OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

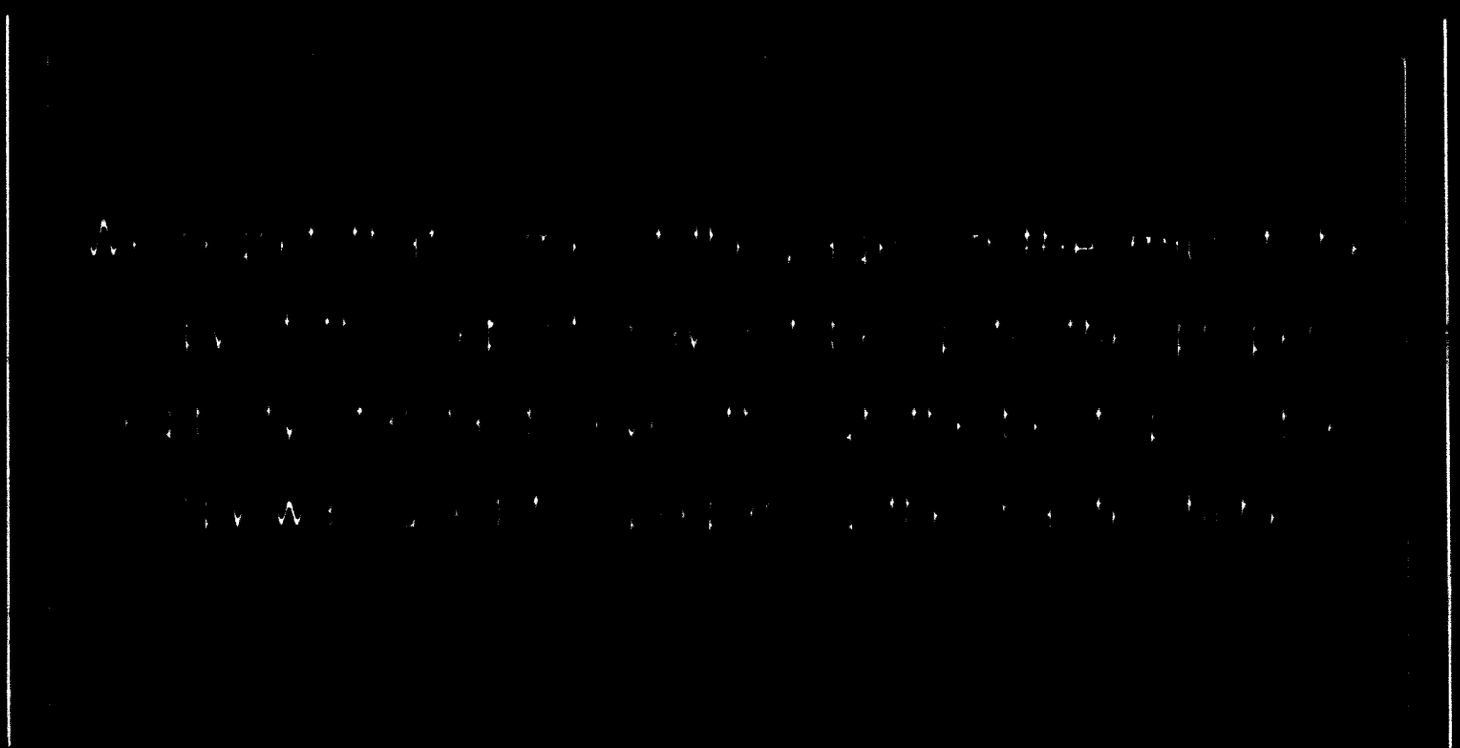
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



07680

Distr.
LIMITED

ID/WG.248/11
13 October 1977

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Workshop on Adhesives used in the
Wood Processing Industries

Vienna, Austria, 31 October - 4 November 1977

EQUIPMENT FOR COATING OF ADHESIVES IN THE WOOD PROCESSING INDUSTRY[1/]

by

H.J. Funke *

---

* Dipl.Ing., Professor at the Fachhochschule Rosenheim/West Germany.

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.77-7394

CONTENTS

Equipment for glue coating

I. Preliminary notes about bonding

1. Wood bonding, developed to an industrial operation after the second world war, occupies a special position in adhesive technology. Basic technology transfer in the field of glue application has developed very slowly. Today we know the close relation between "cohesion" and "adhesion". Cohesion is caused by the forces generated between atoms or molecules in a glue joint after having been cured. Generally adhesion is the adhering force of adjacent molecules. The adhesive force of a glue joint can only be achieved when molecules are in close contact so that they can interlink. Usually a solid has a roughness which is visible to the naked eye, but even if it is apparent smooth, irregularities can be shown up by methods of only moderate resolutions.

2. In practice "adhesion" is effected through liquid adhesives which will gap certain irregularities of the surface. At present all bonding processes of solids are done by application of liquid adhesives. They wet the surface and form glue joints after having been cured. Even glue films and solid hot-melts are passing the fluid like stage before curing.

3. According to this, a liquid which will wet a surface of a solid before curing may be considered as a glue. However, it has to be known that bonding is a process which passes several stages before hardening.

4. When spreading a liquid adhesive to a surface, it is necessary to create a coherent layer. The thickness of this layer should be as thin as possible, to achieve high glue joint strength and to operate as economically as possible. The glue coat or the spread is defined as the glue weight in pounds per thousand square feet or as glue weight in grams per square metre.

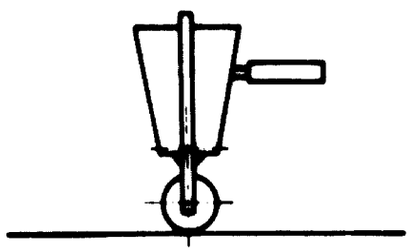
5. The surface of the wood to be joined even after planing or sanding is to some extent rough. The glue covers all irregularities so that an interlinking of bonded surfaces takes place. Too deep penetration of the glue into the wood surface is unfavourable because of generating waste glue, resulting in poor glue joints. When the glue coat is applied, assembly has to follow for not decreasing certain bonding characteristics, before pressing or clamping. Adhesive manufacturers are giving advice about the "open delay cycle".

6. Economic considerations about glue consumption in plywood or furniture industries are very important. It is a main factor in cost calculation of the product and with the increased use of rather expensive resins, the necessity for avoiding waste has become more and more important.

7. Strong wood joints can only be achieved when surface preparations are accurate. Proper spreading, especially uniform distribution of the liquid glue on to the surfaces is essential. The equipment used to apply a uniform layer or adhesive to the veneer or board is generally called a "glue spreader". This term is applied not only to a roller type spreaders but covers all types of equipment for glue coating. Provided that an even coat of the recommended amount is applied, the method is determined mainly by the required capacity. Simple coating by using a brush, a toothed scraper or hand roller as shown in Fig. 1 is quite adequate for hand work. If large surfaces or a batch or components have to be spread per hour, mechanised equipment will be necessary. Mechanised spreaders have been considerably improved during the last years. Automatic in feeding and out feed devices are part of the spreader.

8. It is the purpose of this paper to disouss the principles, advantages and disadvantages of the various equipment operating with different spreading units.

Toothed scraper



Hand roller coater

Fig.1 Equipment for hand work

II. Aspects for the use of glue coating systems

9. The main criteria influencing glueing processes are based on the conditions of glue mixing, surface quality, moisture content, temperature, etc. Before detailing the appropriate equipment for glue coating, the preliminary requirements of glueing processes will be discussed.

A. Pretreatment prior to glue coating

10. It is essential, despite the method applied for coating, that finishing operating of the wooden surface have to follow piror to a well dosed spread. The following facts should be strictly considered:

- The surface to be glued should be flat. Rough, wavy and uneven surfaces do not allow an even and economical spread of glue;
- The surfaces must be clean and free from dust;
- High amount of resin on the surface should be removed by suitable solvents;
- Conditioning of the wood prior to glue coating is necessary for a balanced moisture content of the wood;
- In changing climate regions, stock has to be stored in heated production halls as the curing operation is influenced by temperature.

11. How to prepare the glue ready-for-use and the equipment applied is subject to another paper of this workshop and will, therefore, not be included in this report. The glue has to be mixed to a well balanced stage with all additives. It is then stored for final conditioning so that all lumps are dissolved and the blended mix is ready for use. In this way, the filter system of the spreaders remains always clean.

12. After mixing, the glue viscosity should be checked in any case. The glue viscosity must be high enough to form a coat of appropriate thickness after spreading. If the viscosity is too low, the glue will soak into the wood. On the other hand, glue spreaders require a certain viscosity which is in a range of 4000 to 6000 centipoises.

B. Adaption of the glue coating system to the adhesive

13. The suitability of the glue applicator to the chosen type of adhesive should be considered carefully. It is, therefore, of importance that the glue spreaders are kept in a clean condition to avoid uneven coats generated by chips or adhesive lumps. Thermosetting adhesives with limited pot-life require equipment where the coating units can be removed to facilitate

cleaning operations. The quantity of glue required to maintain an adequate spread should be small, to shorten the recycling of the glue mix and avoiding unnecessary storage in the glue reservoir. In the tropical countries, it might be an advantage to cool the glue applicator and glue reservoir to extend the pot-life of the adhesive.

14. Hot-melt adhesives and animal glues require heated applicator units above room-temperature and maintained - within a small temperature range - at a temperature tuned to the materials to be bonded. For hot-melts it is also important that the adhesive should be at the optimum temperature when applied to the wood. For this reason, it is essential that the temperature of the application rolls as well as the glue reservoir, is accurately temperature controlled. The glue pot should have a heating adjustment for rapid raising of the temperature at start up and to shorten down time while refilling the solid hot melt adhesive.

III. Roller coating

15. Until about 1968 roller coaters were the only well known equipment for applying glue to veneer or boards on a commercial base. The use of these conventional type spreaders with hard, grooved rolls were nearly universal. The first development for this more efficient coating system was done in the 1930's for the application of glue to thin veneers for the manufacture of plywood.

A. The principle of the roller coating system

16. Roller coating is a method of glue application in which the veneer or board passes through a roller system applying the glue. Adhesive can be applied in one pass single or double-sided. (Fig. 2)

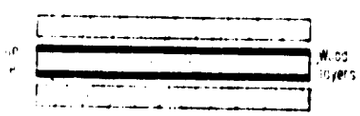
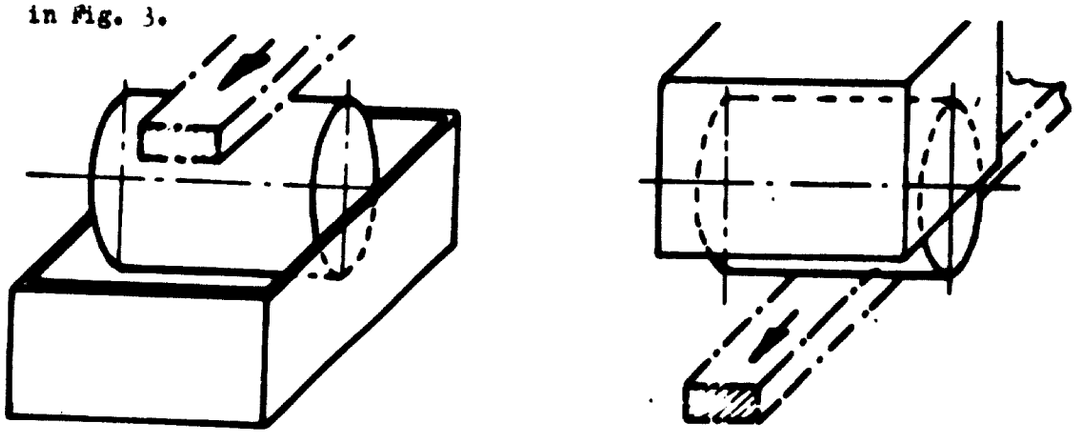


Fig. 2 Example for doubleside glue spreading

There are three types of roll coaters:

a) the top side roll coaters;
b) the bottom side roll coater; and
c) the top and bottom side roll coater.

In the plywood and furniture industry single surface glue spreading is seldom applied. It is mainly used for edges and small parts as shown in Fig. 3.



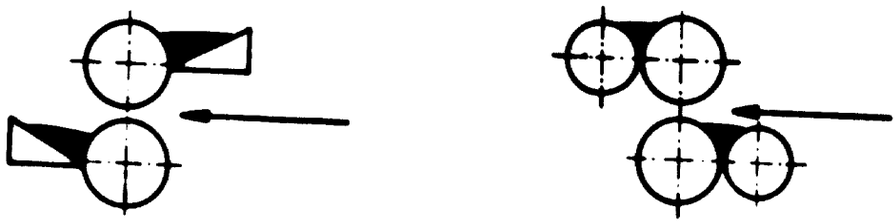
Top side roll coater Bottom side roll coater

Fig. 3 Single surface glue spreading

17. The top and bottom roll coater is the old way for applying glue to both the top and the bottom surfaces simultaneously. There are basically two types, the double side roller coaters (Fig. 4):

a) the double roll coater with "doctor knives" adjusted to each spreading roll; and

b) the four roll coater with "doctor rolls" adjusted to each spreading roll.



Double roll coater Four roll coater

Fig. 4 Different types of double side roller coaters.

After coating both surfaces the veneer or board is caught by a layup man who then places it on to an uncoated ply. Then an uncoated face is laid on the top of this assembly, thus, producing a three-layer plywood panel or a veneered board.

18. The transport and the coating are performed by the same pair of rolls called "spreading rolls" or "applicator rolls". The normal feed speed to operate a roll coater sufficiently for glue application is 30 to 60 feet per minute with a maximum speed being as high as 180 feet per minute. The spreading rolls are adjusted to the thickness of the material to be coated, so that uniform transfer of the glue from the roll on to the surface is performed accurately. Fig.5 shows the arrangement of a four roll coater which is commonly used.

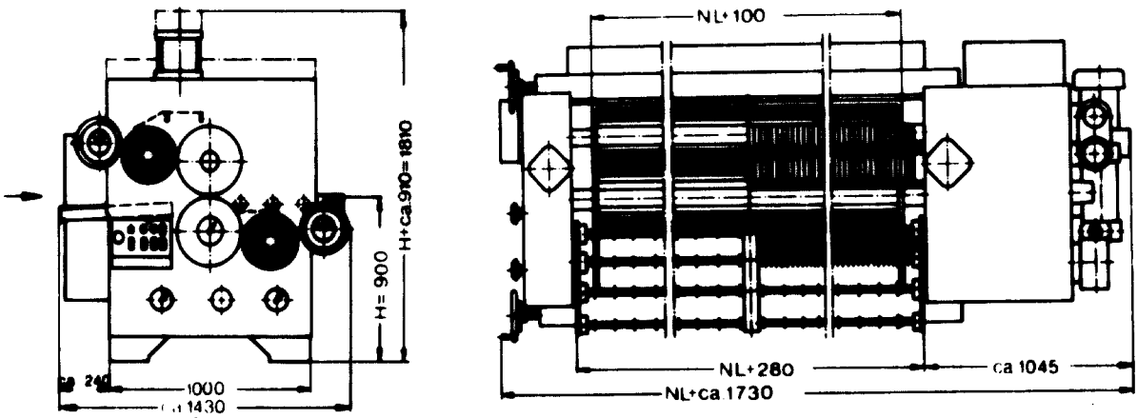


Fig.5: Arrangement of a four roll coater

19. Both rolls turn during operation. The spreading roll is normally the larger one in diameter compared to the "doctor roll" or "dosing roll" and turns with a speed tuned for the feed speed of the board that passes through the machine. The "dosing roll", on the other hand, is smaller in diameter and is normally a smooth steel roll. The dosing roll turns in reverse direction of the spreading roll so as to provide a small opening between both rolls allowing a certain amount of glue remaining on the spreading roll which is then transferred to the surface of the board while passing through the machine. Fig.6.

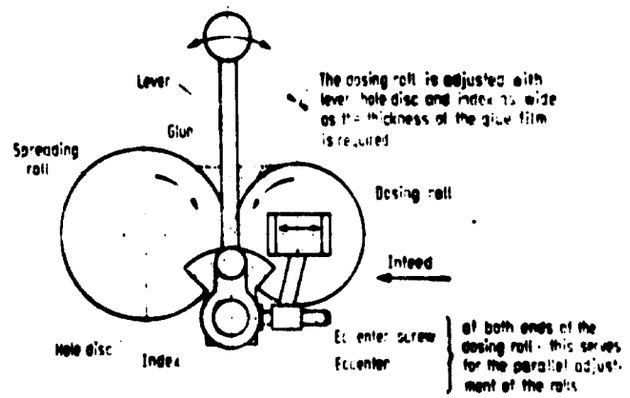


Fig. 6: Glue dosing system

20. The glue spread is set by adjusting the distance and the difference of the surface speed between the spreading roll and the doctor roll. Spread control is fixed by the gap setting between the spreading rolls, also by the groove pattern on the roller surface.

B. Types of rolls

Grooved rolls are not the only possibility of applying spreads compared to sponge rolls.

21. A hard-roll glue applicator has two grooved rolls with the doctor roll parallel to each other. Neoprene or Buna rubber is used for the grooved roll surface. There are three types of "hard" rolls - based on roll hardness:

a) Straight Durometer roll: A 50 Durometer roll with standard grooving;

b) "Soft" roll: A 40 to 45 Durometer roll normally with a grooved surface that suits the application of phenolic glue only;

c) Dual Durometer roll: A dual thickness covering with a softer inner ply and a 65 Durometer outer covering with standard grooving. The cost is high for the benefit of better roll elasticity.

22. The core of the rolls are made of steel and are rigid to prevent any deflection. The steel cores are usually covered with neoprene or Buna rubber to get a uniform distribution also on wavy and uneven surfaces. The rolls are grooved in various ways; the corrugation may run straight or spiral-like along the circumference. The most rolls are grooved in regular pattern (see Fig. 7).

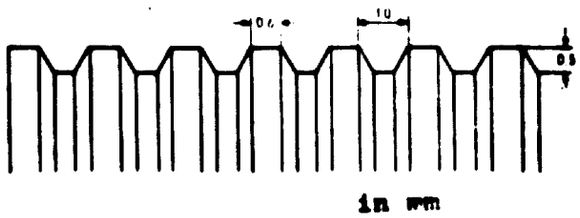


Fig. 7: Roll grooving

23. The ungrooved, closed-celled sponge roll spreader is used most frequently in machines with automated layup. This applicator system is of two types:

a) Insulite type: A soft sponge roll used in machines with automatic layup lines. The roll life is short, with frequency of replacement usually dependent on veneer type.

b) Neoprene type: This type is often used in the soft-roll conventional layup type spreader marketed by a major plywood equipment manufacturer in USA.

C. Clean-up and glue waste

24. The roller coater system is extremely efficient and results in only the clean-up losses for the glue. The glue spreaders are rinsed once per shift. The vat is emptied and the glue is returned into the system. The waste and lumps are collected for landfill disposal. The excess glue is scraped from the rolls and the vat before rinsing or washing the spreader. Very little water is then required to remove the remaining waste. Each spreader is washed thoroughly once per operating day. This includes the same procedures as mentioned, namely inner and outside clean-up of equipment. Fig. 8 shows device for clean-up with brushes fixed at the spreader.

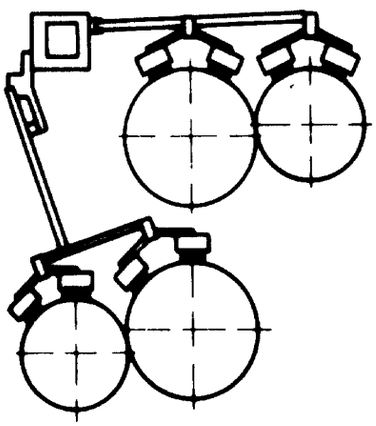


Fig. 8 Device for clean-up

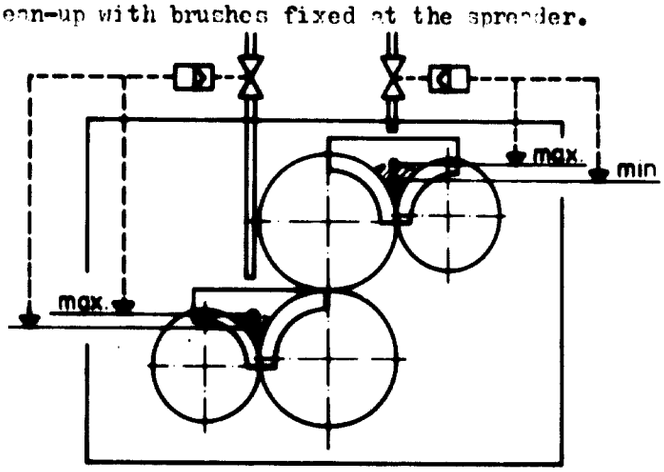


Fig.9 Equipment for regulating the glue level

25. Preventive maintenance is necessary between spreading and doctor roll to prevent glue leaks and supply overflow. This includes:

- maintaining a proper setting of the electrodes regulating the glue supply level in the spreader (Fig. 9).
- maintaining tight seals between spreader rolls shafts and the glue vat.

In this way glue waste water which is an undesirable by-product of glue spreader washing is minimized.

D. Advantages and disadvantages

26. The advantages and disadvantages should be considered for each system:

Hard rolls: Until now the use of the conventional hard-roll glue spreader is nearly universal because the system is very reliable. All kinds of adhesive can be coated on flat surfaces (thermosetting adhesives and thermoplastic adhesives) as well. Glue can be applied single or double-sided on veneers or boards. The spreader acts as gauge or board thickness caliper and applies glue evenly also on veneers and boards with tight thickness deviations.

The disadvantages of hard rolls are:

- The hard rolls restrict automated opportunities and do not allow to use fewer people or produce an increased amount of panels;
- As mentioned before, the hard roll system applies glue evenly also on veneers and boards with tight thickness deviations. Therefore the core rejects are higher than with other spreading systems.

Sponge rolls: The advantages of the sponge rolls are:

- This application system is versatile and widely used in automated laypus as top or/and bottom roll coater;
- Lower spread weights are attainable resulting from an improved spread control;
- The "soft" rolls apply glue evenly on thick and thin veneers resulting in less veneer rejects. It is possible to get a uniform distribution of the glue on wavy and uneven surface.

The disadvantages are:

- Thick and thin cores are not screened resulting in greater variation in panel thickness;
- Frequent roll changes are required.

IV. Curtain coating

27. Curtain coaters are of later development including automated layup lines for plywood manufacture. A broader field of application for curtain coaters is in lacquer and finish coating sections which was introduced later to plywood manufacturing.

A. The principle of the curtain coating system

28. Curtain coating is a method of glue application in which the veneer passes a poured "curtain" of adhesive. The curtain coater is characterized by a pouring unit that is a supply vat for glue with an opening extending the entire length of the pouring head below the vat. Unlike coater rolls the curtain pouring head does not contact the surface to be coated. Like roller coating an effective curtain coating depends on a relatively flat surface. The surface does not have to be completely flat but contoured surfaces can only be coated successfully by a curtain coater. There are basically two types:

a) the pressure curtain coater and
b) the gravity curtain coater

B. Pressure curtain coater

29. By far, the most sophisticated and more versatile type of curtain coater is the pressure curtain coater. Fig.10 displays the curtain coating pouring system.

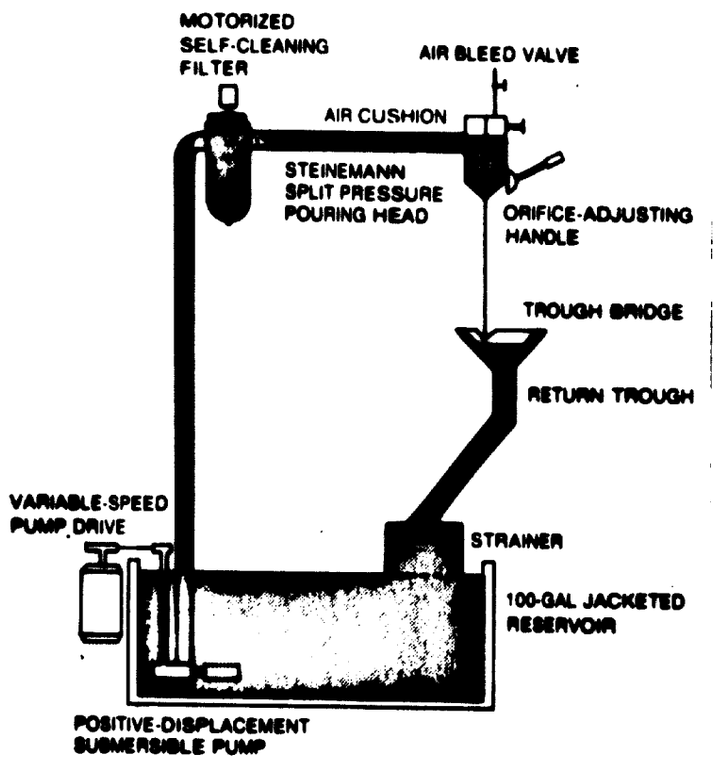


Fig.10: Curtain coater pouring system

This coater is characterized by a slit pressure pouring head. It is specially constructed, V-shaped vat fabricated of mild steel. The inside of the head is nickel-plated. The adjustable orifice slot extending the length of the head at its bottom is made of two ground parallel stainless steel knives. One knife remains stationary and the other knife is removable to obtain the desired curtain performance.

In closed position the head is airtight by a removable cover. At the top of the head is an air bleed valve that allows air to escape until the vat is threequarter full, at which time it is closed to trap an air cushion over the glue. The pressure head system has by far the best possibilities in operating viscous fluids as at low viscosity, the coating head operates in a vacuum and as the glue viscosity increases the head acts under pressure.

30. A vat is filled with glue which is pumped into the head by a powerful gear-type pump. Between the pump and the pressure head there are two filters to catch small particles of wood, splinters or dirt from the glue. It is necessary to use one filter only. The second filter is used when cleaning the first, so it is not necessary to stop the coating operation for cleaning the filter.

31. The glue flows out of the head at a speed faster than gravity speed. The curtain coater is a top coater only. After assembling of core and back an uncoated face is laid on the top of this assembly, thus producing a three-layer plywood panel. Once the curtain has begun flowing, the veneer passing under the head receives a precisely controlled, uniform spread of glue.

32. In curtain coating only the material poured on to the veneer surface is used while passing through the flow curtain. Very little waste occures because the unused glue is reciroulated. The glue continues to flow even when the veneer is not passing underneath the head, and glue which is not poured to the surface is collected in a trough which eliminates entrapment of air, catches the curtain and directs the adhesive back to the supply tank via a pump.

33. The downward curtain velocity is determined by the width of the knife gap, the pump speed and the viscosity of the glue. If the width of the knife gap and the viscosity of the glue are not tuned each other, then two factors will

control the glue spread weight:

- the pump speed and
- the conveyor belt speed

When slowing down the pump speed by 50 per cent, the coating weight would be decreased by a half. When doubling the conveyor belts speed the coating weight would be decreased by 50 per cent. This unit is extremely reliable for repeatable precision results.

34. The revolutions per minute of the pump determine the quantity or the glue quantity that is being pumped up into the head and the volume of the glue passing the orifice opening of the head.

35. For controlling the spread weight it is important that the veneer passes beneath the curtain at a constant speed rate. Therefore the infeed and outfeed belts feeding the veneer are powered by the same variable speed drive motor providing a uniform speedrate. Speedrates for curtain coaters vary between 200 to 250 feet per minute but maximum speed rates up to1000 feet per minute can be arranged. Consequently conveyors in front and in the rear of curtain coaters have to be accelerated or slowed down. Typical production speeds are about 300 to 400 feet per minute.

36. There is very little maintenance or clean-up on the coater. In fact, if used for three shifts, the only clean-up required would be at the weekend. When the operator stops the coating operation and turns off the pump, then opens the air bleed valve and orifice, the glue in the head drops into the trough and returns in the buffer tank. This coating equipment can easily be washed with water. For a complete cleaning the pouring head is vised easily after loosening ninebolts.

C. Gravity curtain coater

37. The gravity orifice-type curtain coater is the forerunner of the pressure head curtain coater. The application method is quite similar except one important difference: the curtain velocity cannot be controlled. The curtain falls similar to a waterfall. The rate is determined by the mass of the glue and the height of the head above the veneer. This coater is characterized by a pouring head that is a supply vat for the glue with a slot extending the entire length of the head at its lowest point. The top is opened to the atmosphere.

38. Usually, an overflow drain located near the top of the head prevents the head from overflowing on to the conveyor belts. Sufficient glue is pumped to the head so that some glue is continuously overflowing through the overflow drain and returning to the supply vat. Therefore, a fixed static volume puts a little downward pressure on the glue. Since more than enough glue is always being pumped to the head, usually a centrifugal or less sophisticated pump is used for delivering the glue to the head.

39. Controlled spreading weight on the gravity curtain coater is achieved by the conveyor belt speed and by adjusting the orifice opening at the bottom of the head through which the coating material falls. The spreading weight repeatability is somewhat complex with this unit as a very small movement in the orifice opening significantly affects the amount of the deposited film very much.

40. The constant glue flow through the orifice is determined by the fixed static volume in the curtain coater head. The terminal velocity where the curtain reaches the surface to be coated is determined by the static volume, the viscosity of the glue and the height of the head above the product.

D. Advantages and disadvantages

41. The benefits of the curtain coating system are:

- First, curtain coating is a very flexible and quick method of applying glue. The conveyor speed can range from 200 feet per minute to as far as the wood can be conveyed. Therefore it is widely used in coating systems with automated layup lines;
- the training time for a new operator crew and the operating time of the worker are shorter than for roll coater operations;
- the pressure head curtain coater applies a uniform film which can easily be controlled;
- the constant spreading weight on thick and thin veneer results in lower glue cost, equal or better glue bonds and less rejects of wood;
- there is no pollution because of the enclosed system. The maintenance costs are low and the cleaning-ups are rare and quick.

On the other hand disadvantages are to be considered:

- Automated layup lines require high capital investment costs;
- the glue mix preparation is critical for successful curtain coating

operations. The installation of a glue balancing system should be considered for

- dissolving small lumps of undigested extender particles, blending into the mix;
- the filter system remains much cleaner;
- the curtain successfully flows with higher viscosity mixes from 12.000 to 20.000 centipoises but normally a range of 4000 to 6000 centipoises is required for curtain coating;
- curtain interruptions result in bare areas on the surface to be coated and in bad glue line bonds;
- thick and thin cores are not screened out, resulting in greater variation in panel thickness.

V. Spray Coating

42. Some years ago spray equipment was commonly used for chip-glue mixing processes in the particleboard manufacture until other chip blending systems were developed. A new use for the spray coating system is the new plywood layup line where it has definite advantages.

A. The principle of the spray coating system.

43. Spray equipment can be applied for coating irregular-shaped stock. Spray coating systems generally tend to be less efficient compared to other systems, such as roll coaters or curtain coaters. The reason is that the atomized particles of glue do not drop all on to the surface to be coated resulting in losses of approximately 50 per cent.

44. The heart of the spray system is the nozzle. It guides the glue in droplet form, which means less surface area for the air to dry out and less surface contact with the wood before pressing. The spray system can use conventional glue mixers, identical to those used in roller spreaders. Viscosities in the 5000 centipoises-range seem to offer the best spray coat.

45. The glue is spray-applied within a spray booth, which is an enclosure around the spraying equipment. It is designed to recycle nearly 100 per cent of the overspray from the area. It is the further purpose of the spray booth to separate the oversprayed glue from the air stream by means of filters, water or other types of separating technique so that air is free of glue

particles and can be exhausted outside the building into the atmosphere. Thus it provides a controlled environment for spraying adhesive in summer or winter without noxious fumes and pollution problems.

46. The spray system is a very flexible and quick method of applying glue with a mechanized layup. The speed of the conveyor which feeds the veneer through the spray booth can range from 50 feet per minute up to as fast as the wood can be conveyed. The normal speed is in a range of 50 to 100 feet per minute. The limiting factor is the ability to handle the veneer at a higher speed. The coating system is flexible because of start and stop of coating operations without interrupting the spread. On the coated surface stop- and -start spots are normally not visible.

B. Types of spray-systems.

47. There are basically three types of spray systems:

a) the compressedair system. The adhesive is sprayed by compressed air through a specially designed nozzle. For a long time this type was used in glue-chip mixing processes (Fig.11)

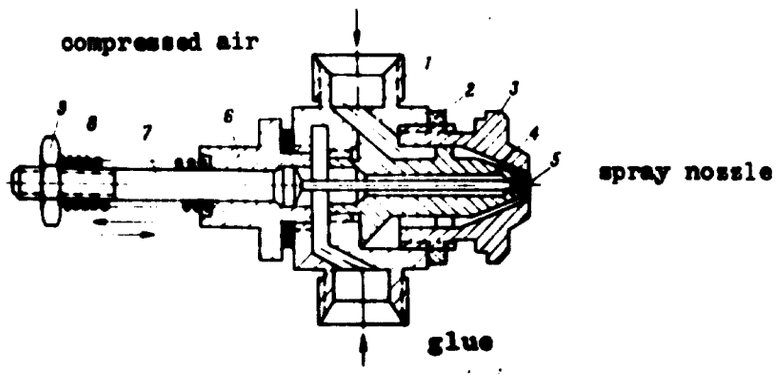


Fig.11: Nozzle for compressed air spraying

b) the high-pressure airless system. The adhesive is sprayed by high fluid pressure which forces the glue through a nozzle generating the glue spray. This system reduces spray mist and overspray an advantage against compressed air.

c) the hot spray system. The adhesive will be preheated while passing the tube system to the spraying unit. Thus the application efficiency

is improved by dropping the glue viscosity and by reduoing the energy required for atomizing.

48. In new plywood layup lines any type of glue can be spread by airless systems; spraying heads are equipped with oarbide nozzles. The spray pattern is circular which can be adjusted to different sizes covering the entire veneer surface, whether thiok or thin veneer will be spray ooated. A fixed head applicator can cover a 10-feet space when the nozzle pressure is applied by 300 pounds per square inch (21 kp per square oentimetre).

49. The glue mix has to pass the balancing equipment to remove any lumps still remaining in the mix. It is filtered for screening the recycled glue mix which often includes small wood particles and will then be pumped to the storage tank. This tank is oonnected with the spraying heads. From the storage tank the glue is pumped through a heat exchanger for preheating the adhesive to about 105 degrees Fahrenheit (40°Celsius.)

50. The key to successful glue spraying is a well operating pumping system. Normally there are two high pressure pumps feeding the glue to the spray heads. A pressure valve controls the oonstant glue pressure at the spray head. The valve is gauged at 300 pounds per square inch and will recycle the overrated glue caused by overrated pressure. The hot-spray glue is spread in a pattern that allows to flow under heat and pressure during curing at the pressing cycle. The nozzle locks when glue temperature and glue pressure is untuned, thus glue at a constant viscosity will be spread. Nozzle wears normally in about nine months and has then to be replaced.

51. The spread weight can be ohecked easily and controlled completely aoross the veneer which is quite difficult with other methods. The amount of glue spread will be controlled by adjusting the spray cap and the veneer speed or by ohanging the size of the spray nozzle.

C. Clean-up and glue waste

52. The oversprayed glue will be recycled through the filter system for re-use. The glue is mechanically soraped from the conveyor belts by a high-density polyethylene soraper and flows into a buffer vat for recycling.

A flexible screen at the bottom of the spray booth prevents that particles will flow into the recycling system.

53. Former glue spraying lines were not equipped with recycling systems which resulted in high glue waste. The V-belt or multi-belt conveyors did not allow to recycle glue spray in the same way. In order to minimize glue waste it is necessary that the veneer sheets follow up without any gap between the veneer sheets loaded on to the conveyor belt.

D. Advantages and disadvantages

54. Advantages of spray coating are similar to curtain coating:

- the spray coating system is a very flexible and efficient method of glue spreading with automated layup resulting in less labourers operating on the pressing line;
- the spray head applies glue droplets which means less surface area for the air to dry out and less surface contact with adjacent sheets before pressing;
- the spray coater applies accurate spread (weight) on to the veneer surface whether it is rough, wavy, thick or thin resulting in less veneer rejects;
- there is no pollution because of using a spray booth.

The disadvantages are:

- automated layup requires high capital investment costs;
- the glue mix preparation has to be done more carefully to render successful spray coating. Addition of glue mix balancing equipment should be considered;
- the clogging of the nozzle cap creates maintenance problems;
- thin and thick core layers (crossbands) have not to be screened out resulting in a greater variation in panel thickness.

VI. Extrusion Coating

Automated layup systems require always the development of new glue spreading technologies. The extrusion coating is one of the methods tried with varying success in plywood manufacture.

A. The principle of the extrusion coating system

55. The extruder is a device used to force (extrude) a formulated adhesive

on to the surface of the veneer or board in a series of glue strings. There are no problems of extruding high visoosity glues also when containing fillers with minute partioles.

56. With the extrusion method of applying the glue a metering pump controls the constant rate. The glue passes a foaming device where a fivefold volumn increase is generated. It is then extruded through nozzles on to the surface to be coated in form of glue strings, often called "spaghetti"-strings.

57. The extruder spreading unit is a straight multinozzle bar with approximately 260 nozzles (1/10 mm diameter) for 50 inch spreading width similar to the spray system the glue is spread in a form which means less surface area for the air to dry out and less surface contact on the veneer surface before pressing, providing a barrier against pre-drying. The extruded glue is spread in a pattern that allows it to flow under heat and pressure during the curing cycle.

58. Extrusion spreading is a relatively clean application process. No glue is wasted in the extruding area except on the extruder itself to be cleaned at the end of each shift. The use of glus with short pot-life will cause troubles because of nozzles, and pipework clogging which requires frequent cleaning.

B. Advantages and disadvantages

59. Advantages of extrusion coating:

- the system can be used in automated layup lines;
- high viscosity glue and glue foam can sufficiently be extruded;
- the "spaghetti-like" glue strings provide a barrier against dry-out of the glue line before pressing;
- extrusion spreading is a relatively clean application process;
- there are less core rejects because the glue strings are spread equally on to the surface even when veneer thickness differs.

Disadvantages of extrusion coating:

- the extruder system is too slow to accommodate the appropriate production speeds;

- the excessive clogging of the extruder nozzles will cause bare glue line areas;
- extrusion coating does not require preselection of layers with different gage;
- the costs for maintenance and for clean-up are higher compared to other spreading systems.

VII. Glue Gun Coating

60. Application of glue to profiles, edges, mortices, dowel holes and other small areas will be carried out by specially shaped spreading units connected to pressure glue containers.

A. The principle of the glue gun coating

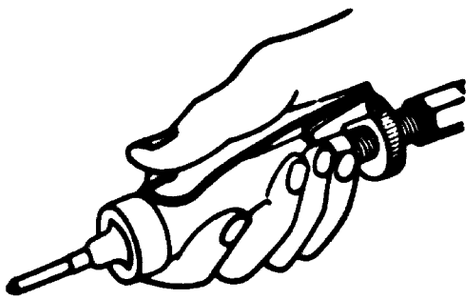
61. Like extrusion coating the glue is forced on to the surface to be coated through specially shaped spreading devices fixed to a glue gun which is mainly manually operated. This hand gun can spread dots, lines or fine surface coats using various kinds of adhesives.

62. There are three types of glue guns tuned to different adhesives:

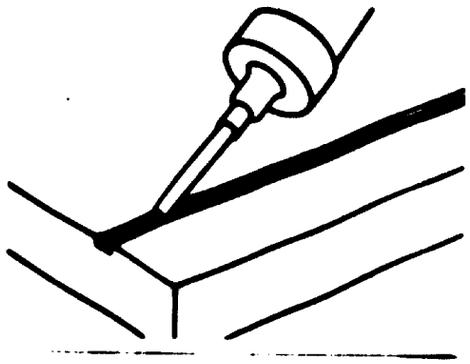
a) glue gun for single component adhesives like PVAC;
b) glue gun for double component adhesives and
c) glue gun for holt-met adhesives.

The pressure container of the glue gun for PVAC is filled half as an air cushion on the top of the glue is needed. The container is then filled with compressed air. Neither electric nor other feeding forces are required. The whole unit will be located wherever needed. The compressed air forces the glue to the glue gun. A large variety of spread tools for edges, spot surfaces, tenons, grooves, edge lippings, dowels, dovetails, etc. is available for use on the glue gun. (Fig.12).

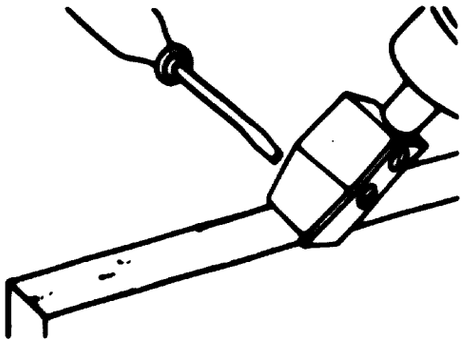
63. As the gun, the spread tools and pipes remain full of adhesive one should avoid glue with short pot life. Therefore PVAC is the best suited material for cold glue spreading systems; UF resin without hardener can also be used. The hardener has to be pre-applied to the opposit face of the joint, so curing follows when the two components are in touch.



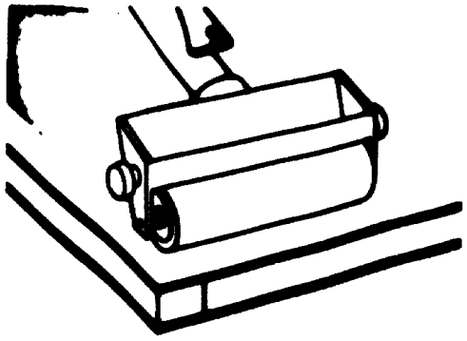
for spots and lines



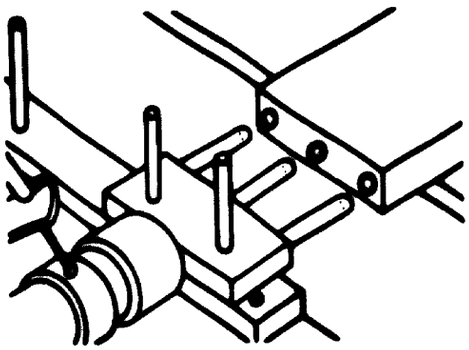
for grooves



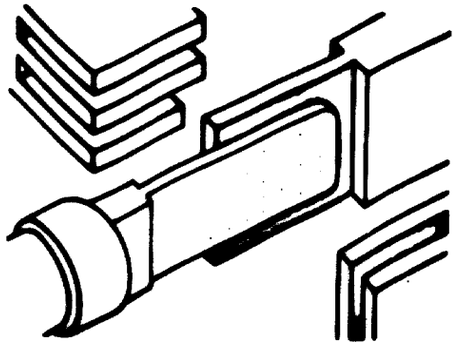
for edges



for small surface areas



for dowel holes



for tenons

Fig. 12: Samples of spreading tools for cold glue application.

64. The glue gun for double component adhesives operates with two nozzles adjacent to each other. Glue and hardener will mix on the surface (Fig. 13). Nozzles do not clog through cured glue.

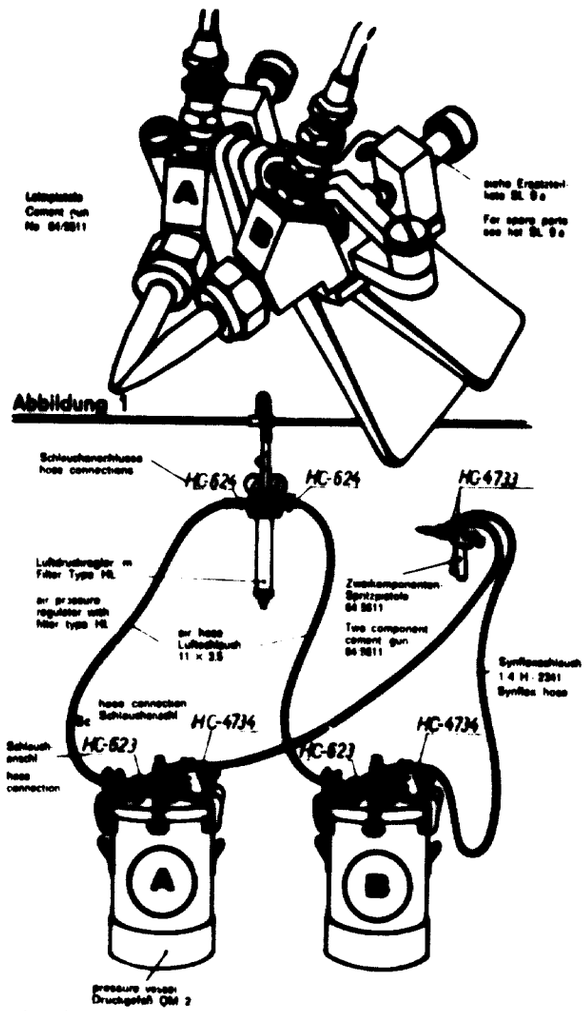


Fig. 13: Glue gun for double component adhesive

65. The third type of glue guns in this line has been designed for applying hot-melts. Hot-melt adhesives require a glue gun with heating unit. The temperature has to be adjusted within a tight limit to operate the equipment appropriate to the glue. For this reason it is important that the temperature of the handgun is always accurately controlled. A built-in slug system presses the properly oriented ready for use glue to the nozzle. Fig. 14 shows a slug type controlled glue gun for applying hot-melts.

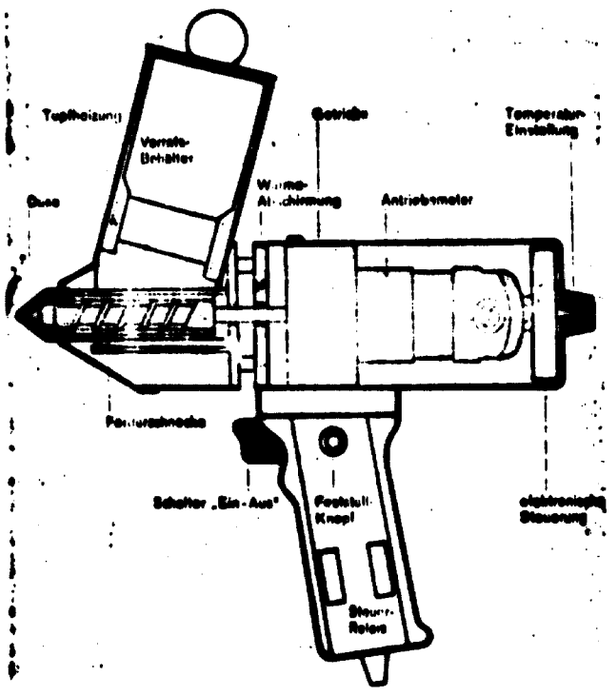


Fig. 14: Glue gun for hot-melts

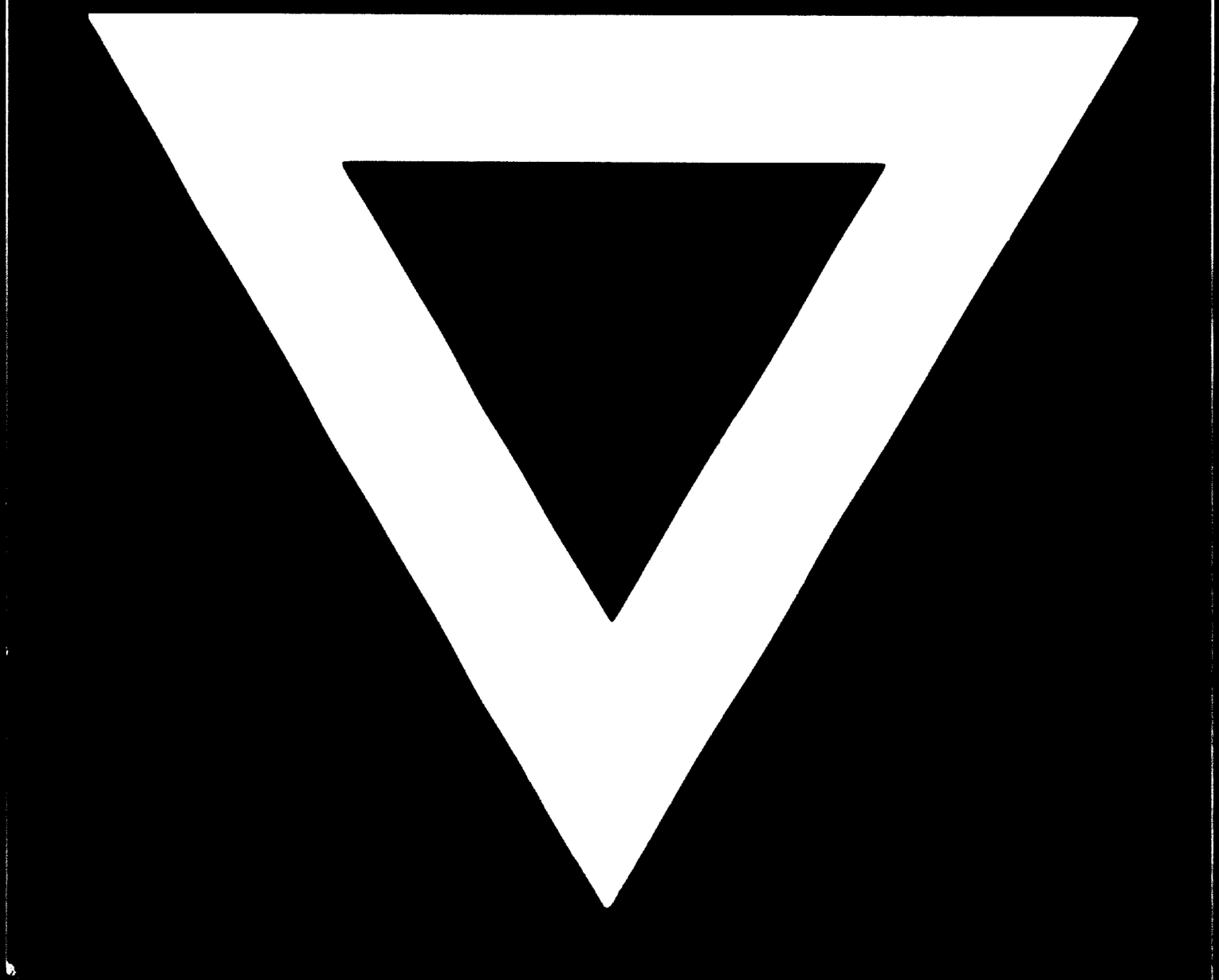
VIII. Bibliography

Kollmann, F., Kuenzi, E., Stamm, A.	Principles of Wood Science and Technology Wood based Materials, Springer-Verlag Berlin, Heidelberg, New York (1975)
Baldwin, R., F.	Plywood Manufacturing Practices, Miller Freeman Publications, INC., San Francisco, California (1975)

Lambert, H., G. Modern Plywood Techniques, Volume 2,
Miller Freeman Publication INC.,
San Francisco, California (1975)

General: For specific information on the construction and performance of particular machines, reference should be made to the extensive trade literature available from manufacturers.

C-671



78.11.09