of the core components. The 5-ply construction still had the stiles and rails bonded to the core and then sanded as an assembly prior to hot pressing the crossbands and decorative face veneers to the core.

Given that the 5-ply construction method was better than the 3-ply the forgone conclusion should be that with the introduction of the 7-ply door it would be even better. This is not the case because the producers of 7-ply doors did not follow the production methodology of the 3 and 5-ply door production. Seven-ply doors were introduced using 3-ply door skins (face veneer, crossband and backer), which were and still are hot pressed together forming a piece of 1/8" thick plywood that is then cold pressed to the core. The face veneer and crossband were the same thickness as those used on a 5-ply door with the addition of a 1/30" backer. The 1/8" door skin could be produced under mass production quickly and very cost effectively. The 1/8" skin also precluded the need to glue the stiles and rails to the core and sand it as an assembly resulting in the doors commonly being referred to as drop in core doors. Also the stiles and rails were typically mill option softwood rather than matching hardwood and of lesser dimensions than required by Architectural Industry Standards. By not bonding and sanding the core the use of hot presses were out of the question because the heat and pressure would exacerbate the telegraphing problems caused by uneven core components. Therefore, 7-ply doors were assembled in cold presses. The low pressure and lack of heat helped minimize telegraphing problems. Many of the 7-ply manufactures did not offer full product lines, factory finishing, complete machining or life of installation warranties. Due to all this the manufacturing cost of the drop in core door was greatly reduced from that of the 5-ply.

While 5-ply doors were being used for the high-end projects requiring strict compliance to Architectural specifications 7-ply doors gravitated towards those projects where cost was more of an issue. Since cost was driving the 7-ply market, manufactures looked for even more ways to reduce the same. The biggest was the introduction of the 4-ply door skin. This door skin had a face veneer thickness of 1/80" to 1/100" thick. Due to the thinness of the decorative face, it could not be applied directly to a crossband because the grain pattern of the crossband would telegraph through the face. To avoid this the decorative face was applied over the face of a 3-ply skin with the grain running in the same direction as the layer under it.

This product is referred to as a 9-ply door and is extremely hard to tell from a 7-ply by visual inspection with the naked eye but becomes quickly apparent when you attempt to sand or repair a damaged door.

As the 7 / 9-ply market became more and more competitive these manufactures started looking towards the still Architecturally guarded 5-ply market for expansion. In order to enter it they started offering bonded cores with matching stiles, factory finishing, complete machining capabilities and extended warranties for an additional charge. Even though many of the 7-ply manufacturers developed these capabilities the bulk of their production still remained at the economy end of the market and the doors were still assembled in a cold press. For these two reasons many Architects have continued to specify 5-ply doors only even though a true AWI PC-7 door properly pressed is just as serviceable and aesthetically acceptable as a 5-ply door. The fear, and it is not unfounded, is that somehow the true AWI PC-7 door will not be supplied and some variation between drop-in core and 9-ply will be substituted simply because PC-7 was allowed. The press method is the second issue.

Cold pressing is achieved by stacking approximately 20 doors on top of each other and placing them in a un-heated press that applies between 30 and 50 lbs per sq. inch of pressure to the top of the stack as depicted in figure 1 to the right. After 35 to 45 minutes in the press the doors are removed and allowed to set for several more hours while the glue finishes curing. Since not all doors are the same width, doors of varying widths can and are pressed at the same time. This is accomplished by using sheets of plywood called “ cull boards” and door spacers. The widest doors are usually placed on the bottom of the stack and then the narrower doors are placed on top separated by the cull boards and spacers as depicted below in figure 2.

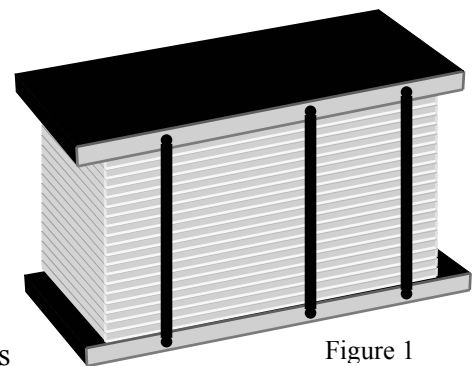


Figure 1

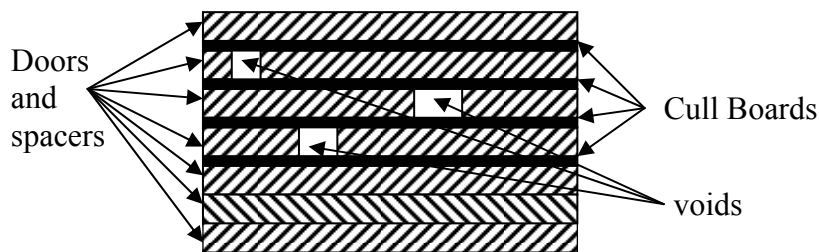


Figure 2

The thickness of the door skins and the core varies to the point that industry standards allows the door thickness to be plus or minus 1/16". When you combine the possible variation in thickness of the doors being pressed, the cull boards and the spacers next to them, the potential for uneven pressure becomes very dramatic.

Even when pressing a stack of doors all the same size with cores that have been sanded as an assembly, the pressure is not always uniform. The core thickness often runs slightly thinner on the ends than in the center as a result of the abrasive planers used to surface them. Even though the amount the ends are thinner is measured in thousandths it is multiplied in a stack of twenty doors so that the centers receive more pressure than the ends. The secret to a good glue bond is even and uniform pressure. Too much pressure squeezes all the glue out, insufficient pressure fails to hold the pieces being glued close enough together to create a bond. The end result in both cases is a weak or non-existent bond. Both these issues are inherent problems with cold press operations. The non-existent bond is visible upon taking the doors out of the press and usually addressed immediately by working glue into the open joint and reapplying pressure with a hand operated clamp. The weak bond may not become apparent until months later after the doors are installed. Indeed, one common chronic problem with dead-stacked, cold-pressed doors is loose corners. Another factor affecting the bond from cold press doors are the atmospheric conditions at the time the doors are being pressed. Changes in temperature and humidity greatly affect the cure times of the glue.

This is not to say that a door made in a hot press will never delaminate. Hot press doors are constructed by curing the glue lines between the face veneers, crossbands and the core in a single operation. This is accomplished in a press which has individual cells, constructed of rigid heated metal plates that press each door individually in lieu of an entire stack of doors. Varying door sizes are not a concern. No cull boards or spacers are needed in a hot press since each door is in its own rigid cell. Not only does this insure absolutely uniform pressure across the whole door surface, the glue bond is formed in 7 minutes or less due to the heat activated catalyst used in the glue. This eliminates concerns about set time, temperature and humidity. When the door leaves the press the glue bond is fully formed. There is no need for the door to set for several hours before being trimmed to size etc. As stated hot pressing does not guarantee that a door will never delaminate but it dramatically reduces the potential.

Another issue between cold press and hot press is Type I vs. Type II glue. Many Specifiers prefer the fully water proof Type I glue over the water resistant Type II. Most hot press manufacturers use Type I glue as a standard and since they are forming all the glue lines between plies Type I glue is used between each ply. Cold press manufactures use pre-manufactured door skins, largely made off shore for economic reasons, which are produced with Type II glue. To order the door skins with Type I glue is costly and adds to the lead-time. Therefore, the issue is often skirted by cold press manufacturers with statements like “Type I modified” or “Type I_{sc}”. What this means is that the face, crossband and backer forming the door skin is glued together with Type II glue and then the cold press manufacturer presses the skin to the core with Type I glue. This is not a Type I glue bond as defined by industries standards. What good does the Type I glue bond due between the skin and the core if the face veneer and crossband separate from it?

Now comes the real issue all 7 / 9-ply cold press manufacturers now can and many are offering a 5-ply cold press door. This door utilizes a 2-ply skin, which is made up of a face veneer and crossband that can still total 1/8” in combined thickness like the 3 and 4-ply skins, because of a thicker crossband or it may be made from a 3 ply skin by sanding the back off resulting in a thickness of 3/32” in lieu of 1/8” panel. These doors are produced in cold presses using the same methods as the 7 / 9-ply doors always have. All the issues that Specifiers have been guarding against by specifying 5-ply doors only, are now subject to being loop-holed. Certain manufacturers have even made blatantly deceptive statements to gain acceptance into a 5-ply specifications such as “ The 2-ply architectural grade door faces are hot pressed with hardwood veneer crossbanding.” Yes, just as a 3 or 4-ply door skin is hot pressed together so is the 2-ply door skin, but they are still cold pressing those hot pressed faces to the core, except they fail to mention it. This is a shell game fully intended to deceive the specifier.

For those Specifiers who want to maintain the integrity of their specifications they need to add strict verbiage to prevent the substitution of 5-ply cold pressed doors. We recommend the inclusion of the following statement to insure the continued quality level of 5-ply doors received in the past.

CONSTRUCTION

Doors shall be 5-ply and comply with AWI / WDMA PC5 construction. Doors shall be manufactured by the hot-press method, bonding faces, crossbands and core together in a single operation with Type I glue. Doors manufactured by cold-pressing 2 or 3-ply pre-manufactured door skins to multiple cores in the same press will not be accepted.