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D04665

United Nations Industrial Development Organization

Distr.
LIMITED
ID/WG.133/25
17 January 1973
ORIGINAL: English

Seminar on Furniture and Joinery Industries

Finland, August 1972

MACHINE MAINTENANCE 1/

by

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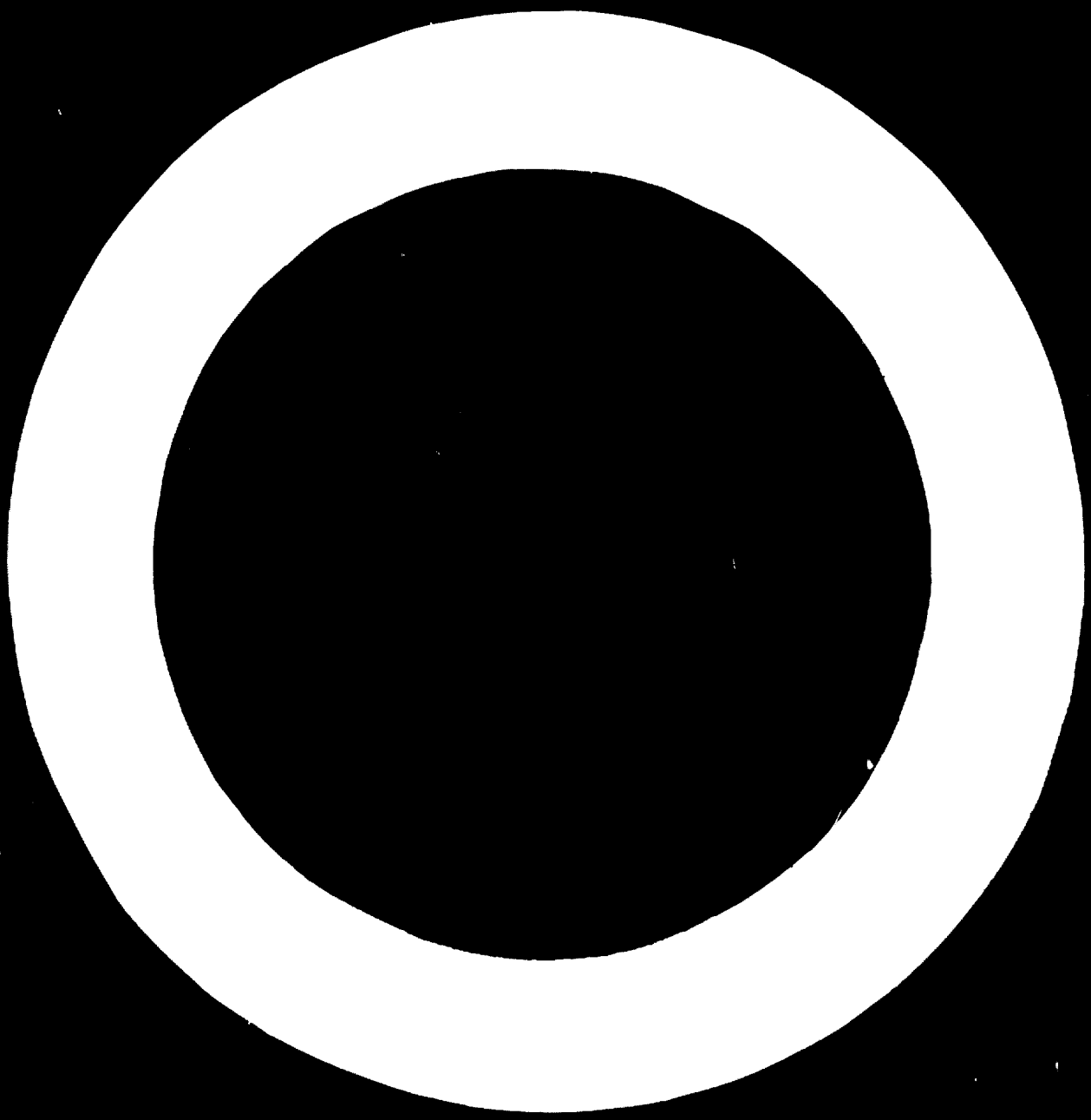


As you surely know, maintenance attempts to keep a production plant with all machines, equipment, buildings and departments in operation.

In this short lecture I however confine myself to machines and equipment, and even there only to so called primary functions of middle-sized and small industrial plants. These functions comprise:

- maintenance of machines and tools
- advance service and lubrication
- erection of new machines and equipment
- various alteration works
- generation and distribution of electricity, steam, compressed air, etc.

The so called secondary functions in maintenance work comprise:

- cleaning
- handling of trash, waste, etc.
- experimental works, building of new machines and equipment
- certain stock functions
- watching, landed property, protection from fire.

These secondary works have to be accomplished as a centralized part of maintenance in a large-scale industry, if the plant comprises several industries or if it deals with several fields of wood working industry and not only the joinery industry.

The amount of maintenance work in industry has continually increased, and the same tendency goes on. At the moment we can say that the number of maintenance workers in mechanical wood processing industry is 10-15 % of the total number of workers. In particle board industry this number is even more.

The continual increasing of maintenance work is caused for instance by the following circumstances:

1. Quickly and continually increasing mechanization, automation and general development of industry have greatly reduced the number of workers in actual industry.

2. Facilities and tools for maintenance have increased considerably.

3. Instead of watching over the non-attendance of labor power as before, it now seems in several industrial enterprises to be more important to watch over machine downtime because its significance is more essential.

4. The investment of capital in industry has grown tremendously and calls for uninterrupted running to the most possible extent, in other words for two- or three-shift work.

5. Speeds, pressures, temperatures, capacities etc. of machines have increased and thus also their wearing.

6. Higher precision of machines and higher quality of products are demanded.

7. Machines and equipment must be movable.

8. Safety at work, air conditioning, industry hygiene and other circumstances call for new tasks.

9. Treatment of waste becomes in industrial plants more and more a social and economical problem.

With increasing amount of work, the demands for craftsmanship required for maintenance have also continually increased. Especially, the instrumentation and automation make quite new and with difficulty fullfilled demands. The use and handling of new materials, for instance plastics, contribute to the some direction.

Earlier and partly even now, maintenance means only repairing, in other words: repairing is done when something breaks down. Nowadays, there is a strong tendency towards preventing maintenance, which has to be considered a fairly far developed form of maintenance.

The repair work was earlier accomplished by common workmen, nowadays skilled craftsmen are doing it. However, the course of progress is to have the maintenance done by a labor power with relatively little skill that makes the maintenance just by "changing".

The ever increasing **automation** makes that even necessary. The equipment are becoming so complicated and their maintenance and repair are beginning to call for so high professional skill that only few industrial plants afford to employ such personnel. Only very bi concerns are self-supporting in this respect. Th other enterprises then must resort to change and spare part arrangements, even to whole change machineries, by which then the damaged ones will be replaced. The damaged part will be sent to a special factory or repair shop for being repaired. Importers or licence manufacturers give information on such special repair shops. By making annual or other agreements it can be ascertained that the special repair shop always has such a spare part or spare machine in readiness for the customer concerned.

In general, an external help in the repair works will obviously come more and more to the fore, even for the reason that, by this means, it will be possible to get specialized service also in those tasks that are not possible within the own organization. For the time being, the Diesel motor for truck or for another working machine is a good example of such a changeable part. This motor is usually changed and taken to a special shop for repairing. There it will be repaired and returned, when a new motor is in readiness if some damage occurs. This arrangement is very suitable for instance at lumber yards, log stocks etc. However, it should be remembered that, when the work machines are bought, the motors should be of a same type and at least made by the same manufacturer, even if the work machines are of different marks.

Organization of maintenance

In the course of years, the organization of the maintenance has changed in a very decisive way. In old times, all repair work was done by only one man, but nowadays a modern form of organization has gradually developed. This becomes clear from open organization scheme, and the essentialness of this scheme is no more brought into question by any modern industrial management. It may be stated from the very outset that the organization set forth by no means is any generally accepted aim, but it only serves as an example. In the present form it is suitable for the requirements of middle-sized and big industries, but somewhat modified also for a smaller enterprise. The position of maintenance in an enterprise has also changed decisively. Having earlier been subordinated to production it is now becoming equal with the production and will account for the works direct to the highest management.

In connection with the re-organization of the maintenance and with the organization in general, the following circumstances should be noted:

1. If the field of tasks becomes wider, technical and economical know-how should be added to the supervision of the maintenance. In general, when the amount of work increases, the number of fitters and other workmen is increased too, but not the number of engineers and techniciens. Lacking clerks, the maintenance supervising personnel has to do much mechanical and routine work, there is not sufficient planning control, etc. It is often forgotten that the increasing of the number of persons and of the amount of labour always calls for additional persons for supervision, control and routine works. Lacking technical staff, so called "foremen" can be appointed to the field, when the supervising persons can control bigger groups and their time can be used in more various ways,

2. The use of too many incompetent workmen must be avoided. The number of auxiliary workers should not exceed 20% of that of craftsmen. The maintenance department, however, should not become a place for retired persons nor the repair shop a museum of woodworking machines. Securing of a new skilled labour power calls for training. But the training should not be done in such a way that a young man goes from year to year helping an older craftsman, but it should be done under the leadership of competent trainers.

3. Further, it should be noted in budgeting and in future planning that, into the maintenance organization, there are coming entirely new tasks and departments, as for instance:

   - preventing maintenance department
   - scrapping and repair department
   - plastics department
   - instrumentation and automation (possibly even electronic department)

In general, among the inner maintenance organization, there are so called decentralized and centralized systems. The firstnamed means that the maintenance men are divided to small groups all around the factory and often in some way subordinated to the local production supervision, whereas the lastmentioned works from one point and is subordinated to a centralized supervision.

Both systems have certain benefits and disadvantages. A suitable system should be selected separately in each particular case, when many circumstances such as nature of

working process, price of downtime per minute, number of interruptions in work, degree of mechanization and automatization, general development of maintenance works, etc. should be taken into consideration.

As a rule, centralization should perhaps be strived for in small enterprises. But when the factory area grows so big that unnecessary walking and herewith connected waste time are beginning to form a considerable cost factor, it is advisable to consider at least partly entering on a decentralized organization. However, it is advisable to try to retain the centralization of the supervision. The same applies to automation and the situation where expensive basic machines with high capacities (for instance a paper machine or, in joinery industry, a painting line) are in operation. Then it is of course worth having maintenance workers to control their operation and condition.

However, the following functions should be centralized nearly without exceptions:

- planning works
- power plant
- generation and distribution of electricity, gas, steam, compressed air, etc. to production areas
- elevators, cars, trucks
- sprinkler extinguishing system, pneumatic conveying and air conditioning
- machining works
- major part of board works
- building and repairing works
- inner telephone network
- auxiliary labor power.

In principle, each occupational labourer should be led by a foreman of the same occupational group. Thus, it is not advisable for instance to give maintenance workers over to the subordination of production leadership. It would be advisable to subordinate also decentralized maintenance groups direct to the maintenance leadership, as far as the crafsmanship is concerned but, in respect of proceeding, they should be subordinated to the production leadership.

Maintenance card files

Arranging of proper maintenance is not possible without some recording, that is to say: card files. It is almost impossible to begin even a preventing maintenance without repair statistics made during several months (preferably during several years) for each particular machine, and certain basic data for machines and equipment are surely necessary. It is

very easy to record data on a machine card when the card is at hand, to put down the numbers of bearings when the machine is disassembled and the numbers of belts before the belts are worn out, the weight of a machine when it is to be seen in the waybill, etc.

The objects to be filed are almost the same in various industrial plants. However, it is worth thinking what objects should be filed and what not. For instance, in joinery industry, the objects for filing are woodworking machines, presses, conveyors and certain hand tools as for example sanders, etc.

The basic card (Fig. 14.1) serves for instance also as a list for fire insurance, deducting card, etc. If it includes sufficient data on belts, bearings, lubricants, etc., it gives an excellent starting point for interior standardization.

Special cards have sometimes been prepared separately for each machine type. At least in the joinery industry, such profoundness is not of much use. In practice, data that are common to different machines, are generally most needed. So only one blank form type where plenty of room has been reserved, has often been considered quite sufficient.

As an exception, the card for electric motors might be mentioned. This form may be of minor size and it is usually kept in the department for electric repairs. Only electro-technical basic data such as motor number, effect, rate of revolutions per minute and type are put on the machine card. For practical reasons, data on repairings and maintenance have been entered on a separate blank form which of course can be kept together with the machine card. Data on repairings are in fact coming so frequently that the columns of the basic card would be too quickly filled. It is also difficult to get in the basic card space enough for detailed work descriptions, data on spare parts used, etc.

The basic card and repair card as such can also be used for time schedule control (inspections of preventive service, lubrication service, etc.).

The numbering of machines for the file of machine cards can be done in many various ways, but the most usual way is a running number arranged in the buying or arriving order or a certain number series for each machine type. The third alternative is to have an own series of numbers for machines of each individual department.

Preventive Maintenance

In general, the nature of maintenance is still passive, because the function begins only when the machine is broken, but it should be active. By inspecting and service lubricating,

the condition of the machine should be continually observed and the basic repair, carefully planned, should be made in right time, in respect of production.

The preventive maintenance is no new idea. In some fields, as for instance lifts, airplanes, railroads, pressure chambers, etc. regular inspection have been done for decades.

The preventive maintenance is considered a very extensive function which comprises for instance:

- various inspections of machines and devices
- small repairs, adjustments, cleanings etc. made when inspections are being accomplished
- planned repairs made after inspections
- in advance planned complete repairs and works made during downtime.
- lubrication service
- investigation and selection of constructions and raw materials
- comparative investigation and recommendation of various protections and layers.

The field of preventive maintenance consists of machines, equipment, tools, conveying equipment, outfit, buildings, ways, briefly: the whole factory.

The preventive maintenance, naturally, causes some costs. Therefore, the objects and scope of maintenance should be carefully planned. In the joinery industry, the maintenance should be extended to painting and laminating equipment, quickly rotating bearings, drive belts, chains and chain wheels.

Before the maintenance program is started in its whole extensiveness, the persons concerned should be charged only with this work and not with others. The following documents and data will then be essential:

1. Card files on machines and devices
2. All documents, instructions etc. for each machine
3. Drawings on machines and devices, particularly on big machines
4. Statistics on downtimes.
5. Data on repairs
6. Scheme of pipings
7. Arranging of reliable spare part service. Further, it is important that the preventive service group consist of

eager and active workers.

The inspecting activity comprises two different functions:

- Routine inspection and maintenance
- Inspection according to the program for each particular machine.

Both in joinery and other industries, the former functions could comprise

- Electric motors
- Power transmission devices
- Pipings, valves, pumps
- Conveying equipment, elevators, lift tables
- Air conditioning devices, dust suction devices
- Lighting devices
- Office machines
- Instruments and automation devices.

As some example of inspection periods, the latter functions could comprise

a) Weekly inspection
   - scales
   - cooling equipment
   - photocells
   - tools equipped with electric or compressed air motors
   - spraying and air conditioning devices for paintshops

b) Inspection every second week
   - belts, couplings, starters, electric motors
   - instruments, electric control devices
   - air compressors, pumps, air conditioning

c) Monthly inspection
   - blowers, belt conveyors, pneumatic and hydraulic conveyors
   - water treating plants
   - lifting devices, elevators

d) Inspection every three months
- battery charge for accumulators
- boilers, lighting
- welding machines and transformers

e) Inspection every six months
- fire extinguishing equipment, water tanks with fittings
- pipings, power lines, heating outfit

f) Yearly inspection
- small electric blowers
- normally operating ball bearings

A good example of an object for preventive maintenance is the observation of bearing of a knife shaft, more than 9000 RPM, for a high-speed machine such as a single spindle shaper. A broken bearing may cause the breakdown of a whole knife spindle. By observing it regularly, it will be possible to fix the right moment for replacing it and thus avoid the damage.

The above list serves only as an example, because even for same equipment may be required several inspection periods such as daily cleaning, weekly adjustment, monthly inspection of operation and annual whole repair. The right fixing of an inspection period makes the basic condition for a successful program for a preventive maintenance. Too frequent inspection means a waste of labour power and money, inspecting too seldom means jeopardizing the machinery. The periods must be changed to conform to changed conditions, and by observing the changes occurred, it is possible to fix the right periods.

The inspections may take place

a) When machines are running, when abnormal vibration, wearing, lubrication faults (oil leakages), excessive heating, poorly fixed parts, play of shafts etc. can be observed. However, it should be noted in this connection that, in the joinery industry, a knife in poor shape may cause some of these abnormalities so that the intervals between knife replacements in woodworking machines should be observed.

b) During machine downtimes, the inspection possibilities

are of course considerable **greater** one experience has shown that at least every third inspection should be made in that way. Inspection and measuring of shafts, bearings, gear wheels, slide surfaces, belts, flanges, as well as of tensions will then be possible. Especially machines producing much sawdust and chips should be inspected **only during downtimes** because parts normally not visible can then be surveyed. For inspection, the dust and chips should be removed from the machines. For instance in tropical conditions, the thicknesses and protectiveness of grease application should be ascertained at the same time.

Preventive Engineering

Preventive Engineering means the investigation and selection of raw materials and various protections, so that repairings would be avoided in advance. When the preventive maintenance has developed, some causes for different **breakdowns** and repairings have been revealed. In many cases constructions, raw materials and protections have been the reasons. In respect of them, there is really much to do,

The first task here is to investigate repair statistics and separate out the most essential and frequent repair works. The second task is to find out if a wrong construction, raw material or protection is the essential cause also here.

Lubrication maintenance

Successful lubrication brings along the following advantages:

- Machines are kept in condition
- Lifetime of machines is extended when the wearing is reduced
- The efficiency of machines increases
- Danger for accidents is reduced

For attaining these advantages, it is essential to use right lubricant in right place and time.

The following is important:

- The assortment of greases to be stocked should be as small as possible.
- The lubricants chosen should be included in the internal factory standard and marked with the same sign as the lubrication points and tools are marked.
- All lubrication points should be lubricated in the right way, that is to say: the lubrication must be done according to the plan made by an expert. Oil companies give up such plans free of charge.
- Lubrication should be accomplished in right time, but unnecessary lubrication must be avoided. It has been ascertained that over-lubrication is more frequent than under-lubrication especially when ball bearings are concerned. In general, a small or middle-sized bearing in normal use and with usual rates of rotation needs lubrication once a year.

The amount of grease in one filling can be calculated from the following formula and is approximately

$$G = \frac{D \times B}{200}$$

where G = amount of grease required, in grams
D = major diameter of bearing
B = width of bearing in mm.

To save in lubrication costs and to ensure a reliable lubrication, some bigger enterprises, especially sawmills and plywood factories have proceeded to automatic lubrication, where hydraulic pumps press grease through a piping to lubricating points, as required. The amount of grease for each point is adjustable. This way of lubricating is becoming general for instance at the slide surfaces of conveyors and in the process industry. In joinery industry, however, there are not many points for lubrication by this system.

Oils used once or even several times should not be thrown away, but an effort should be made to clean them. In general, waste oil is taken to special cleaning plants. If this is not possible, a filter arrangement can easily be built using waste wool.

Most usual damages in machines and other equipment used in industry are caused by corrosion. With you, this matter is no doubt familiar and more troublesome than with us in the north.

When striving for a reasonable use of metals, they have all over the world paid special attention to corrosion. For instance, the speed of rusting of steel is directly proportional to the temperature. Most usually, corrosion is caused by water or oxygen. Oxygen is an especially difficult factor, because the strength of the metal in some cases calls for its presence, because the oxygen forms a protecting film on the surface of the metal, but sometimes it greatly contributes to the corrosion.

Preventing of corrosion

In principle, the preventing of corrosion is rather easy. By protecting the steel surfaces for example, the corrosion speed is reduced either by preventing mechanically the surface of the steel from getting in touch with oxygen or moisture or by having a passive influence on the rusting itself.

For the time being, we know the following means for preventing corrosion:

1. **Observing some constructional viewpoints at the planning phase.**
2. **Changing of outer conditions**
3. **Covering the materials which may corrode by:**
   a) suitable paint or lacquer
   b) suitable plastics
   c) suitable rubber
   d) suitable ceramic material, or by glazing or using protective boiler masonry
   e) suitable metal
   f) some other protective layer (anodic covers, **phosphate etc.**)
4. Making the metal cathodic (cathodic protection)
5. Preventing of some reactions involved in corrosion (inhibitors)
6. Using such materials that do not tend to corrosion in the neighbourhood and care in question.

In the above list you will see that the corrosion preventing methods in very many cases require a considerable knowledge of chemistry and corrosion.

On second inspection, it is to be found that the point 1. seldom can be altered in the site but the manufacturer has already solved it. At the time of ordering, however, you can influence the matter and ask for such a solution in respect of construction that you think will endure your particular conditions to the largest possible extent.

On the other hand, alterations of conditions according to point 2. is possible also where:

The air of the factory hall can be cleaned and dried.
The amount of carbon dioxide can be reduced.
The speed of the flowing fluid can be reduced, if it deals for example with pipings.
It is possible to arrange a good ventilation.

The protective methods in point 3. are the most familiar and in use from very early times.
When painting, the following three circumstances should be noted:

- the surface should be cleaned very well
- corrosion preventing priming should be used
- tight and covering paint should be applied on the surface.

Of primings might be mentioned the well-known red lead and zinc yellow.
Of surface paints may be mentioned bitumen paints, reaction lacquers and paints, as well as silicon resin paints.

Among plastic coverings we might mention plastic lacquers and paints, plastic pastes and solutions. Polyvinyl chloride, teflon, fluor, phenol, polyester, furan and epoxy plastics are most in use and have proved the best for protection and wear resisting purposes.

Rubberizing can be considered in tanks, pipes, conveying rollers, glue rollers and gluing machines in general. Rubberizing can be entrusted only to a vulcanizor familiar with this work, so that the rubber holds fast to the surface.

Boiler masonries, glazings and ceramic treating should be used only in high temperatures.

Metal layers are not always intended to protect against corrosion but sometimes they are used for protection against wearing or to give gloss to the object in question. Hot dipping, spraying and electrolytic methods are the most usual. Zinc, chrome, nickel, aluminium, tin and lead are used as covering layer.

Other methods listed will hardly be considered in the joinery industry, except of such plants where the furniture parts are made of metal. In the lastmentioned cases, there should be an expert in this line available, so that those parts are treated correctly and with right materials.

Finally, we might mention a so called provisional protection which means the use of materials influencing the surrounding air or the use of protective films.

A protective film is of PVC-plastics, which can be torn up. They are first melted, after which the object in question is dipped into the melted plastics (temperature 185° C).
Chemicals that influence the surrounding air are the V.P.I. or Vapor Phase Inhibitors which form a protecting gas layer onto the object concerned.

Stocks for maintenance

The materials to be held in maintenance stock are mainly the following:

Parts of standard nature: parts of pipes, nuts, bolts, fuses, bearings
Part for separate machines: special bearings, spare parts
Spare devices: motors, pumps, condensation-water, removers, couplings
Requisites: packing twist, lubricants, paints
Outfit: changeable gears, conical turning device
Machine tools: knives, drills, grinding wheels
Hand tools: wrenches, measuring gauges, compressed air tools, electrical tools

The ever increasing machines and automation have also contributed to the capital value of maintenance stock. The increase of the price of downtime has had a similar influence. As

The repairings have to be accomplished as quickly as possible, there should be sufficient spare parts in stock.

There are two basic problems:

1. To accelerate the repairings, more and more spare parts and devices for the most essential machines should be held in stock
2. On the other hand, when the capital and stocking costs are considered, the stock should be kept as small as possible.

In general, the final solution is some kind of a compromise between those two extremes.

If the factory is located far from the manufacturing country, as the case is with the most of you, the spare part stock should be rather big, to guarantee the run of the factory. However, the spare parts needed should be observed at the early stage when the machine is being ordered, and a list for spare parts to ensure the operation of 2 years, and for some machines even for a longer period, should be asked for. Further, it is worth while discussing the necessity of each particular spare part with other users of machines, especially if it deals with an expensive spare part.

Standardization should also be strived for, for instance all the machines and machine parts, as threads, holes, bearings etc., should be in metric system. Measures in inch should be avoided.

It is easy to keep the stock up to date if it is kept in order and duly card filed. The so called alarm limit or required time of ordering should be marked on as many cards as possible, when an order could be placed immediately as soon as the amount of parts in stock falls beneath that limit. Here, a goods card or spare part card is used as help. With regard to small machines, only the most essential spare parts are written onto the machine card. But if it deals with standard spare parts, a summary must be prepared for departments and for the whole plant to indicate their total number. Such parts are for instance belts, chains, motors, bearings etc. The summary list forms a base for acquiring, stocking and inner standardization.

As the maintenance is more and more developing to changing work, the repair takes place decisively quicker, but finally a limit will be attained when it is no more economical to exceed this limit. You could even calculate in advance how much could be invested in spare parts for some essential machines.

Here are some examples:

It deals with an essential big electric motor. The work is made in 3 shifts and the downtime costs have been calculated to 200 mk per hour.

Spare part stock		Winding etc.	Whole rotor	Whole motor
Repair time	240 hours	144 hours	7 hours	3 hours
Stillstand cost	48.000	28.800	1.400	600
Price of spare parts	-	1.000	8.000	16.000
Repair cost	6.000	2.900	300	100
Total cost	54.000	32.700	9.700	16.700

The calculation thus shows that it would be more paying to keep the whole rotor in reserve.

The spare parts are usually identified by means of their number. In general, the stock should be kept in order either by numbering or by letters, so that the parts will be easy to find when needed.

Mounting

The mounting of each machine has to be accomplished with special care, because an incorrect or faulty mounting can cause irreparable damages in operation.

Before the beginning of mounting, the instructions which usually are delivered with the machine, should be taken careful notice of. It is important that such instructions are requested with the machine, or preferably already in advance when ordering the machine. Even if the ways of mounting the most usual woodworking machines do not actually differ from each other, it is, however, worth while noting the necessary tools and arrangements in the instructions

for each particular machine. This is important even if the machine is familiar before, because the machines and their sizes are changing so frequently.

Some heavier machines as wide belt sanders, wide planing and thicknessing machines, below fitted milling cutters etc. can be mounted in place without fastening. Vibration softening rubber mats should in such case be placed below the machine. However, this method of mounting requires an absolutely even and straight floor level.

In any case, no matter what the machine is, the mounting can be done by using fastening screws. When the site of the machine is fixed, cavities for foundation screws should be made in the floor or, if the plant is under construction, the holes required for foundation can be observed in this early stage. When making these holes or cavities for foundation screws, they must absolutely conform to the drawings of the manufacturer. In no case must the hole or cavity for the bolt be smaller than the drawing indicates, or the fastening bolt gets loose as soon as the machine is started. Then the machine is fitted to place and the foundation screws are fastened on the holes of the frame so that they hang freely from the holes or cavities in the floor.

For casting, the machine is hoisted from the floor about 20-25 mm by placing metal wedges, lead plates etc. between the frame and the floor level. The wedges should be placed as near as possible to the fastening holes. At the same time, a water level should be employed to check the horizontal position of the machine, and after that the screw cavities are filled with cement grout. When the cement has hardened, the foundation screws are tightened. At that, care should be taken that no tension is created at the machine, in other words: the screws must not make the frame twisted or cut off it, which can occur if the machine is not steadily in place or horizontally fitted. Tension or bending make the function of moving parts difficult, and even the frame may be damaged.

When the place of the machine is planned, also the inlet of electric cables, compressed air and hydraulic pipes to the machines

should be considered. The same applies especially to the removal of dust. For each working machine, a possibility for sufficient removal of saw dust and shavings should be provided for.

If the removal of saw dust and shavings is not arranged efficiently and correctly, it makes the production difficult in several ways. The circumstances in respect of the workers' health and safety at work in dusty surroundings retard the work. The maintenance of a dusty machine is often neglected. Drive motors among shavings and chips get overheated and the windings burn. If dry shavings and saw dust cannot be efficiently removed from the machine, they can cause fire and thus much damage.

The best way to remove shavings and saw dust is to remove them pneumatically from beside the knife of the machine, when they do not sail all around the factory hall and floors. The pneumatic shaving suction system has to be extended to the whole factory hall and to each working machine. The advantage of such a centralized system for the removal of shavings and saw dust is not limited to the above mentioned, but the waste wood gathered can be used further in particle board mills, blockboard mills or cellulose mills.

The fitting of saw dust or shaving piping in old buildings may present difficulties and extra costs but one must not get frightened at them. In such cases, in general, a piping hanging at the ceiling is the only solution. In new plants under planning or construction, it is possible to make in the floor canals for shaving suction piping. Then, the shavings on the floor can be swept through relevant holes for being transported away.

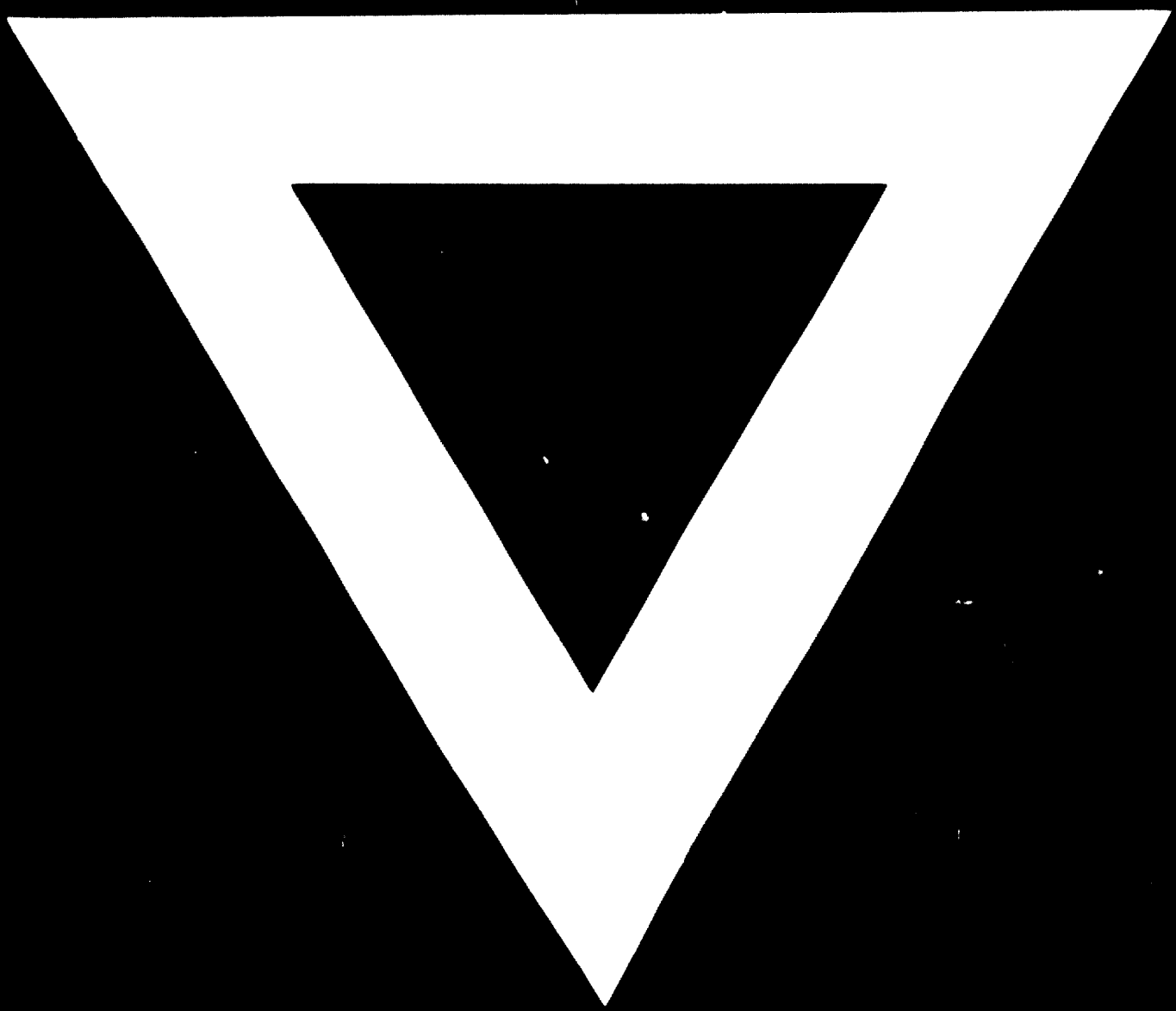
Finally, we might stress that a clean factory produces more and better goods, in a fewer number of working hours per product unit and that it runs without any considerable maintenance.

NUMBER OF USERS

WORK DIMENSIONS		RATES OF REVOLUTION	FEED SPEEDS

OTHER DATA ON CAPACITY AND OPERATION SPECIFICATIONS

Figure 1.1.1. Basic card



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