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Technical Course on Criteria for the
Selection of Woodworking Machines

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PLYWOOD AND VENEERED WOOD PRODUCING LINES MACHINE SELECTING PRINCIPLES 1/

by

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C O N T E N T S

1. FOREWORD

The production of plywood or veneered wood panels has presently become remarkably important, in spite of the appearance and use in some fields of succedaneous products, also due to their development and introduction in particular and new fields, besides the traditional applications, and due to the increasing demand on the market of furniture obtained by natural veneering.

The plywood and veneered wood industry is therefore remarkably interesting and still admitting of important developments, above all in the countries in course of development, where a higher number of logs and labour at lower costs are usually available with respect to the traditional countries producing plywoods and sheared woods, which are presently more or less affected by scarcity of raw material and by a high labour cost.
Obviously, the transforming industries shall be equipped in the modern manner, so that the plants may allow taking in due consideration the following main requirements:

- good quality of the product
- good utilization of the raw material
- reduced use of labour
- modern but at the same time simple plants for an economic operation, a simple maintenance and a quick depreciation of same.

The purpose of the following report is that of giving some factors of judgement and of a rational plant selection, examining the modern technical solutions in the light of the above mentioned considerations.

2. LOG HANDLING CHOICE AND DEBARKING

It is obvious that not all logs can be used for the fabrication of plywoods; it is therefore necessary to make a choice destining for this purpose those logs having physical and geometrical characteristics suitable for the peeling.

In fact, it is almost impossible to work logs with shakes, cracks, foliations or in a bad condition, as well it is not advisable to use logs with scarce rectilinearity and excessively irregular section with respect to the circular one, as the rounding off operation by the peeling lathe would involve a remarkable material and time waste.

The logs selected on the basis of such considerations are piled up in a yard adjacent to the factory; the dimensions of this log yard are to be established depending on the factory consumption, in relation to the supply frequency, without forgetting possible problems of logs preservation depending on the essence and on climatic conditions.

For the logs movement it is a normal practice to make use of self-propelled crane trucks, or other traveling hoisting or conveyance equipment; still better locating the log yard in an area provided with a bridge or gantry crane.

However, at the beginning of the proper log working, it is more advisable to make use of mechanized handling systems which guarantee a working continuity and quickness, associated with the operators' safety, much higher than those offered by transports by cranes or other traveling means.

The first operation to be performed on the logs is the cross-cutting; this operation is for reducing logs to the length required

by the production cycle and it is normally performed by suitable chain saws which allow the log cut-off and the subsequent cutting to measure. Cross-cut stations are advisable, mainly consisting of entering and outgoing conveyors, supporting rollers and clamping arms for the logs; the saw is placed in the interval between the two conveyors and the blade comes down (with manual or hydraulic control) perfectly perpendicular to the log, eliminating material waste and making easier the subsequent peeling operation.

The so prepared logs shall be debarked; this operation is performed by different ways according to whether they are short or long diameter logs.

For the short diameter logs it is employed the rotor debarking machine, consisting of a sturdy bed inside which an annular rotor, on which some sprung blades are mounted, rotates.

The log is inserted, by means of suitable self-centering rollers (with which the machine is equipped), in the rotor. The log head, striking the sprung knives, makes them to open: these knives fit the log shape and, rotating, they cause a bark sliding action with respect to the wood below which therefore is not damaged.

An engraving knife, which intervenes before the debarking knives, performs a regular bark mincing.

From the above described operating principle it results evident that the use of such type of debarking machine is conditioned by the log essence and by its freshness condition.

For the long diameter logs it is instead usually adopted the cutter debarking machine. This machine consists of a bed, on which two parallel shafts equipped with large rotary disks are mounted, and of an articulated arm provided with a cutter. The logs are

placed in the space created by the disks and are rotated with variable speed, whereas the cutter holding arm by means of a hydraulic shaft remains in contact with the log and it translates longitudinally to the same; the cutter rotates at high speed and, due to the particular shape of the installed tools, it removes the bark by a combined hammering and cutting action.

Various construction solutions allow the debarking machine supply and discharging by belt conveyors lateral or perpendicular to the machine. It is also provided a solution wherein the cutting arm is fixed and the whole machine structure is mounted on truck; such solution is less rigid and, in some cases, it allows using the same debarking machine for mixed workings, serving not only the peeling lathe but also the shearing department. The output of the debarking machines of both types is rather high and a single machine can serve more working lines.

An operation often necessary before the peeling is the vaporization, consisting of exposing the logs to vapour for a period of 12 to 36 hours. The operation is necessary for some types of hard essence woods and it serves the purpose of softening and plasticizing the wood fiber making easier the subsequent workings.

For this purpose, cement underground tanks are used, on the bottom of which there is a coil heated by the factory heating system and immersed in water.

The tanks, provided with suitable covers, are filled with logs, which are thus lapped by the vapour produced by the water evaporation.

3. LOG CENTERING

After the previously described operations, logs are ready for peeling. From the economical point of view it is remarkably important the centering operation: in fact it could not be accepted an inexact centering which would cause high material losses, or an accurate centering which, owing to its difficulty, would involve time wastes. Therefore it is not advisable in the modern plants the centering manually performed by the help of hoists, and are instead to be taken into consideration the modern centering-charging devices.

Such devices are mainly subdivided in two types: the geometrical type ones for small logs and the optical type ones for long diameter logs.

- Geometrical centering devices

As above stated, they are suitable for small-medium logs and consist of two picking up gears, each equipped with three self-centering jaws connected by a pneumatic cylinder driven parallelogram system.

The picking up gears are positioned at about 1/4 and 3/4 of the log total length to take into account a log axis irregularity, if any. The center determination is automatic and thus very fast, absolutely required with the small logs, whose peeling times are very short.

The geometrical centering device working cycle takes place while the peeling lathe is working the previous log (thus without affecting the idle times); the centering device moves automatically to the "wait" position in front of the peeling lathe with the log pre-centered so that, when the peeling lathe has completed the peeling, a few seconds are sufficient for charging.

- Optical centering devices

They are particularly suitable for the long diameter logs. The

centering is determined semi-automatically by the projection of concentric circles on the two log heads.

The operator moves the log by easy pushbutton control so that the maximum diameter circle may be framed on the log heads, then it tightens the arms of the lift truck which will change the log on the peeling lathe maintaining its pre-centering: in fact, the projected circle centre is at the same level as the spindle centre, whereas its horizontal distance is equal to the truck stroke.

4. PEELING

Considering the tchnolcgical requirements in relation to the present technical developments, it can be stated by all means that the type of peeling lathe to be provided in the modern plants is the hydraulic operation double telescopic spindle type.

The log is initially clamped on the two heads by both spindles: the internal and the external one, and it is then hold by a jaw of remarkable diameter when the effort for its rotation is higher: in fact during this sequence the log has the maximum diameter, besides, not being yet perfectly cylindrical, it causes some pulsating and thus more insidious stresses. Should the log not be adequately hold by the telescopic spindle, it would be run the risk of the jaw slipping with respect to the log due to the exceeded mechanical characteristics of the wood itself; the percentages of logs rejected by the working process would thus be increased, with simultaneous loss of production times.

These serious troubles do not occur with the double telescopic spindle peeling lathes, as the peeling starts with the log clamped by a long diameter jaw which automatically withdraws when the log diameter decreases. The log peeling process continues, without interruptions, using the internal jaw until reaching the log minimum possible diameter.

The best and most economical yield of the utilized wood is obtained by this way.

Besides, the modern peeling lathes are designed taking into account the present quality and production requirements.

In fact, a general sturdiness with a cautious material selection

and a rational distribution of same allow obtaining uniform thick ness, smooth and perfectly even peeled woods.

They are also equipped with devices which positively influence the working quality or the production times, such as :

- quick opening: it is a device which allows the quick opening of the port between blade and pressure bar with return on the preset peeling thickness.
  The removal of wood splinters or bark fragments is therefore very easy.
- backlash device : it is a hydraulic device which recovers continuously the backlash between the lead screws and the cutter block nuts, guaranteeing uniform thicknesses even after years of work eliminating expensive maintenance operations.
- thickness replacement with auxiliary thickness: besides the thickness chosen in the table for the thickness selection it is possible to have available one or two additional thicknesses absolutely independent of the base thickness which allow performing the peeling of a same log with different thicknesses without having to stop the peeling process; for instance, it would be very useful to perform the peeling on a different thickness during the log rounding off or when the wood quality gets worse.

  The simultaneous and automatic pressure bar positioning makes this operation instantaneous.
- central control systems: whihh allow timely actions, easy for the operator and permitting the arrangement of the control desk in the position required by the plant.
- Cutter block quick return: with high speed for a reduction of idle times.
- Variable speed control unit: realized with direct current motor

and control equipment for a speed continuous variation in order to comply with any working condition determined by peeling requirements or by the subsequent peeling wood collection and storage system.

It is also possible, by such control units, to obtain the peeling at constant surface speed and to obtain synchronising impulses for the plants placed downstream of the peeling lathe.

- An effective hydraulic operation presser: which presses the rotating log to hold up the cutting reactions and to avoid the log deflections when this is reduced to minimum diameters.

Such hold up systems can be schematically reduced to two types:

- central roller presser
- continuous roller presser.

The first consists of an arm pressing at the log middle and mounted on the pressure bar carriage; the control is hydraulic with adjustable pressure so as to comply with the various peeling sequences. Such type is normally used on the long diameter log peeling lathes.

The second type is normally mounted on the small and medium log peeling lathes; in fact, due to the need of performing the peeling up to shorther diameters than in the case of big logs, it is necessary to effectively hold up the log by a bar equipped with rollers which presses over the whole log length. Also in this case the control is hydraulic with possibility of the exerted pressure regulation.

As it may be seen from the previous description, no distinction has been made between peeling lathes for big or small logs, excepting the presser: in fact, with the exception of the sizing

and the different sturdinesses, the provisions and the modern devices are common to both types.

It would instead be advisable to make a distinction between short and long diameter logs, when the peeled wood collection and storage systems are considered.

It is necessary to separate the peeling products, when leaving the peeling lathe, in :

- rejections
- rounding off
- continuous peeled wood

- The rejections are usually collected in a belt conveyor and removed from the working line.

- The rounding-offs are usually collected on trucks for being recovered by suitable recovery shears.

- The continuous peeled wood can instead be handled according to two different techniques:

  - coil windings
  - collection of deck system.

The winding system, recently improved by the introduction of peripheral coilers synchronized with the peeling lathe, is particularly suitable for long diameter and good quality logs, as it is possible to collect, with reduced dimensions, large amounts of peeled wood. The high development of the peeled wood band and its good quality allow a long time uninterrupted winding with good productions.

Many variants are provided for these types of plant: the simplest solution consists of a store where the wound up coils are stored

and unwound then at their ends, whereas the empty coils are collected in a floor below.

Also more sophisticated solutions are however being adopted, with one or more high collection floors for the wound up coils and an upper floor for the collection of the empty coils.

The coils are driven by automatic cycle with electromechanical control devices.

Such plants allow the location, on a floor below, of the recovery lines for the rounding offs and when they are realized with several floors for the full coils, they allow a peeled wood qualitative subdivision.

The deck system technique, even if it can be successfully employed with the long diameter logs, is usually recommended for short and medium diameter logs.

The deck system consists of a group of belt conveyors overlapped and driven in synchronism with the peeling lathe.

The peeled wood coming from the peeling lathe is sent, by a movable baffle, to one of the floors (collection sequence).

Similarly, but with discharging functions, a traveling belt connects the other end of the deck system to the pneumatic shear.

During operation, the belts alternate continuously, exchanging one another the charging and discharging operations, guaranteeing very high working rates.

This is the solution particularly suitable for small logs, as the reduced quantity of peeled wood obtainable from a log would not justify the use of the coiling. Besides, with the small logs, the nonproductive sequences times (charging and rounding off) are so reduced that it is possible to obtain the shear work continuity, during such sequences, with the limited peeled wood stock on the deck system belts.

The deck system is recommended also with medium logs, often of bad quality with consequent shakes and breaks of the peeled wood, as in such cases the coiling would take place only at reduced speeds; the handling on belts can instead be independent of such unfavourable circumstances.

The high efficiency of the peeled wood collection plants, both on coils and on deck system, is guaranteed only if, at the end of the line, there is a pneumatic type modern belt shear.

Such pneumatic control shear performs the cutting cycle in a 1/20 of second and therefore, due to its remarkable quickness, it allows cross-cutting the peeled wood band in continuous movement with a forward speed up to 80 m/min. To get then free from the human problems connected with the collection of the cross-cut sheets, it is advisable to equip the shear with an automatic one- or multi-stage sheet charger-stacker, to allow the selection per size or per quality of peeled wood.

A recent device has improved the working of the rounding off peeled woods: it is well known that one of the main problems of the rounding offs is their tendency to rolling up; it has therefore been decided to collect the same between two overlapped belts so as to prevent such phenomenon, then turn them by a rotary drum on another belt below where they find themselves overturned and then easy to work by a pneumatic shear placed in line.

It has therefore been possible to make fast a traditionally hard and low efficiency.

5. DRYING

Before being sent to the subsequent workings, the sheared wood shall be dried for eliminating the wood humidity.

The modern sheared wood drying methods can be schematically subdivided into two groups: the drying method by roller driers and the method by continuous driers.

The main technological difference is the fact that in the first case the wood is sheared in the humid condition and introduced in the roller drier with its fibre perpendicular to the feed direction, whereas in the second case the wood is introduced in the drier in continuous band, thus with grain parallel to the feed direction and sheared after drying.

The two systems shall be compared evaluating two aspects: the economical (considering not the only drier but the whole technological cycle) and the qualitative one. The use of the continuous drier allows some labour saving, besides, being shaving performed after drying, that is after the wood removal, the cutting can be performed at the exact dimension with wood saving and simplification of the subsequent workings.

Another wood and labour saving is due to the fact that the cutting to measure performed with dry material can often be considered already valid for the jointing, eliminating the need of performing the edge sawing operation or making it necessary only for the sheared wood to be used for the first faces.

On the contrary, in the continuous drying technology there are limitations which, if not taken in due consideration, may cause remarkable troubles.

From the economical point of view, it is advisable to use a continuous drier with sheared woods having width close to the drier nominal one, as, in the contrary, the efficiency gets remarkably reduced with a high operating cost increase.

On the other side, almost all factories frequently require to work with often highly variable sheared wood dimensions: a complete utilization of the drier in case of uses with narrower sheared woods is therefore not possible.

Another problem connected with the continuous drying is the impossibility of adapting instantaneously the working conditions to those required by the wood humidity conditions, which often vary even remarkably from point to point on the sheared wood coming from a same log.

Besides, the wood hygroscopicity causes, during drying, a high shrinkage in the direction normal to the fibres: this shrinkage is variable depending on the wood and on the point also in the same log, besides, the shrinkage occurs before and more quickly on the peeled wood edges, with consequent dangers of shakes or cracks of the band of peeled wood dried by the continuous system which, being introduced in long sections, shall slide on the drier nets. Several provisions have been devised to reduce the negative effects of the above mentioned phenomena. However, for some essences to be classfied as difficult, such as, for example, the beech, the poplar and some species of pine, the above indicated troubles are so remarkable and with so serious consequences to make unadvisable the use of the continuous drying.

The troubles get worse with the peeled wood width increase, as the wood structural differences in the various points will be

more felt, and with the peeled wood thickness increase, due to the combined action of the greater weight which becomes a difficulty for the sliding on the nets, and of the higher difficulty for the water outflowing with the consequent addition of higher inside stresses.

The roller drier behaves instead much better on the difficult essences, as, introducing the sheets already cross-cut, the problems connected with the avoided contraction during shrinkage practically disappear, being the phenomenon of insignificant proportions, as well as modest are the sheet dimensions. Besides, it is possible, during the green sheet collection and piling-up, after the shear, to perform a qualitative choice of the material, classifying it on the basis of humidity groups; such operation is with some practice easy enough, being of help, for such choice, the material colouring, and it is of great advantage as, regulating differently the drier for the various groups, the recycling of the not completely dried sheets can be eliminated.

Another advantage of the drying by roller drier is, from the qualitative point of view, the less material waviness and a harder and brighter surface, due to the stretching effect caused by the presence of rollers in contact with the wood during the whole drying process development.

Besides, when it is mentioned a less utilization of the peeled wood for the roller driers with respect to the continuous drier, it is necessary to carefully consider also the waste caused in the continuous drier by the breaks and cracks connected with the material shrinkage. As to a higher requirement of labour, it may be said that to-day it is contained enough, due to the fact that have been set up some high efficiency and productivity machines

for the humid.sheared sheet automatic discharge and for the subsequent automatic charge of the roller drier.

In conclusion, it is evident that the continuous driers and the roller driers can each be most suitably and conveniently used, and only in a very few cases it may be said that one system competes with the other.

The choice of one or of the other system will depend on the types of wood essences which will be worked, on their quality, on the plant type and on the provided working line.

It can anyway be stated that, when it is necessary to dry by a working line several species and essences of peeled wood of different characteristics, as in many countries of the world, the use of the roller drier is to be recommended as the most advantageous one.

6. PANEL PRESSING

The plywood panels are obtained, as it is well known, pressing 3 or more sheets of dried peeled wood suitably composed with cross grain.

The pressing operation can be performed following two different methods: pressing by multi-opening press or by one opening press.

Due to the high production values required by a modern plywood factory, normally the most suitable type is the multi-opening press.

The press consists of many overlapped hot plates, in the openings of which the panels are inserted; hydraulic pistons draw the plates near each other and exert the pressure required for glueing, which is normally of 10 to 12 kg/sq.cm.

Presses are instead normally sized for values of 20 kg/sq.cm.

The number of press openings, in case of panel manual charge and discharge, is usually of 10 to 12, being a high number of plates only an apparent advantage.

In fact, the charging and discharging times of a considerable number of openings would bring to remarkable idle periods of the machine.

Equipping the press with automatic chargers and dischargers, the idle times for the panel charging and discharging are remarkably reduced and become practically independent of the press size; presses with a number of openings never considered before have thus been made possible, as there are examples of 40-opening presses.

Schematically, the press charger consists of a belt on which the panels are composed and of a pusher placed at the end of this belt which introduces automatically the panels in the charger. When the charger is completely filled with panels and the press opens at the end of the previous cycle, all panels are simultaneously introduced in the openings discharging at the same time, from the other side, the pressed panels.

The advantages are therefore evident: as it has been said, there is a remarkable reduction of the idle times, being it possible to reach 16 to 18 pressings/hour against the 10 pressings/hr presently possible, for instance, with a 12-opening press manually charged; besides, it is possible to reduce the employed labour reducing as well the risk of accidents, being the employed workmen kept far from the proper press.

- A technique recommended in some cases, such as, for example, in case of hard woods or of presses with a high number of openings, is the pre-pressing consisting of the cold pressing of the panels in packs; suitable pre-presses with feeding and discharging conveyors perform this operation which gives the following technological and technical advantages:

  - reduction of the press opening height, which can be reduced from the usual 120 to 140-mm value to a 60-mm value, with consequent press height reduction associated with a cost reduction and an easier installation in the industrial sheds;

  - easier handling of the pre-pressed panels;

  - lower number of breaks, overlappings, working defects

  - better quality of glueing for a better glue penetration and a more even distribution of same.

Such improvement is particularly appreciated on hard woods such as, for example, the beech, and in particular with phenolic glues.

- reduction of possible vapor lock with consequent glueing lack, as the water contained in the glue spreads in the wood whereas the glue density increases.

- slight reduction of the pressing times for the better heat transmission of the pre-pressed panel.

Summing up, the typical plant for a modern plywood factory is the multi-plate press, equipped, besides than with a certain number of plates, with automatic charger and discharger, and in some cases coupled also with cold pre-press.

7. FINISHING

After pressing, panels are squared and sanded.

Squaring is normally performed by automatic feed squaring machines, performing the squaring in two times, first on a couple of sides, then on the other.

When the production volumes cannot be reached by only one squaring machine, it is advisable to make use of the double squaring machines coupled with angular transfer which performs automatically the squaring on the four sides by only one passage.

Similar considerations are valid also for the sanding. The usually employed machine is the superior belt sanding machine which sands the panels on a single face. The panels to be sanded on both faces shall be recycled, but when the production values are high, it becomes advisable to make use of the double belt sanding machines which perform the sanding simultaneously on the two faces.

8. SHEARING

Logs for shearing are stored in the log yard and handled by cranes.

Before shearing they are cross-cut at the required length, debarked and sent to the belt saw on truck for preparation.

In fact, depending on the diameter, the logs can be sheared cross-cut into quarters, cut in half or even entire.

Before shearing, the so prepared blocks shall be evaporated in tanks for a variable period depending on the wood essence.

Shearing can be performed by two types of machines; the horizontal shearing machine and the vertical shearing machine.

Due to the versatility and universatility of use with any type of wood essence, it may be said that the horizontal shearing machine is normally the most suitable one. In fact, it has not, practically, any operative limitation, it is suitable for any species of wood, and it allows working also logs of widths exceeding those allowed by the vertical shearing machine.

The several improvements have made the horizontal shearing machine a high efficiency machine, easy to use, and giving the best results from the quality point of view.

The devices which chatacterize such machines are :

- motorization at variable speed to meet all working conditions
- automatic sheet extractor

- motorized lifting or lowering of the log fastening hooks
- device for the automatic coupling or release of the tool holder truck for an easy and quick opening during the cleaning and maintenance operations
- rigid blade fastening, which takes place below the cutter block rather than over it, as traditionally done. Such type of fastening, similar to that of the peeling machine blade, allows a remarkably improved rigidity and stability with possibility of obtaining perfectly even and smooth sheared woods; it is also possible an easy shearing of reduced thicknesses, such as 0.2 mm.

The obtained sheared woods shall be dried and this is usually performed by lattice driers with blowing nozzle ventilation.

After drying, the sheared wood sheets are sent to the cutting line consisting of cutters for cross-cutting sheet packs both longitudinally and transversally to the fibre direction.

The line is normally completed with an automatic binding system and a measuring system, if required.

I deem I have made a sufficiently detailed outline of the machines concerning the plywood and sheared wood industry, even if, sometimes, the description has been intentionally quick and brief due to the extent of the subject.

I express my thanks for the attention and remain at your disposal for any clarifications and information you might require.

ENCLOSURES 1/

D 955 Diagram of peeling line for medium-long diameter logs with optical centering device and coiling system.

D 964 Diagram of peeling line for medium-long diameter logs with optical centering device and 2-floor coiling system and humid peeled wood cutting.

D 918 Diagram of peeling plant for small-medium diameter logs with geometrical centering device and 2-floor deck system.

ID1007 Diagram of peeling system for medium diameter logs with geometrical centering device and 6-floor deck system.

ID1032 Diagram of peeling plant with optical centering device, 2-floor coiling system, continuous drying and rounding off peeled wood recovery line.

ID1036 Diagram of plant for the plywood panels production.

ID1037 Diagram of plant for the veneered wood panels production.

1/ The graphs referred to in this text will be distributed separately at the Course.

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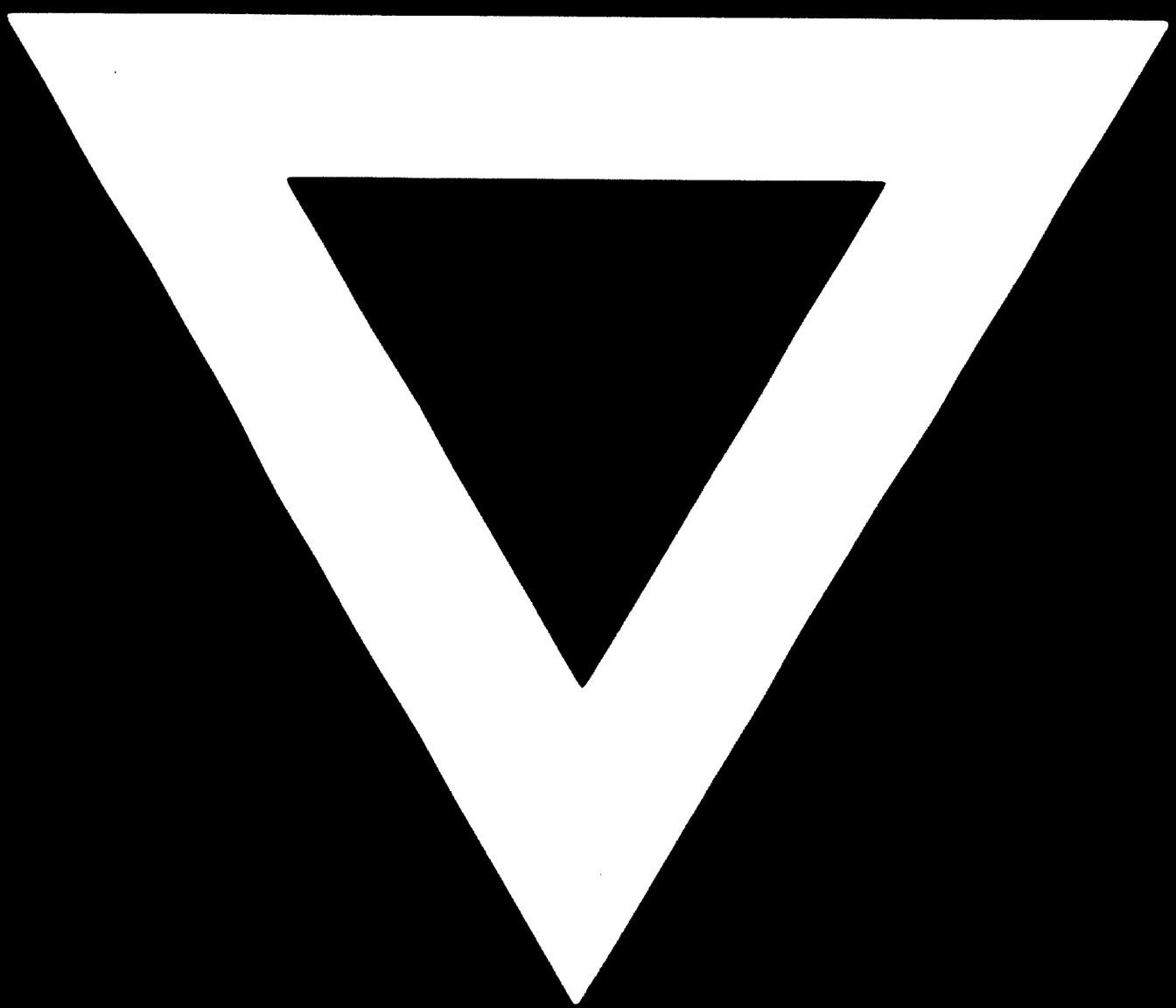

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