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FINAL REPORT

RESTRICTED

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04457
(1 of 4)

by
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United Nations Woodworking Adviser
attached to Light Industries Services
of the Government of Singapore.

Appointed under the
UNITED NATIONS INDUSTRIAL
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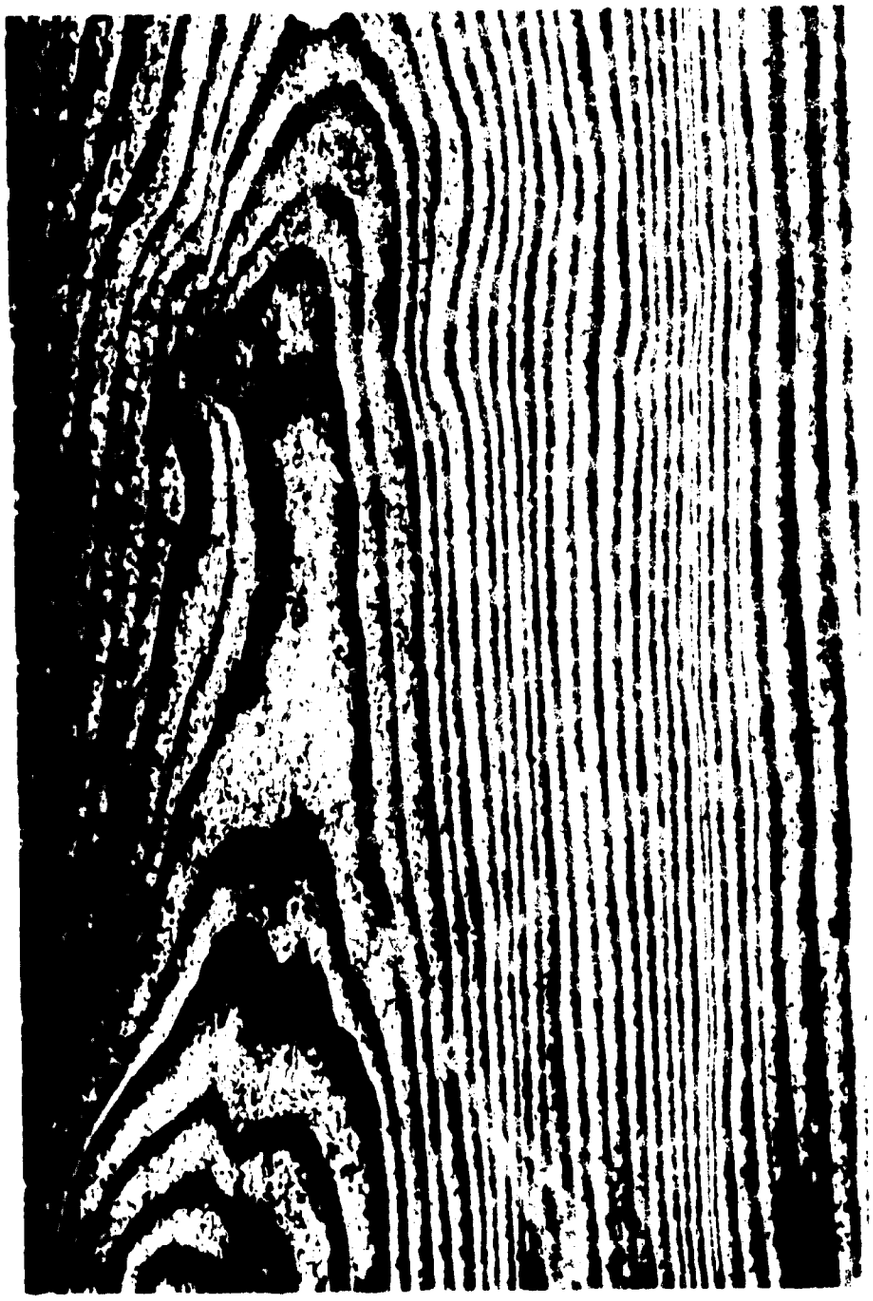

This report has not been cleared by Unido which does not therefore necessarily share the views expressed.

31 May 1972

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Part 1 INTRODUCTION

1.1 Objective of the assignment

Assist the local furniture industry in its modernisation and expansion programs in view of promoting export.

1.2 Duration of the assignment

The assignment started in November 1969 for an initial period of six months. Subsequently, two one-year extensions were granted by the United Nations as requested by the government.

1.3 Reporting contacts

The assignment was carried out within the framework of the Consultancy Services provided by the Light Industries Services (LIS) of the Economic Development Board (EDB).

I reported to LIS Ag. Director as follows :

i)	Dr. Khoo Sian Wah	November 1969 - December 1969
ii)	Mr. Tan Hui Boon	December 1969 - January 1970
iii)	Mr. Michael Yap	January 1970 - May 1972.

1.4 Purpose of the report

The purpose of this final report is to :

i) Present basic data and review the situation of the Timber industry as a whole (see Part 2 & 3).

ii) Review the main problems of the industry (see Part 4 to 7).

iii) Describe the assistance provided to the industry (Part 8).

iv) Describe the development projects undertaken (Part 9).

v) Draw conclusions from the findings assess the work performed and recommend follow-up actions required (Part 10).

Part 2 BASIC DATA* ON THE TIMBER INDUSTRY

2.1 Overall Data

The timber industry has grown rapidly since the post-war in spite of the fact that this country has no forest of its own.

Today, a total of over 152 firms provide employment to some 8,000** representing 8.32% of the total industrial employment.

The total sales value for the timber industry in 1970 reached S$183.601 millions, an increase of the 32% over 1968. The total added value is of approx. S$66 millions.

Today, the timber industry ranks as Singapore's fourth largest export-earner after rubber, petroleum and textile.

2.2 Saw Mill Sector

The saw mill sector includes 98 plants with a total of 3,500 workers. Its sales value for 1970 amounted to S$97.466 millions, an increase of 30.7 % over 1968. These figures, however, include re-export of logs.

Preliminary figures for 1971 show a 10.7% decrease in volume of sawn timber as compared to 1970.

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*Data presented in this chapter refer to establishments with 10 and more workers. Timber Trade Statistics related to all sizes of saw mills are shown in Annexes A-4 to A-12.

**Workers include all persons engaged directly or indirectly in the industrial activity of establishments.

About 69% of the production of sawn timber was exported to more than 40 countries, the major markets being South Africa (57.869 tons), France (27.000 tons), and UK (20.956 tons).

2.3 Plywood & Veneer Sector

This sector consists of 8 plants with a total of 3.683 employees. Its sales in 1970 amounted to S$53.290 millions, an increase of 66% over 1968.

Approximately 79% of the total production was exported mainly to USA, UK, the Far East, Middle East and Australia.

2.4 Furniture Sector

This sector includes 30 firms* with an employment of some 1.560 workers. Its sales value in 1970 was 21.876 millions, an increase of 90% over 1968. However, in 1968, a 9.2% of the total sales was exported overseas; in 1970 instead, the ratio was reduced to 6.6.

Almost no standard mass-produced furniture is exported from Singapore with the exception of a simple knock down chair (see Annex 1) manufactured by Koya Wood Industries and shipped to Holland through INTRACO (a government owned marketing organisation). S$100.000 worth of this item was exported in 1971 while S$500.000 has been set as the sales target for the current year.

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* Firms with more than 10 workmen. There are in addition some 100 very active "Backyard Workshop".

2.5
Joinery Sector

The products of this sector include general type of woodworking. It consists of 16 plants with a total of 1,044 workers. Its sales value for 1970 was of S$56,411 millions as compared to S$9,776 millions in 1968.

This dramatic growth was due mainly to the increase in direct export sales of as much as 113% (S$12,234 millions in 1969, as compared to S$5,737 millions in 1968).

No breakdown figures by product, are available yet. However, it is presumed that this phenomenal jump in export sales is to be credited partly to the increase in demand for wood mouldings. **

** Mouldings is a term used locally to indicate various types of planed and moulded timber components such as : flooring board, window and picture frames parts, wall panelling elements, etc.

Part 3 REVIEW OF THE GENERAL SITUATION OF THE INDUSTRY

3.1 Difficulties of the saw mill, plywood & veneer industries

3.1.1 Although statistics show an overall increase in the sales volume of all the sectors of the timber industry, this should not lead to undue optimism as many problems are looming on the industry's horison. The most critical one is to obtain regular and prompt supplies of large quantities of high quality logs from the neighbouring countries economically. Traditionally, West Malaysia has met this demand with 95% of the log supply while the rest were from Indonesia. However, Malaysia is expanding its plywood and other wood industry itself and this is making the supply situation tighter. Sarawak, for example, has recently announced that it is devising a system of taxation for its timber industry to encourage local processing and dampen export of raw logs.

3.1.2 What is pertinent to Singapore and for that respect a regional point of view, the log production in Malaysia, principally for export, is governed largely by a policy of land clearing for food production and the growing of cash crops for exports. Because of these land-clearing programmes, it is expected that in less than twenty years, almost the whole of logs output will go to local timber industry.

3.1.3 As a result of these factors, Singapore's timber industry is turning to the unexploited forests of Indonesia - the largest in South-East Asia - as a potential source of supply. Indonesia with its extensive but largely untapped resources could become in time the monopoly supplier of logs to Singapore, and may also present an unparalled opportunity for joint co-operation in the exploitation of its forests. In fact most of Singapore's sawmills, plywood and veneer companies have already or are looking for logging concessions in Indonesia. In 1971 there was an increase of about 36% in the amount of logs imported from Indonesia as compared to the previous year (117,007 tons in 1971 as against 73,646 tons in 1970).

3.1.4 In addition to availability in the supply of logs, the sawn timber industry is faced with increase in freight rates, lack of shipping space and increase in bundling charges. Moreover the labour cost is increasing and it is already much higher than in the neighbouring countries rich in raw materials.

If the sawmill, plywood veneer industries are to survive in the long run, the emphasis will have to be on upgrading of value and improvement of productivity.

3.2 Difficulties of the furniture industry

3.2.1 As for the furniture industry, much of its increase in sales is to be attributed to the transient boom in hotel construction. The furniture industry will be heading for real trouble if proper steps are not taken in time. This sector of the industry has been affected since 1967 by the increase in the cost of raw materials (20% to 50%) and skilled and semi-skilled labour (30% to 60%).

3.2.2 One of the most critical objective problems consists of market difficulties generated by the phasing out of the hotel boom and the run-down of British forces here. The furniture industry is feeling the effects of reduction in expenditure with the repatriation of 30,000 British service families. Incidentally, it is estimated that British military expenditure in Singapore amounted to S$350 millions for 1970.

The irony of the situation is that the furniture industry cannot derive any significant business from the tremendous amount of activity in the public housing sector (which has been producing an average 20,000 flats per year) because of the deep rooted monopoly of "backyard workshops".

3.2.3 This situation has created very keen competition among the small scale furniture

manufacturers some of whom are aware of the impending crisis and are considering diversification into the manufacture of standard products for the local and/or export markets.

Whether this can be achieved or not, depends on the solution of the numerous, inherent and objective problems of the furniture industry. The main inherent problems of the furniture industry are examined in parts 4 - 8 of this report. Some difficulties of the sawmill industry are also reviewed. The analysis is conducted in the following order :

Part 4	Problems of manufacturing structure and management
Part 5	Lack of trained Processing Supervisors (see Part 6)
Part 6	Lack of specialised skills and advanced production methods (see Part 7)
Part 7	Lack of Furniture Design facilities (see Part 8).

Part 4 PROBLEMS OF MANUFACTURING STRUCTURE AND MANAGEMENT

4.1 Factory System & Handicraft System

4.1.1 In addition to objective problems, such as the absence of marketing data, the industry must also overcome some substantial shortcomings which are inherent to the present structure of the industry itself.

At present, the business and production management methods of Singapore's furniture industry, in most cases, differ only slightly from those of the family-type workshop. In fact the shifting from the Handicraft Methods to the Factory Methods are taking place at a slow pace and, at times, it is not fully realized that the structure of the two systems are fundamentally apart.

4.1.2 The basic difficulty is originated by the absence of Division of Labour. The present arrangement in most plants consists in delegating the complete manufacturing responsibility for each job to sub-contracting team leaders.

4.1.3 The traditional "Factory Sub-contractor" production arrangement is very common in South East Asia and consists of the entrepreneur assigning jobs, on piece-rate basis, to a Sub-contractor Team Leader. The Leader employs his own group of workers over whom the entrepreneur has no control. The Sub-contractor's work is carried out within the entrepreneur's plant and making use of the entrepreneur's equipment and materials. This system is by no means an ideal production arrangement; on the other hand, it is deeply rooted and cannot be superceeded.

4.1.4 The system is based on the initiative of highly skilled workers who carry out the fabrication of job orders from the raw material stage to completion by making use of machinery and handwork. The

planning and execution of fabrication methods depend on the ingenuity of the individual worker. The workers negotiate among themselves on how to share the use of machinery and other plant facilities. Under these circumstances the rational utilisation of resources cannot be achieved.

4.1.5 The economics of the Factory System and mass-production cannot rest on these premises. Its basic approach consists in Specialisation or Division of Labour whereby jobs are broken down into individual operation which can be performed by semi-skilled workers.

4.1.6 The Factory System also calls for the transfer of skills to machines thus decreasing the proportion and cost of labour required per unit of output. By this method the quality and quantity of output is dependent more upon the machine process than on the worker. Therefore, a reduction of skilled labour and an increase of semi-skilled workers is possible.

According to the Factory System all the jobs and operations within each job are planned, scheduled and controlled as a whole by the management in view of full utilisation of man-power, equipment and materials. This in turn leads to increased output, higher profit and better quality products at lower prices.

4.2 Management

4.2.1 A major problem of the industry is that old generation manager-owners tend to rely on intuitive judgement and "rule-of-thumb" practices and procedures. Managerial function and pratices are frequently improvised to meet problems as they arise. Such improvised methods become fixed managerial practice and re-examination and re-appraisal of them are seldom re-considered.

This practice may be appropriate for the running of small, family type workshop where

management is comparatively simple, as the worker is left largely to his own initiative. But it is not consistent to the requirements of the Factory System.

4.2.2 The industry is experiencing at its own expenses that this approach cannot be adopted for the manufacture of standard products and large scale jobbing, which require a well defined organisation and the co-ordination of many-fold factors. Failure in achieving good organisation of production procedures and in collecting relevant data in connection to actual performance of labour and usage of materials have invariably resulted in the failure of proposed Cost Accounting Systems.

Basic Cost Accounting is essential to the satisfactory operation of standard products. Its main purpose consists in accummulating and analysis of all the expenses (actual and estimated) chargeable to a given unit of products for purpose of measurement and control, analysis, or planning of business operations.

4.3 Standards and Wage Systems

4.3.1 Another difficulty which the industry has to face, in its efforts towards the manufacture of standard products, is the introduction of task standards and the control of Labour Performance as compared to present standards. At present, there is no furniture factory in Singapore using standard of any kind. In addition to the absence of Standard set by Time Study there is also lack of Standards based on Past Performance. In fact but for the firms assisted by the Team, no Daily Labour Records are maintained as means of building up Past Performance Records.

4.3.2 This is partly due to the fact that workers are highly suspicious in this respect and consider Worker's Job Cards as a sign of mistrust on the

part of the employers. On the other hand, employers are hesitant in motivating the setting up of Standards and related procedures, as part of an overall wage system involving Incentive Schemes, devised to stimulate workers to optimum performance.

4.3.3 A proper Wage System is essential for the manufacture of standard products. The prupose of an effective compensation plan is many-fold :

i) It emphasizes low labour cost and increased production, and also determines a compensation level sufficiently high to enable recruitment of suitable personnel.

ii) It provides for fair pay and adequate wage differentials that compensate for skill, training experience and other requirements of each job.

iii) It allows the payment of workers on the basis of merit and output.

4.3.4 Unfortunately, this is not always appreciated by the parties concerned in the industry. It is not fully realized by the woodworking industry that line manufacture of standard products (for either export or local market) cannot become a viable proposition unless the basic requirements of the economic utilisation of labour are fulfilled.

Part 5 LACK OF TRAINED PROCESSING SUPERVISORS

5.1 Lack of training facilities

5.1.1 One of the most serious single problem of Singapore's Woodworking Industry had been the lack of a specific training programme for personnel at Processing Supervisory level. At present most of the Processing Supervisors available in the industry lack the right training background in wooden processing methods and above all, they lack the appreciation of the Factory System as opposed to the Handicraft System.

It is very appropriate and timely that the Singapore Technical Institute is offering now a 2 years full-time course for Woodworking Technician. This initiative should contribute towards offsetting the critical problem.

5.2 The Supervisor's role

5.2.1 It can be stated that most of the difficulties encountered by the Woodworking Team, in the course of its assistance to the industry, have arised from the lack of appropriate contacts at factory floor level.

Larger type of industries can afford elaborate organisation structure with highly qualified and highly paid personnel. But this type of personnel is seldom within the reach of the small scale industry.

5.2.2 In the small industry the Processing Supervisor is the backbone of the factory. The maximum utilisation of men, equipment and materials depends mostly on his skills, knowledge and also ability to motivate and lead (see Paper dated 8 July, 1970 on Identification of Training Areas for Processing Supervisors). A good Processing Supervisor is the best production tool to be found. The best production control system will not function properly unless it is administered by a capable supervisor.

5.3 Available Supervisors

5.3.1 At present most of the Processing Supervisors in Singapore's Woodworking Industry are self-made individuals who were brought up in the craft since their early years, as part of an age-old handicraft apprenticeship system. They are practical men gifted with ingenuity and drive, but they lack the necessary appreciation of modern workshop techniques and management which would be superfluous for the operation of the Handicraft System, but are essential for the efficient performance of the Factory System.

Part 6 LACK OF ADVANCED PRODUCTION METHODS & SPECIALIZED SKILLS

6.1 Production Methods & "Information Gap"

6.1.1 Processing methods adopted by the furniture industry here show the extraordinary gift of Chinese craftsmen for ingenuity and improvisation.

6.1.2 However, this positive attitude is, in most cases, limited by the lack of advanced type of machinery and, above all, by the absence on the market of up-to-date types of cutting tools and attachments, which add to the versatility of the equipment and contribute to its full utilization. This is especially true of Spindle Moulder and which is essential to the efficient operation of the modern furniture industry. All in all there is a dramatic "Information Gap" on new technical developments.

6.2 Specialised Skills

6.2.1 Another serious shortcoming of the industry consists in the lack of proper training in specialized skills such as Tool Maintenance, Saw Doctoring and Kiln Drying.

The future of the saw mill and woodworking industries in Singapore is based upon their ability to increase quality and 'added value' of the wood products. There is also a critical need to reduce overall costs and minimise waste. These objectives cannot be achieved unless Tool Maintenance and Seasoning Techniques are mastered.

6.2.2 In furniture plants maintenance is often neglected and machines are usually rusty. In many cases cutting spindles run on damaged bearings. Tool grinding is generally done on unsuitable equipment and without observing standard grinding practice. Often dull cutters are used which give a poor cut.

All this results in added labour cost, as the

machine produce poor work and the quality of the product depends upon final craftsmanship. In addition, rapid deterioration of machinery and tools, inflates operating costs. This maintenance shortcoming also applies to Saw Doctoring, that is the upkeeping of cutting tools used by the sawmill industry.

It is fortunate however that Wolmer of Germany have recently set up in Singapore (in connection with the establishment of a plant for the manufacture of grinding machines) a Maintenance Service Centre for Saw Mills Tools and Carbide Circular Saws.

6.2.3 The other problem to overcome is related to Seasoning. The amount of moisture in timber is an important factor in its usability and up-grading. Any progress towards producing better quality wood products is conditioned by proper kiln drying treatment of timber.

Unfortunately at present kiln drying facilities in Singapore are not adequate in number, and the related technology is not always fully mastered as to avoid faulty quality and losses caused by drying defects.

6.2.4 At present, the number of kiln drying facilities are not adequate. The combined capacity of the Dry Kilns is estimated at about 65,000 tons per year. On the other hand, the export volume of graded timber alone reached 320,000 tons in 1970.

6.2.5 In addition to the lack of capacity of the present Dry Kiln facilities, in some instances, attempts have been made to construct kilns without technical assistance or the relevant know-how under the mistaken notion, perhaps, that there are no essential principles involved and that a Dry Kiln plant may be acquired without any expenditure for engineering advice.

Part 7 LACK OF FURNITURE DESIGN FACILITIES

7.1 The Situation

7.1.1 A critical shortcoming, in connection with the industry's efforts towards standard products, consists in the lack of design capabilities on the part of the furniture industry as a whole. This casts a serious doubt on the ability of the small scale furniture industry to diversify into the manufacture of standard products for either export or the local market.

7.1.2 The situation can be summarized by saying that at present there is no proper training in Furniture Design available in Singapore. In addition, it can be stated that, besides the isolated cases of Design Mobel and Diethelm there is no consistent source of design for standard furniture.

7.1.3 A relevant indication of the lack of design facilities in Singapore consists in the fact that there has been no significant local contribution in the designing of furniture in connection with the booming of international class hotels in Singapore. In fact most of the designs have been provided by one American designer and some by a design firm from Thailand.

7.1.4 The long established Swiss firm, Diethelm & Co. produce a complete range of office and domestic furniture of medium and high class types (see Annex 2).

Diethelm must be credited with having helped in introducing furniture of modern design in Singapore although their designs are not original. Diethelm's impact in this respect can be termed as substantial. This is proved by the extent to which their products are being imitated and reproduced by the 'backyard workshops'.

7.1.5 The other firm with design capabilities is Design Mobel which was established two years ago. In fact Design Mobel is the only local firm with the capability of designing original standard furniture which can compare very favourably with the best of overseas designs.

7.1.6 It should be noted that standard furniture of modern design was first introduced in Singapore in 1963 in connection with the requirements of the British armed forces here (see Annex 6). The furniture, of both office and domestic type, was specially designed in England and has been produced over the years by a number of local furniture firms. Incidentally, most of the furniture factories, including Diethelm, originated their operation from this particular sector of the market.

7.1.7 A typical instance of the need for design facilities in Singapore is given by the situation of a small but enterprising furniture firm which was established a few months ago. Its range of products is limited to a knock-down chair and a matching dining table (see Annex 1).

The chair is of low cost and general purpose type. Its basic knock-down design is quite interesting. The relevant processing methods are very simple and involve only a few pieces of automatic equipment.

No doubt, basically this particular product has potential, but aesthetically it is far from being satisfactory. If proper design facilities were available, the product could be redesigned to increase its appeal.

7.2 Source of the problem

7.2.1 The Furniture Design problem in Singapore seems to reflect the present general conditions of the other fields of Art and Design in Singapore, which appear to be related to the lack of a co-ordinated cultural pattern in which to develop.

The fulfilment of any aesthetic experience depends, inter-alia, upon suitable objective "antecedentes" such as intellectual and social environments. Singapore's environmental "antecedentes" in the past have not been conductive to the fulfilment of Art & Design.

Since independence Singapore has been wholly absorbed in the work of establishing from scratch an industrial economy as a means to prosperity.

7.2.2 The colonial rule, had not been donductive to the fostering of cultural values, national identity and local talents. On the other hand, the massive industrial efforts created a climate which could not constitute a fertile ground for the promotion of Art & Design on the same priority basis as Technology.

But now that the Singapore's 'rugged society' has accomplished its primary purpose for survival, a very urgent need has developed in respect to the promotion of Art and Design not only to increase the export potential, but also to improve the overall living environment as proposed by the 'gracious living' approach.

Part 8 REVIEW OF ASSISTANCE PROVIDED

8.1 Assistance to Design Mobel Pte, Ltd.

8.1.1 Design Mobel plant (annual sales of approx. S$1 million) was set up 3 years ago by its present Manager and owner, Mr. T.K. Wang, with the specific objective of producing knock-down standard furniture for the local and export markets. The company is at present on the forefront of the local furniture industry in that it has been successful in the unprecedented feat of introducing in Singapore the first original standard furniture designed locally. The designs (Annex 3) are by Mr. Wang himself, a qualified Architect, and can be considered outstanding by any international standard.

8.1.2 Inspite of its positive and dynamic approach, the firm soon experienced substantial problems in the implementation of company objectives. At this juncture, the Woodworking Team was called in to appraise the situation and make pertinent recommendations. The survey revealed that the major problems were the lack of a well defined organisation structure, of clear-cut relationship among the key positions, and of systematic production control procedures.

8.1.3 The Team consequently proposed a revised organisation chart, job descriptions of critical positions, and gradually developed suitable production control procedures. Implementation of the recommendations encountered many difficulties over an extended period of time due mainly to the fact that supervising personnel, at factory floor level, would not appreciate the necessity and the advantages of systematic work and would resist the introduction of modern management. No substantial improvement of the situation could be achieved until the unco-operative personnel was replaced.

The basic control system was consequently implemented due to the very positive attitude of the new Factory Manager and the shifting to the position of Production Supervisor of an able and dynamic individual.

8.1.4 One of the major achievement was in the estimation of usage of materials and labour being prepared in advance of production, thus providing a valuable basis for both production control and cost control. The overall control of production is now facilitated by a continuous and systematic feed back of data from Processing Sections to Production Control.

8.1.5 Assistance provided to the firm also included revised plant layout, demonstrations of processing methods and trouble-shooting advice on technical matters.

8.1.6 The benefits brought about by the introduction of the system have been openly acknowledged by the company (see Annex 3A) and I am satisfied that Design Mobel is now in a better position to enter export markets because of the assistance provided by the Team. However, the implementation of the export objective will require a sustained effort in further rationalising the use of labour and increasing the detailed control of processing activities on the part of the Processing Supervisor.

8.1.7 It should be strongly emphasised that Design Mobel is to be considered a unique asset for Singapore because of its outstanding design capabilities and dynamic outlook.

8.2 Assistance to Henry Pte. Ltd.

8.2.1 Henry Company (annual sales approx. S$3 million) is a long established Interior Decoration & Furniture firm which has gained over the years a well deserved reputation especially in the interior contracts field and is considered today the fastest expanding firm of its kind in terms of sales and profitability.

Henry's standing in the business community is so high that the largest furniture manufacturer in Singapore, Diethelm has recently sought to establish a marketing link with the company.

8.2.2 Inspite of its success in providing Interior Decorating Services, the company could not develop a national operation for the manufacture of furniture which consisted mainly in designing jobs to sub-contractors with the firm making available factory facilities and materials. Because of this arrangement, the company experienced low profitability in the furniture side of business. In view of this situation and in order to generate further expansion a decision was taken to establish a new plant for the production of standard furniture. The Woodworking Team was requested to assist in the project.

8.2.3 The assistance scheme initially included plant layout and selection of machinery (see 2nd Periodical Report). Delay in the implementation of the scheme occurred due to the difficulties in obtaining furniture designs suitable for mass-production techniques. In the absence of other alternatives I decided to take up the task of designing ad hoc for the company a Desk system in order that the project could be launched. The item was selected in view of the increasing demand on the market for office furniture.

The design assignment was carried out successfully to full satisfaction of the company and prototypes were made. The company has full confidence in the potential of the design and plans are being made to start production of the system at the soonestpossible date.

8.2.4 The basic principle of the design (see Annex C) developed is derived from a traditional design of a Chinese piece of furniture which has an old history. The original table consisted of a demountable piece consisting of a 'box & board' system, that is, a loose board supported by two free standing drawer boxes. The idea initiated by the Chinese, is very modern in concept in that it anticipated the modular and knock-down type of furniture.

The new design is based on the 'panel & board' system whereby the primary support for the board, that is the table top, consists of flat vertical

panels supplied in two basic widths. The basic desk arrangement will consist of a table top supported by two vertical panels. Depending on how the panels are arranged to support the table top, various desk arrangements can be obtained. For example the panels set at U shape will provide an enclosure for the drawers thus creating the pedestal assembly.

The other original feature of the new system is that the panels instead of being painted or polished are lined with tough plastic material which is available in various colours to fit individual customer's requirements. It is therefore possible to match the desk with the colour scheme of the environment in which it is to be set. In addition the lining of the panels can be easily replaced, thus allowing renewal of the appearance of the desk at a minimum cost. In fact the customer himself can possibly line the panels with paper posters, a material which is becoming more and more popular with modern interior. As shown in the illustration, the front panel of the desk can be lined with paper poster. This original feature of 'renewable look' coincides with the contemporary conception of interiors stressing dynamic environment as against the rigidity of permanent schemes.

8.2.5 In addition to specific technical and design assistance, Henry was also provided with guidance in reviving the company organisation structure and in introducing basic production control procedures related to the operation of its existing plant. The recommendations were implemented bringing about an overall improvement of the operation.

8.2.6 The Team is pleased with the practical benefits resulted from its efforts as acknowledged on the part of the company (see Annex 4). The progress made has served to establish a suitable basis for the manufacture of standard furniture for the local market. The ability on the part of the company to fully implement this first objective, will determine the feasibility to enter the export market. With a view to speeding up the implementation of the second objective, Henry is considering

the establishment of a joint venture project with a Danish firm for the manufacture of furniture for export. Incidentally this contact resulted from the UNIDO Investment Promotion Meeting held last year in Singapore.

8.2.7 Henry is now making plans to establish a regional export-import centre in Singapore for furnishing products. Because of the tremendous dynamism of its leader Mr. L. Yang, the company typifies the progressive attitude and the very aggressive business approach of modern Singapore.

8.3 Assistance to Roxy (Pte) Ltd.

8.3.1 Roxy is a well known large company operating at regional level and diversifying in various trading and manufacturing activities. For instance, the company is involved in the manufacturing of wooden T.V. cabinets; assembling of T.V. electronic components; pre-finishing of plywood panels for the woodworking industry.

8.3.2 The assistance of the Woodworking Team was sought to help in the establishment of a plant for the manufacture of furniture for local and export markets. In view of the difficulty of obtaining furniture designs locally, on which to base the technical requirements of the project, the Team established contacts between Roxy and various European furniture firms so that the company could acquire patent rights for the manufacture of suitable designs. As a result an agreement materialised with the Dutch firm Pastoe for the manufacture by Roxy of a knock-down cabinet system very popular in Europe (see Annex 5). The European counterpart also made recommendations on machinery requirements for the production of the particular range of furniture. The valuable assistance provided by the Team in this respect consisted in proposing an alternative selection of equipment more suitable for local conditions and requiring a much lower capital investment.

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8.3.3 In order to acquire additional designs, to complement the Pastoe's range, the company entrusted this expert with the task of establishing further contacts with Swedish manufacturers. The mission, undertaken at Roxy's expenses, was carried out successfully and resulted in the company expanding the scope of the proposed manufacturing programme to selected types of knock-down chairs.

8.3.4 Consequently, additional equipment was selected by the Team and its recommendations were accepted by Roxy. Finally, a plant layout scheme was provided.

The first batch of machinery has now been installed and commissioned with the assistance of the Team. The project has already entered the first stage of implementation.

8.3.5 The determinant role played by the Team in establishing Roxy's furniture operation has been .... openly recognised by the company (see Annex 5A).

Roxy's realistic approach in acquiring designs from overseas coupled with its existing sales outlets stretching from Indonesia to Hong Kong, will no doubt constitute a substantial asset in the export of furniture. It is essential, however, that the present system of assigning production work on sub-contracting basis should be revised towards a more rational utilisation of labour, if cost are to be maintained at a reasonable level and products are to be marketed at competitive prices.

8.4 Assistance to Hup Cheong Pte. Ltd.

8.4.1 Hup Cheong Co. (annual sales volume of S$1.2 million) was one of the first furniture workshops established in Singapore to cater for the needs of the British forces here. Today it is one of the very few furniture firms still depending on this sector of the local market. Due to the gradual withdraw of most of the Forces the company decided to improve its operation with the view of diversifying

and expanding its production facilities. The Team was called in to assist in the task.

8.4.2 The assignment was carried out by the Team to the satisfaction of the company and resulted in moderate improvements of control methods, especially in the control of sub-contract work. Trouble-shooting on technical matters was also provided including finishing techniques, information on low frequency pressing techniques, demonstrations of routing processing methods. The company was also provided with overseas marketing contacts for the manufacture of skis. Samples were successfully made and met the approval of the prospective buyers. The company expects steady sales to originate from these initial contacts.

8.4.3 The Production Manager of Hup Cheong, Mr. L.H. Wong, is the driving force behind this initiative to expand and diversify. On the other hand, the effort is handicapped by the existing company structure which is still based on the traditional pattern of very close family ties, leaving not sufficient room for flexible and innovating decision-making.

8.5 Assistance to Cheng Meng Furniture Pte. Ltd.

8.5.1 This company (annual sales of S$3 million) was established rather recently during the period coinciding with the beginning of hotels construction boom. Cheng Meng rapidly become one of the main manufacturers catering for large contract jobs. In fact the company was involved, in various degrees, in the furnishing work related to the construction of 12 major hotels including Hilton Hotel, Hyatt Hotel, Imperial Hotel, etc. With the tapering down of the volume of business in the contract field, the company decided to re-orient its objectives towards the manufacture of standard furniture. At this juncture the Team was asked to advise in the improvement of production facilities and organisation.

8.5.3 The main recommendations regarding plant layout were implemented and some basic control

procedures were introduced. All through the duration of the assignment the Team obtained full co-operation from Mr. Choo Ker Yong, the young Assistant Managing Director of the firm. Unfortunately, due to the uncompromising attitude of the old generation General Manager, it was not possible to achieve comprehensive and systematic results. The major obstacle consisted in the unwillingness of the Manager to delegate responsibilities needed for the establishment of a functional organisation. In fact the company still operates on the basis of the traditional handicraft system, where the "Master" considers himself as the only expert in all fields of activities performed in his enterprise and is involved in decision-making at practically all levels.

8.5.4 Despite the present functional problems it is felt that the potential of the company will increase proportionately with the gradual taking over of the younger members of the family and especially of Mr. Choo Ker Yong, who has displayed a very dynamic outlook and a keen interest in modern management.

8.6 Assistance in the establishment of a joint venture

8.6.1 The Team was asked to assist in the selection of equipment for a joint venture project between a well known local industrialist, Mr. Lam Thian, and a large sales and manufacturing company, Action Industries Inc. The project involved the manufacture of inexpensive wooden utility items, such as coat hangers, book racks etc. for the American market. In the past, the merchandise had been manufactured to Action's specifications by Taiwan and Hong Kong factories and distributed in United States by the American company. Recently, Action Inc. looked into the possibility of manufacturing the products in Singapore in view of increasing shipping cost of logs from sources of supply to both Taiwan and Hong Kong. A feasibility study of the proposed project was conducted with the assistance of the Team and gave positive indications. The joint

venture company was formed and final steps are now being taken for the implementation of the project.

8.6.2 The initial sales output of the plant is estimated at S$72,000 per month and it is expected to take eventually the major share of the yearly S$5 million worth of woodware sold at present by Action in USA.

8.6.3 The project will be the first of its kind to be established in Singapore and it is regarded to have a very good export potential for the following reasons :

i) The foreign partner has been actually involved for years in the direct marketing through franchised and company owned stores of woodware for the American market. Therefore, the main advantage of this arrangement is that the sales volume is expected to be maintained at a steady level. In addition the end price of the products will be quite competitive because of the elimination of high mark-ups usually imposed by exporters, agents, and distributors before the merchandise reaches the public.

ii) Supply and cost of raw material will not be a critical factor as this type of wood product involves minimum material requirements and substantial added value.

iii) The shortage of highly skilled woodworkers will not be critical too because of the possibility of using semi-automatic and automatic equipment. In fact very little of the traditional hand-making skills will be required, thus eliminating the dependence of the project on workers who find difficulty in adapting to industrial conditions and requirement.

iv) It will require simpler production control procedures than those needed in the manufacture of furniture.

8.7
Assistance to Atlas Sound Co.

8.7.1 This company recently acquired the rights to manufacture high quality speaker boxes for the markets of South East Asia. The speakers are at present imported from Europe. The Team provided the relevant selection of machinery for the project and introduced for the first time in Singapore, two machines specially designed for speaker boxes and T.V. cabinet production. They are the Vee Grooving Machine (one of the latest development in woodworking equipment) and the Automatic Overhead Multiple Boring Machine.

8.7.2 The project is now being implemented and is expected to generate a successful manufacturing operation because of the ready market, specialised manufacturing process and relatively simple production control requirements.

8.8
Minor Assistance to other Firms

In addition to the extensive assistance provided to the above firms, the Team assisted occasionally the following companies :

i) Wan Hin Furniture Pte. Ltd.

a) Demonstration of machinery methods.
b) Demonstration of finishing methods.
c) Selection of cutting tools.
d) Selection of sanding machine.

ii) Patent Furniture Co.

a) Selection of machinery and plant layout for proposed new plant.

iii) Southseas Souvenirs Industries

a) Selection & commissioning of Multiple Spindle Carving Machine.

b) Training of machine operators for above.

c) Selection and commissioning of Grinding Machine for carving cutters.

d) Training of machine operators for above.

e) Selection of sanding equipment for carved surfaces.

iv) Merlin Furniture Pte, Ltd.

a) Demonstrated operation of automatic router.

b) Demonstrated principles of template making for above.

c) Selected cutting tools for above.

8.9 Assistance to WIDC

8.9.1 The Woodworking Industry Development Centre was originally established in 1963 as a unit of LIS-ILO Project. In 1968 WIDC separated from LIS and became part of the EIDA (Engineering Industries Development Agency). Recently the Centre became a commercial manufacturing set up, Metro Wood Co., as a subsidiary of INTRACO, a government owned marketing organisation.

8.9.2 The original task of the Centre had been to conduct in-plant training with the purpose of (1) upgrading skill of personnel from the woodworking industry; (2) preparing technical school leavers for factory work (3) providing consultancy services to the industry. To implement these objectives a total of S$230 thousand worth of woodworking equipment was provided to the Centre, mainly from Colombo Plan Assistance Scheme. With this substantial amount of equipment, far exceeding training needs, the Centre got increasingly involved in manufacturing activities on commercial basis with jobs being generally accepted regardless of their training content. This resulted in the training aim becoming very marginal. On the other

hand, the Centre also failed in its semi-commercial role because, naturally, trainees could not perform at a suitable level of productivity.

8.9.3 Some part-time basic training was conducted by the Team for the benefit of some of WIDC staff as well as trainees from the Teachers Training Institute attached to the Centre. The training included the following subjects :

i) Safe operation of woodworking equipment.

ii) Preventive maintenance of equipment.

iii) Theory and practice of tool grinding.

iv) Operation of basic woodworking machine. Emphasis was given to training on routing machine and a few training projects were developed in this connection.

v) Techniques related to oil finishing.

8.9.4 The training served an additional useful purpose in that from the training notes the Team eventually developed some useful reference material for the industry and training institutions. (see Annex F).

8.9.5 WIDC was also assisted in the selection of equipment in connection with its anticipated full commercial role.

8.9.6 The assessment of the performance of WIDC during 8 years of operation, in relation to its original objectives is rather on the negative side. In my personal opinion, the failure of the Centre has proved once again the fallacy of the 'in-plant training' system when provided by specialised government agencies. I strongly believe that this type of training (so far as woodworking is concerned) should be conducted within the industry itself as part of apprenticeship schemes. The government instead should concentrate in rationalising the vocational and technical training so that students may acquire an adequate technological background and a basic appreciation of industrial methods.

Part 9 REVIEW OF DEVELOPMENT PROJECTS CARRIED OUT

9.1 Production Control Development Project

9.1.1 As mentioned earlier one of the major problems of the furniture industry in Singapore consists in the lack of modern industrial management which is essential for operating at a profitable level and producing competitive goods. To be economically viable, plant activities have to be planned, organised and controlled. The shortcoming is evident especially at middle management level which is of critical importance for the small scale industry.

9.1.2 The situation is worsened, so far as the small scale furniture industry is concerned, by the absence of appropriate standard reference in production control procedures. This is very unfortunate in a situation such as in Singapore where training and consultancy services schemes are not fully rationalised, and where the general trend is to promote the introduction of production control procedures unrealistically sophisticated for the needs of the small scale furniture industry.

9.1.3 In view of the circumstances, the Team volunteered to prepare a Manual of Basic Production Procedures for the use of both the furniture industry and relevant technical training institutions. The manual was based on the extensive field experience of this expert in South East Asia and on the intimate knowledge gained by the Woodworking Team in the course of the consultancy services to the furniture industry in Singapore.

The proposed procedures were devised mainly for the requirements related to the mass-production of standard furniture. However, in order to maintain a realistic approach the manual included also procedures on the control of traditional 'Factory Sub-contractors' type of production (see para. 4.1.3) which may have to be utilised for the manufacture of Non-Standard Furniture to customer's requirements.

The Sub-contractor is by no means an ideal production arrangement; on the other hand it is deeply rooted and cannot be superceded overnight.

9.1.4 The Manual elaborates on the following subjects:

i) Product and Process Specification

ii) Plant Capacity & Load

iii) Authority to manufacture

iv) Scheduling

v) Overall Control

vi) Estimating & Costing of Products.

In addition to the text, the Manual includes various charts and basic forms required for the implementation of the procedures. The forms present Chinese headings alongside with the English ones in order to facilitate the understanding and the adoption of the procedures.

I feel confident that the Manual, by being utilised by the industry and training institutions, may bring an important contribution toward a meaningful modernisation of the furniture industry.

9.2 Design Development Project

9.2.1 Lacquered furniture takes a large share in the export, from mainland China and Hong Kong of the traditional type of Chinese furniture. This furniture consists of lacquered surfaces carved out by hand to produce patterns and designs usually representing scenes from Chinese legends. The most popular articles of this type are folding screens, but the range also include small bookcases and general purpose cupboards. In the past lacquered furniture on sale locally had been imported.

Recently a master carver from Hong Kong set up the first workship in Singapore for the manufacture of these items.

9.1.2 This expert took the opportunity to undertake a design-development project having two main aims :

i) Promote the export of furniture reflecting oriental culture, in keeping with present overseas trends.

ii) Promote the preservation of particular traditional crafts which could play a meaningful role in the context of industrialisation.

9.1.3 The design resulted from the adaptation of the traditional Chinese Folding Screen into a Folding Bookshelf (see Annex B) serving a definite practical purpose beside being a decorative object.

The bookshelf consists of two side panels (with carved insets), simply hinged to a back panel, and four shelves supported by the side panels. The assembly of the piece of furniture requires no tools. In fact it is sufficient to fold out the side panels and snap in the top and bottom shelves, with the remaining two shelves simply resting on brass pin. The bookshelf folds absolutely flat thus minimising shipping costs. An interesting feature of the design is that the three hinged panels, when folded out without shelves, become a decorative screen in the traditional way.

9.1.4 It should be noted that in production only the carved portions of the bookshelf will be executed by the master carver at the carving workshop, while the rest will be made entirely by machine at a plant geared for modern production methods. This shows that in appropriate case, modern technology can be effectively employed in conjunction with handicraft techniques.

The successful implementation of this particular project has also proved that the handicraft heritage can be a valid source of creative interpretation.

Part 10 CONCLUSIONS & RECOMMENDATIONS

The purpose of the following conclusions and recommendations is to :

i) Extract from the main text critical information and findings to be brought to the specific attention of the Government.

ii) Review and assess briefly the relevant work performed during the assignment.

iii) Present recommendations to give the expert's view on follow-up actions required.

10.1 Production Structure and Procedures

10.1.1 The Situation

-1 The Singapore furniture industry has hardly been able so far to mass-produce furniture at the right cost and quality in order to compete in the export markets. The main factors in this respect consist in the lack of proper industrial management, and proper labour utilization. These shortcomings are quite critical in a situation such as in Singapore where labour cost is steadily increasing.

-2 Practically all the furniture plants in Singapore are based to some extent on the handicraft system and tend to retain its original working methods and human approach. This constitutes a handicap in respect to the rational development of the industry in that the structure, the human background and the motivation of the chinese handicraft nuclei are basically conflicting and inconsistent with the nature of the factory system. In fact, the experience has proved that entrepreneurs, supervisory staff and workers brought up and trained in the traditional handicraft environment can seldom adapt themselves to industrial methods.

10.1.2 Work Performed

-1 In view of the prevalent conditions described above it became clear to the Team that simple trouble-shooting type of assistance would not serve to generate any significant impact. It was therefore decided to select for assistance only a restricted number of entrepreneurs with dynamic outlook whom the Team could re-orientate plant activities in respect to organisation planning and control.

-2 Initially, very slow progress was achieved due mainly to the lack of appreciation on the part of supervising personnel of industrial working methods. However, the persistent and painstaking efforts of the Team generated good results in terms of improvement in the control of materials, control of labour and the general production flow.

-3 In the absence of appropriate standard reference on basic production control, a "Manual of Basic Production Procedures" (see Annex A) was prepared in order to generate a long term impact in this connection. The Manual was specially designed to fulfil the needs of the small scale furniture industry and it constitutes a major achievement in that it is probably the first attempt of its kind. I am confident that the Manual, by being used as permanent reference of both the industry itself and the relevant training institutions, will bring an important contribution toward a meaningful modernisation of the Singapore furniture industry as a whole.

10.1.3 Recommendations

-1 It should be realised that, so far as the furniture sector is concerned, the appreciation of the Factory System is a matter of total human attitude which cannot be superimposed on adults by any type of "In-plant", "In-Service" and let alone Seminars. The problem of providing the furniture industry with suitable personnel (supervisors as well as workers) should instead be tackled in a radical way by conditioning the individuals to a proper industrial outlook during

the formative years of vocational and technical training. Therefore, the critical and primary role in improving the overall potential of the furniture industry rests with the educational system.

-2 The following recommendations are made in this respect :

i) Introduce as part of the curriculum vocational and technical training the subject on "Industrial Orientation" which include, at basic level, topics such as production control procedures, wage systems and work measurement. It is suggested that the Manual prepared during my assignment be utilised in this connection.

ii) Arrange for senior instructors of vocational and technical institution to attend selected training courses on middle management subjects organised by the National Productivity Centre.

iii) Provide a long term systematic fellowship scheme for vocational and technical school instructors, whereby senior instructors would spend a period of no less than two months a year attached to furniture plants overseas.

10.2 Woodworking Technology

10.2.1 The Situation

-1 A critical deterrent in the export of furniture is the lack of right quality and cost of the products due to technological problems.

The Chinese woodworker is by nature extraordinarily gifted in improvising and adapting

techniques. Much imagination is shown in the use of existing equipment which, however, is seldom utilised to full advantage due mainly to the lack of know-how with respect to up-to-date processing methods and cutting tools technology.

-3 There is in fact a very critical information gap on new equipment and processing techniques developed overseas. Generally speaking, the furniture industry is practically at the mercy of local distributors of machinery for advice on the selection of new equipment. Bearing in mind that hardly any of the agents has any woodworking background, one can well imagine how serious the situation is.

10.2.2 Work Performed

-1 Great emphasis was given by the Team to introduce in Singapore equipment of automatic and semi-automatic type in order to improve quality and reduce labour content of products. However, a realistic approach was adopted by avoiding recommending sophisticated equipment difficult to maintain and of output capacity higher than normally required.

-2 Among new type of equipment first introduced* by the Team were : Automatic Routing Machine, Automatic Round Tenoner, Automatic Slot Mortising Machine, Vee Grooving Machine, Overhead Multiple Boring Machine, Semi-automatic Carving Machine. In addition, inexpensive and versatile air clamping equipment was introduced to promote "low-cost automation". Most of the equipment introduced was actually commissioned by the Team.

-3 As for processing methods, the unique ingenuity of the chinese woodworker was complemented by demonstrating the versatility of new type of machinery and introducing advanced technology related to cutting tools, finishing methods etc.

-4 Basic training was conducted at WIDC on Tool & Machine Maintenance and on the operation of basic machines. Information sheets were prepared from the training notes for distribution

* (see Annex D)

to the industry and technical institutions (see Annex F). Information sheets were also distributed on topics such as Industrial Safety, Low Frequency Heating and on specific needs of individual firms.

-5 A major accomplishment was the setting-up of a reference library on woodworking machinery, the only one of its kind in Singapore.

-6 I am satisfied to the extent to which the aim has been fulfilled with respect to the spreading of woodworking technology and the narrowing of the "information gap".

10.2.3 Recommendations

-1 Technical services to the industry is a recognised and accepted long-term necessity in most developed countries and some developing countries as well. In Singapore, however, the feasibility of providing these services on long term basis has proved to be an unrealistic proposition due mainly to the very high turnover of extension officers. In fact LIS would have to drop entirely the type of assistance provided during my assignment, if my main counterpart, Mr. Foo Siew King, was to leave the organisation.

-2 The difficulty on the part of the Government to provide systematic long term services to the woodworking industry highlights the critical importance of technical institution training as the primary source for the spreading of technology.

-3 However, despite the limiting circumstances LIS should continue to provide assistance within realistic limits and in keeping with the current government policy stressing self-reliance on the part of small industries.

-4 The following steps are recommended to be taken by LIS :

i) Promote joint-venture projects to speed up the in-flow of technical knowhow, and acquire ready market outlets.

ii) Provide the industry with consultants' contacts required for specific woodworking projects of proven export potential. The scheme should make provision for the industry itself to share the cost of hiring consultants.

iii) Conduct workshops based on the materials prepared during the woodworking assignment such as Tool Maintenance, Production Control, Kiln Drying.

iv) Channel technical enquiries from the industry to appropriate overseas contacts to facilitate the transfer of technology on specific topics as required by the industry. Possible contacts in this respect are given below :

a) Woodworking Section of UNIDO Industrial Technology Division.

b) Question and Answer Service of European Productivity Agency DEEC (see Appendix 7).

c) Technical Inquiry Service US Department of Commerce (see Appendix 8).

v) Contribute to fill the "information gap" by providing library services for the benefit of members of the industry and technical school instructors. This is one absolutely essential service which is strictly related to the scope of LIS and should be implemented without any further delay.

vi) The role to be played by the Technical Education Institutions in spreading technology should consist of consolidate and up-to-date on systematic basis the technology knowhow of senior

instructors in order that trainees may receive a training adequate to the needs of the industry. This may be achieved by :

a) Providing a systematic and long-term fellowship scheme whereby senior instructors would be attached periodically to furniture plants overseas (see para. 9.1.3. iii)

b) Providing a similar fellowship scheme for the training of instructors at the Timber Industry Training Centre at Rotorua, New Zealand (see Appendix 9).

-5 I would like to emphasize very strongly that UNIDO should play a main role with respect to the bridging of the "Information Gap". The role should consist of providing periodically, and on global basis, information on new equipment, processing methods and materials relevant to the furniture industry of developing countries. This is obviously one program that can be carried out objectively ~~only~~ by the United Nations only.

10.3 Product Design

10.3.1 The Situation

-1 Another critical shortcoming of the furniture industry is the lack of design capabilities on the part of the furniture industry as a whole. Even when problems of technology and plant organisation are solved there remains the stumbling block of design. In fact at present there is only one furniture manufacturer in Singapore, Design Mobel, producing standard furniture of high international standard. which, incidentally, are designed by its Managing Director himself, Mr. T.K. Wang.

-2 The furniture design problem in Singapore reflects the general condition of industrial design

as a whole. In fact to judge from the products designed and manufactured locally, industrial design is practically non-existent here.

10.3.2 Work Performed

-1 In the course of providing assistance to a very dynamic company, Henry Pte. Ltd., the Team was faced with the difficulty of seeing its recommendations implemented due to the lack of designs suitable for mass-production. In view of the circumstances and in the absence of alternatives, I took up the unscheduled task of designing ad hoc for the company, a desk system (see Annex C & para. 8.2.4). The system was developed from a traditional chinese design which anticipated the modular principle of modern furniture.

-2 On another occasion the need arose to utilise the chinese traditional technique of lacquered furniture for designing furniture of oriental character for the export. Here again, I was left with no choice but to take up the task myself. The design this time consisted of a folding bookshelf (see Annex B) derived from the traditional chinese concept of folding lacquered screens. The successful implementation of the design has established a precedent proving that traditional chinese furniture can be a valid source of creative interpretation.

-3 An alternative approach adopted to help the industry acquire suitable designs, consisted in establishing contacts between local furniture firms and overseas counterparts for the manufacture of furniture on licence. One agreement was successfully finalised through the specific involvement of the Team (see para. 8.3.2).

10.3.3 Recommendations

Many reports have been prepared by various experts for the Singapore Government on the subject of promoting industrial design. It is not for me to put forward additional proposal and recommendations, as the subject falls outside the original scope of my assignment.

10.4 Training of Counterparts

I am particularly pleased with the accomplishment of my assignment in respect to the training of counterparts, considering that the senior counterparts of the Team had had no previous experience in the woodworking field.

10.5 Closing Notes

10.5.1 This report has been purposely critical in evaluating Singapore furniture industry so that a realistic assessment of this industrial sector might be made by the relevant authorities.

10.5.2 It is unfortunate that the assets which are usually associated with the people of Singapore - hard work, stamina, ambition and extraordinary ability to acquire skills are undermined (so far as the furniture industry is concerned) by the lack of adequate consciousness of the requirements of the industrial system.

10.5.3 There are however a few young-generation entrepreneurs of very dynamic outlook who constitute an invaluable asset for the Republic. No effort should be spared by the government in helping them to help themselves in their quest for enlightened achievements.

10.5.4 In Singapore today, there seem to be a keen attitude to give preferential promotion support to multi-million dollars industrial projects. In this connection I wish to point out that - contrary to other sectors of the industry - the furniture industry does not have to follow necessarily this pattern in order to generate an impact on the economy of the country. A close look at the structure of the ... Danish furniture industry (see Appendix 10) should clear any doubt in this respect.

10.5.5 In my opinion, Singapore has a very slim chance of competing with Eastern European communist countries in the field of inexpensive mass-produced furniture. Western Europe is at present being flooded with such furniture produced under conditions of strictly controlled labour costs.

As with Denmark, Singapore has no timber resources of its own and therefore I believe that the ultimate aim of the furniture industry here ought to be directed towards the manufacture of top quality wood products with a high degree of added value. Moreover it would be very difficult for Singapore to compete in the export of low-cost furniture with East European communist countries which are already flooding West Europe with very cheap furniture produced under conditions of strictly controlled labour costs.

10.5.6 I wish to conclude by expressing my gratitude to the United Nations for having given me the privilege of being of service to this extraordinary country to which my family and I have become very much attached.

I owe a lot of gratitude to the present LIS Director, Mr. Michael Yap for his understanding, guidance and unreserved support. My thanks also go to Mr. Tan Hui Boon.

I should not forget Mr. Foo Siew King who in his capacity as main counterpart contributed in a determinant measure to the success of the work performed by the Team. Also I cannot fail to mention the important part played by Mr. Lim Chin Heng, the other senior member of the Team.

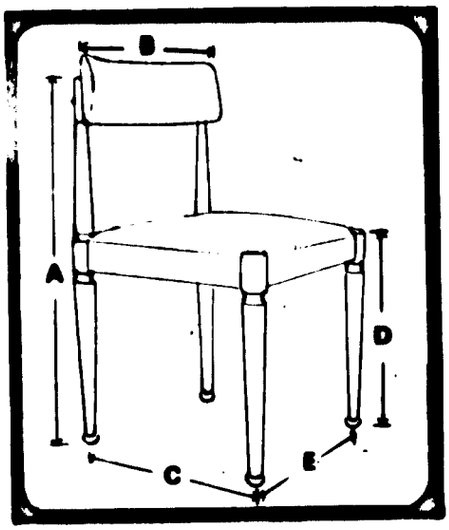
Due credit must go to Mr. Choo P.H., and Mr. Peter Tan, the draughtsmen who did the draughting work related to the assignment.

My gratitude goes also to all of my good friends at LIS and to the furniture manufacturers I had the pleasure to work with, who contributed in making my assignment so rewarding and my stay in Singapore such a memorable experience.

(Pietro Borretti)
United Nations (UNIDO) Woodworking Adviser

PB-lsc

ANNEXES



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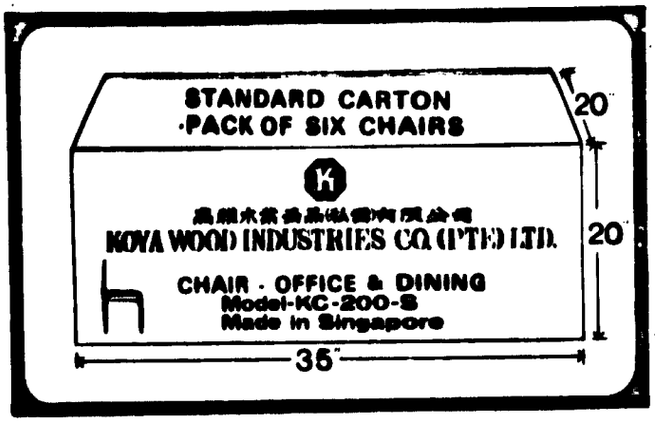

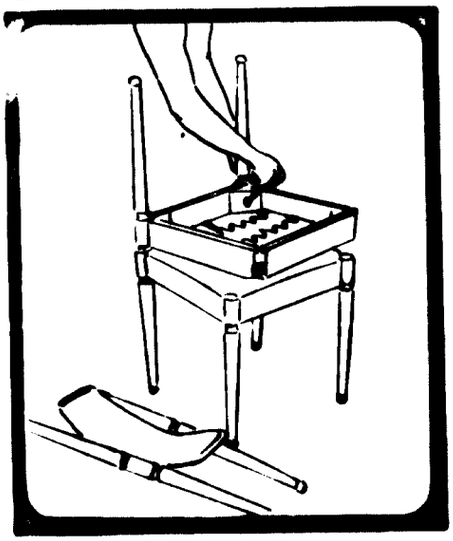

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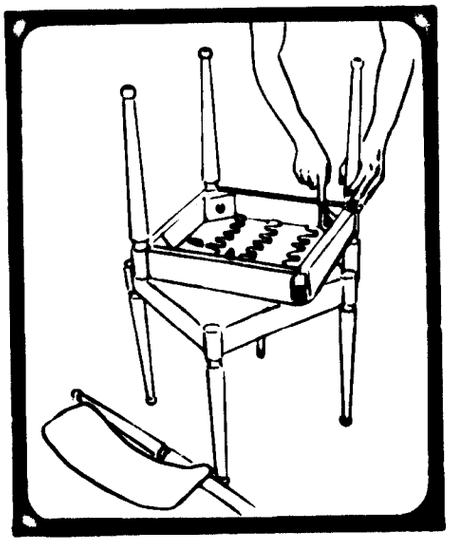

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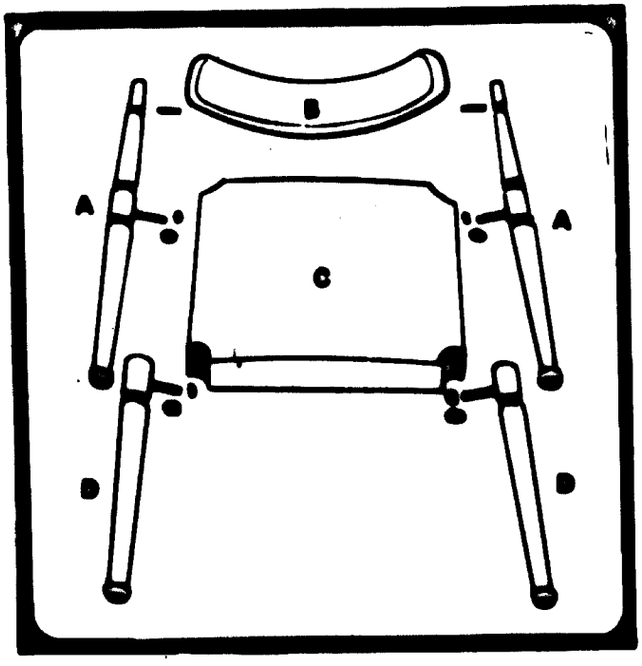
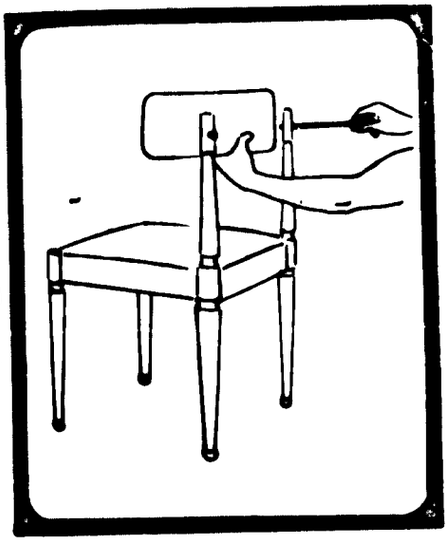
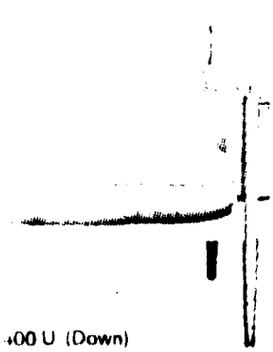




3 FIXING OF UPHOLSTERED BACK

dietheim furniture



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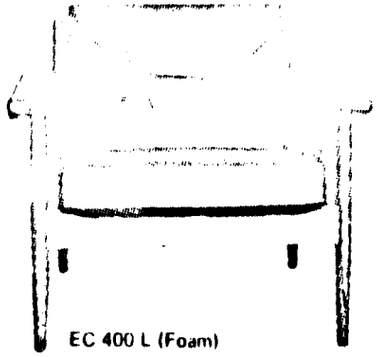

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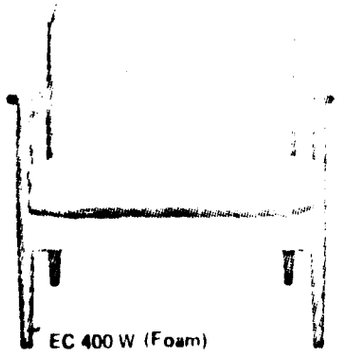

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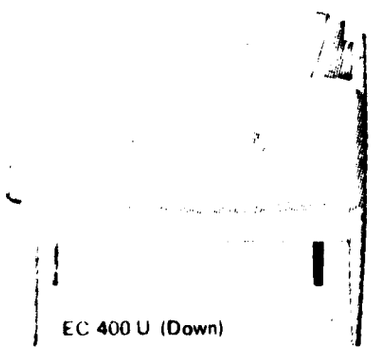

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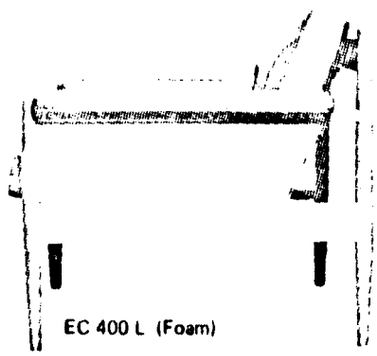

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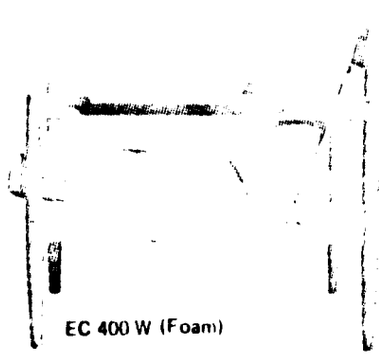
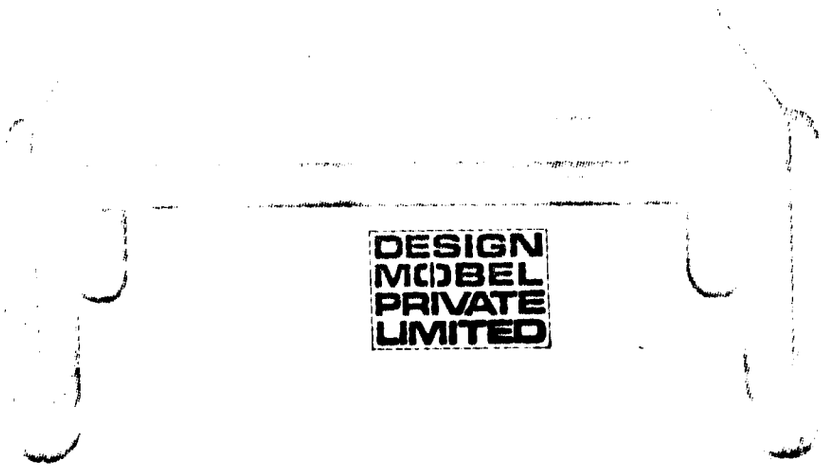


EC 400 W (Foam)



Showroom: Goldhill Shopping Centre,
163 Thomson Road, Singapore. (Junction of Thomson Road and Newton Road). Telephone: 531217.

ANNEX 3

88 KALLANG PUDDING ROAD
SINGAPORE 13 CABLE: DEMOBIL
TELEPHONE: [illegible]

7th March, 1972.

The Director,
M/s. Light Industries Services,
179, River Valley Road,
SINGAPORE 6

LIGHT INDUSTRIES SERVICES
9 MAR 1972
SINGAPORE

Dear Sir,

This is to thank you for the services your Organisation has rendered to our Company during the past two years. Your representative, Mr. Pietro Borretti has during the period patiently guided us in setting up a proper working system, which has not only stream-lined our production and proper control of both the administration and the factory workers but also improved the efficiency of the company.

We were given to understand that Mr. P. Borretti will be leaving us some time in the month of May, 1972. We strongly feel that a man of his experience is a great asset to our country in as far as wood working industry is concerned. We also strongly feel that his assistance is still needed in many areas of this industry and we would be obliged if he could be made available to us for our consultation. As such we would like to suggest if certain arrangement can be made for Mr. P. Borretti to return here for short term visits. We hope that this proposal will meet with your kind consideration.

We would like to take this opportunity to thank you once again for ths services rendered and we would be grateful if you could convey our many thanks to Mr. P. Borretti for the assistance and the expetise he has given to our company.

Yours faithfully,
DESIGN MOBEL PRIVATE LIMITED.

WHANG TAR KUAY.
MANAGING DIRECTOR.

INT	OFF	ACT	INF
M	D	✓	
	ADo		
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		✓	

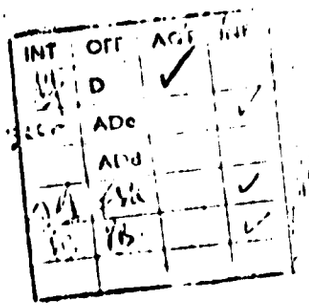
MW/ry.

3A

ANNEX 3A

Rec'd. 25/1

Thursday
Twentieth
January
1972



Mr. Michael Yap,
Light Industries Service
179, River Valley Road
Singapore

Dear Mr. Michael Yap,

We wish to extend our graduate to the Light Industries Service for the outstanding guidance provided for us in various ar[illegible] by the Light Industries Service - UNIDO Wood Working Team. The proposed production control system and the revision of the organisation chart are being implemented with satisfactory results. Final steps are being taken to commence construction of our new factory. The building plans have been recently [illegible] by various relevant authorities. We trust that the project will be built in the very near future. Light Industries Service's recommendations in respect to plant layout and selection of machinery has been seriously considered and applied. Recently the woodworking team has achieved good result in the design and development of a new desk system for us and we intend to adopt them as our first standard type of office furniture which are to be manufactured with the new production technique as directed by Light Industries Service.

We regret to learn that the UNIDO Adviser, Mr. P. Borretti will be ending his appointment in Singapore shortly and leaving us this project half way and we will be difficult to seek proper assistance & advice when full implementation of our application and production of the Light Industries Service scheme takes place. As we understand that no further extention of his present appointment is possible we would therefore appreciate it, if you could kindly consider to take the necessary steps for Mr. Borretti to come back on a follow-up [illegible] together with Mr. S.K. Foo in order to assist us in the application to the Light Industries Service scheme successfully. His follow-up assistance is most important especially [illegible] manufacturing of the new desk system. Our good performance this speculation will eventually lead us to make production plans not only for the local markets but also for the export of furniture to overseas.

Your recommendation and assistance of having Mr. Borretti to come in the follow-up during our vital period of full application of the Light Industries Service scheme will be highly appreciated, otherwise all precious past efforts and time taken will be wasted.

Cont'd...../2.

Your kind consideration will provide us great help in this matter.
Thank you and look forward to your favourable reply soon.

Yours Faithfully
HENRY & COMPANY (PTE) LIMITED

C.C. Yong
Manager

CCY/lc/56/72.

Friday
Twenty-First
April
1972

Light Industries Services
A Division of the Economic
Development Board
179 River Valley Road
Singapore 6

LIGHT INDUSTRIES SERVICES 2 APR 1972 SINGAPORE

Attn: Mr. Foo Siew King

Dear Sirs,

Re: Manufacturing for L.I.S.
Design Folded Bookshelves

With reference to the discussion held at your office on 19th April, 1972 with Mr. Borretti, your goodself and the writer, we would like to confirm that we are interested to manufacture your LIS design folded bookshelves for export purpose.

We are willing to purchase the necessary machineries for the above production and would be pleased to have your details, terms and conditions in related to the above arrangement.

Your immediate reply on this matter is greatly appreciate

Yours Faithfully
HENRY & COMPANY PTE. LIMITED

C.C. Yong
Manager

CCY/mk/448/72

c.c. Mr. Peter Borretti — cc handed to Mr. Borr on 24/4/72

INT	OFF	ACT	INF
	D		
	ADo		
	ADd		

ANNEX 4A

Cable Address:
"ROXYSUPER" Singapore.
Tel: 631911 (8)

樂聲電器工業(星)有限公司
Roxy Electric Industries (S'pore) Pte. Ltd.

483, TANGLIN HALT ROAD,
SINGAPORE, 3.

YOUR REF: 37-1/5
OUR REF: JD372/10/7

19th January 1972.

Mr. Michael Yap, Director,
Light Industries Services,
179, River Valley Road,
Singapore.

Light Industries Services Singapore 24/1/72

Dear Mr. Yap,

Re: Furniture Consultant Service by Mr. P. Borretti

As you know, we are going ahead with our furniture project in our Jurong factory and Mr. P. Borretti has been rendering us his valuable services. To this, we like to thank your Organisation for making it possible.

Since Mr. Borretti will be leaving Singapore sometime in May this year, he will not be able to help us in the full implementation of the project. Thus, we would be grateful if you would make arrangement for a follow-up visit so that Mr. Borretti will be able to finalise the assistance. At the same time, we are interested in getting assistance in establishing export markets through the Light Industries Services.

Thank you very much.

INT	OFF	ACT	INF

Yours faithfully,
ROXY ELECTRIC INDUSTRIES (S) PTE. LTD.

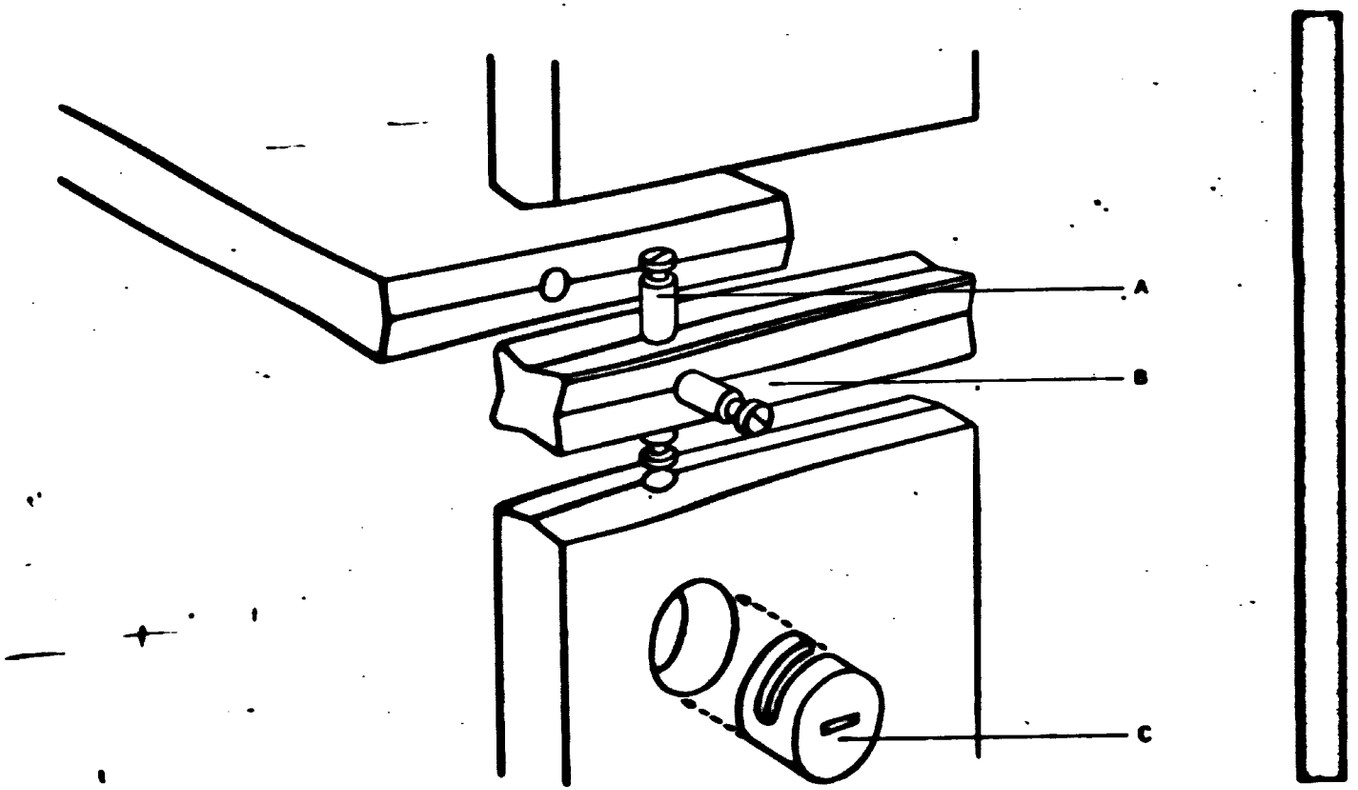
T. K. Fong
Factory Manager,
Jurong Factory.

FTK/Lf

5

ANNEX 5

Das System

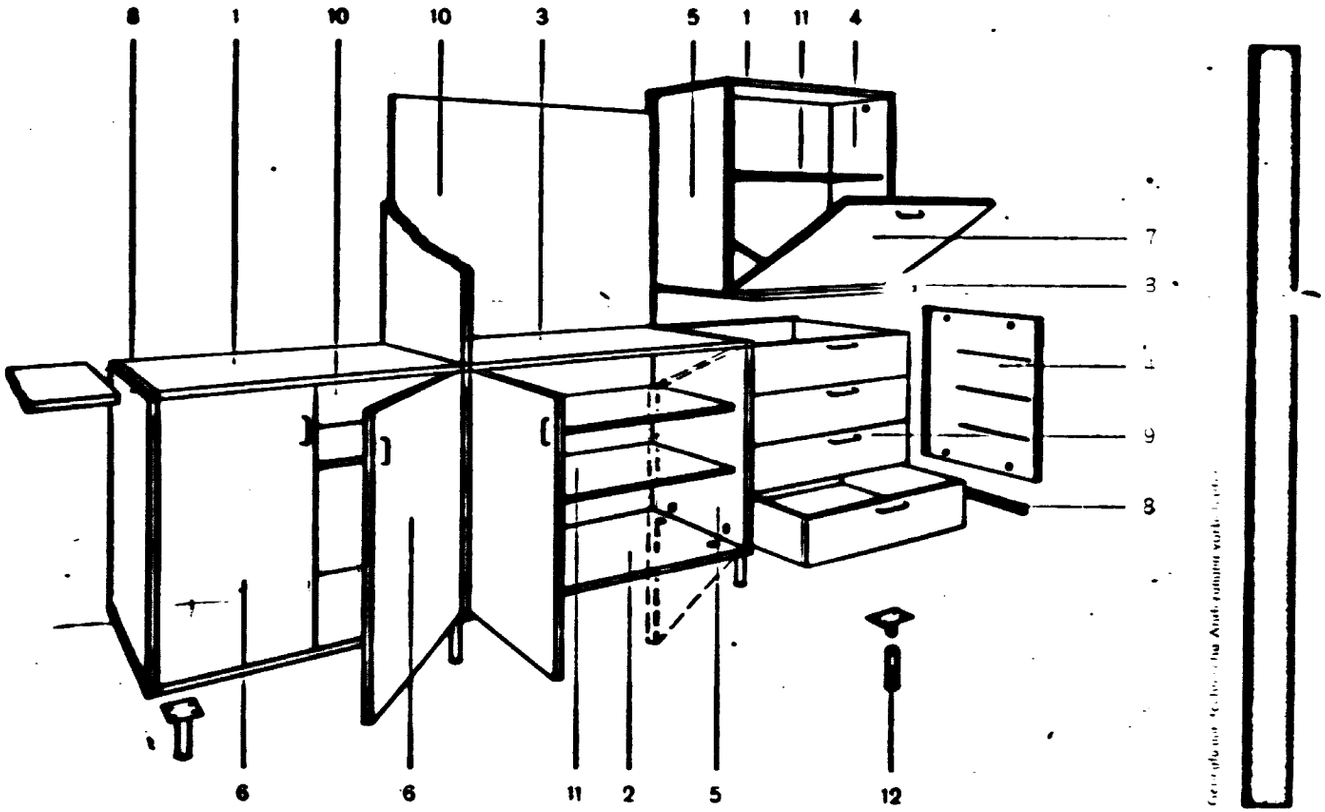


A Verbindungsbolzen
B Eckleiste
C Exzenterbuchse

Das »Skelett« der Möbel bilden die Eckleisten B, die mittels der Verbindungsbolzen A an allen vier Seiten mit Möbelflächen verbunden werden können, die ihrerseits mit Buchsen C versehen sind, in die die Schrauben versenkt werden.

Annex 54

Die Einzelteile

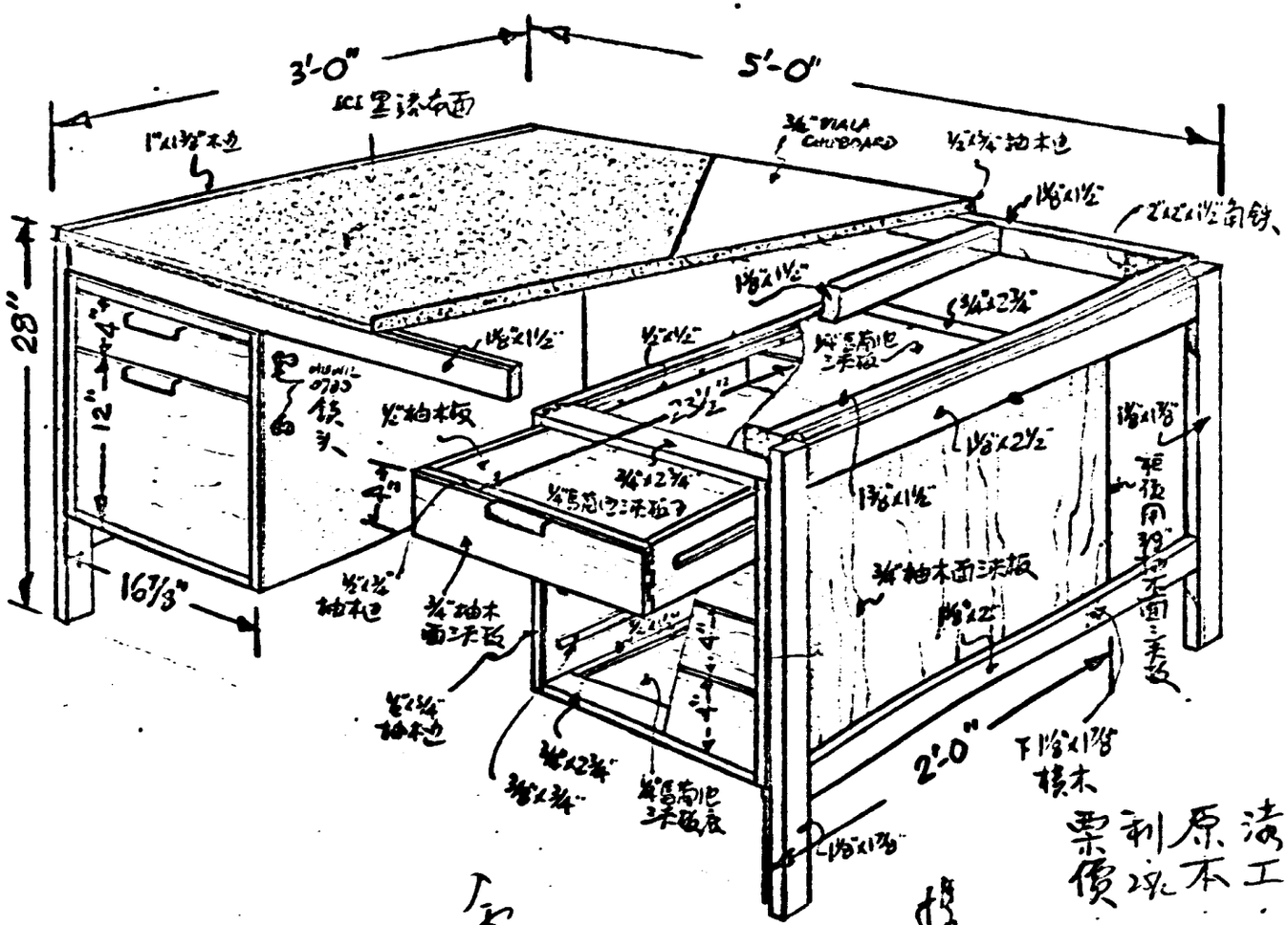


1 Oberboden	4 Außenseite	7 Klappe	10 Rückwand
2 Unterboden	5 Mittelseite	8 Eckleiste	11 Fachboden
3 Mittelboden	6 Türe	9 Schubkasten	12 Fuß

Annex 5A

DESK DOUBLE PEDESTAL N.D.63

DRG. No 113 finish ICI CATYLAC



QUESTION and ANSWER SERVICE

EUROPEAN PRODUCTIVITY AGENCY
ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION (OEEC.)
2, rue André-Pascal, PARIS - Tro. 76-00
OEEC. Mission in U.S.A., 2000 P Street, N.W., Washington 6, D. C.

IR 24213 HP

SUBJECT: Wood Hardening

INQUIRY: Information is requested on chemical processes for hardening woods.

INFORMATION SUBMITTED:

Although considerable numbers of patents have been issued to inventors of chemical processes by which wood becomes harder, dimensionally stable, etc., an important part of the total research in this field has been done by the Forest Products Laboratory of the U.S. Forest Service, a branch of the U.S. Department of Agriculture. The results of investigations conducted by the Forest Products Laboratory have been published in several reports which are generally available, and since this Government agency works in the public interest, any interested parties may profit from its work.

"Modified woods" is the generic term which applies to woods which have been subjected to chemical, compressive and thermal treatments responsible for the changed properties of treated woods. Modifications include improvement of physical properties such as tensile strength, crushing strength, modulus of elasticity in compression, tension, and flexure, modulus of rupture, maximum shearing strength, etc. Five different types of modified woods have been developed by the Forest Products Laboratory: impreg, compreg, staypak, staybwood, and acetylated wood. Impreg and compreg are manufactured by several companies on a commercial scale, but the other three types are not as yet being commercially produced. Phenolic resins are employed in manufacturing both impreg and compreg for impregnation of wood and chemical bonding to the internal cell-wall structure of the wood. Impreg is dried and cured without applying outer pressure at approximately 300°F; compreg is compressed while the resins are cured without application of increased temperatures. Hardness is increased especially in compreg, being up to 20 times as high as in normal wood. Compreg is also highly resistant to abrasion.

The appended bibliography is descriptive of various processes for making modified woods, and shows some of the most common applications of such woods in the United States.

REFERENCES

1. Stamm, A.J. and Seborg, R.M.
   Forest Products Laboratory resin-treated laminated, compressed wood (compreg)
   Forest Products Laboratory. Report 1381, 1955. 16pp.

2. Seborg, R.M. and Stamm, A.J.
   Effect of resin treatment and compression upon the properties of wood
   Forest Products Laboratory. Report 1383, October 1945. 14pp.

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION

TECHNICAL INQUIRY SERVICE

IN COOPERATION WITH
U. S. DEPARTMENT OF COMMERCE OFFICE OF TECHNICAL SERVICES (OTS)

IR 28505

SUBJECT: Molded Wood Products

INQUIRY: Information and equipment sources are requested for the manufacture of molded products from wood particles.

INFORMATION SUBMITTED:

Molded wood waste is essentially a molded and cured mixture of wood particles and 10-20% of a resin plus small amounts of stearates or wax for mold release and water resistance. Molded wood waste has many potential uses and, where applicable, frequently brings about saving in raw material cost, increased production rates, and the elimination of some operations as compared to other production methods.

The cost of an average wood waste mix molded to a specific gravity of 1.0 has been given as $3-4.00 per cubic foot. Comparisons of costs of an article made of solid wood and molded wood waste depend mainly on the labor cost of production by the two methods. One cost advantage of molded wood waste is the absence of waste from the molding operation. In general, all of the wood waste mix charged to the mold comes out as finished product. Various kinds of wood waste may be used, although they do not all give the same results. Softwoods make stronger molded articles, but hardwoods give better water resistance. The wood should be ground in a manner designed to preserve fibers as much as possible.

Phenolic resins are used where high strength and water resistance are essential. Their fast cure and rapid flow are useful characteristics. Usually, several varieties of resin are offered to meet various application conditions. The molds are usually of the positive type, in which the mold closes against metal lands. The wood particle-resin mixture is capable of very little flow in the mold, and thin sections and abrupt changes in cross section should be avoided in the design of the molded article. Best results are obtained when the article is reasonably flat.

Pressures of 500-1200 psi are commonly used in wood particle molding, with mold temperatures of 300°-350°F. Molding time varies with the mold temperature, the thickness of the molded part, the character and proportion of the resin, and the moisture content of the charge. Equipment requirements for a wood particle molding plant include hydraulic presses, mixing equipment, molds, and high-pressure steam boilers. These are expensive pieces of equipment, and probably represent a higher capital investment for a given daily output than standard woodworking machines.

More complete information on the molding of wood waste, the necessary equipment, costs, and the properties of molded articles is presented in the references cited in the appended bibliography. Necessary equipment is available in the United States from a large number of firms. The following is a representative listing of American firms which offer a line of used equipment, which may permit the inquirer to effect some saving in initial capitalization costs:

A. First Machinery Corporation
209-289 10th Street
Brooklyn 15, New York

The firm states that they have supplied equipment for wood particle molding to many plants in the past, and feel confident that they can satisfy the inquirer's requirements with good used and rebuilt equipment for the entire operation. They urge, however, that the inquirer utilize the services of a consultant who can supply up-to-date information on the best possible and most efficient processes for his purpose, and specify equipment best suited to his needs. The above firm could then quote on specific items recommended by the consultant and, thereby, furnish an up-to-date, efficient plant at great saving of time and investment without sacrifice of quality. The firm has worked closely with one consultant in this field, who has set up numerous plants in the U.S. and throughout the world for the manufacture of molding powders and their various finished products. They feel certain that his services would be more than justified by the savings that would be incurred not only in the initial cost of the plant, but in continued efficient operation and the savings derived therefrom over many years. If interested, the inquirer may contact the above firm directly, and they will be pleased to put him in contact with the consultant.

B. Erie Engine and Manufacturing Company
963 East 12th Street
Erie, Pennsylvania

The firm handles a complete line of used hydraulic presses, mixing mills, etc., and from time to time brokerages complete plants for use in the production of molded wood particle articles. They would require such information as capacity and size of equipment necessary (i.e. contemplated daily or monthly output), and will then be in a position to offer a quotation on a package unit for this equipment.

C. Johnson Machinery Company
90 Elizabeth Avenue
Elizabeth, New Jersey

A complete line of used and rebuilt machinery for the plastic industry is available.

INTERNATIONAL COOPERATION ADMINISTRATION
OFFICE OF INDUSTRIAL RESOURCES

TECHNICAL INQUIRY SERVICE

IN COOPERATION WITH
U. S. DEPARTMENT OF COMMERCE — OFFICE OF TECHNICAL SERVICES (OTS)

IR 24832

SUBJECT: Bamboo Laminates

INQUIRY: Information is requested about processing bamboo into laminates, as to the process, machinery, best bamboo, and sources of technical aid on this type of undertaking.

INFORMATION SUBMITTED:

I. In Japan, bamboo is being processed into laminates that are used in the manufacture of certain kinds of furniture, paneling, and novelties.

II. The following is a description of the process used to laminate the bamboo:

Step in Process	Name of work	Machinery & Tools required	Details of work
A.	Cutting bamboo plant	Hand-saw or chain-saw	Cutting in autumn bamboo-plant of right height, straight, and 4 or 5 years old.
B.	Cutting bamboo in fixed length	Rotary cutoff saw	Cutting in round slices of a fixed length (3 to 4 feet) for convenience in working.
C.	Splitting	Rip saw	Splitting in fixed width.
D.	Cutting off bamboo joints inside & outside	Bamboo joint cutting machine	Planing off joints on both sides to make them smooth and even.
E.	Boiling	Boiling vat	Boiling for more than 3 hours for insect extermination and prevention.
F.	Drying	Dry kiln	Drying until moisture is reduced to less than 10%.

G.	Selection		Selection is made according to quality and measurement.
H.	Planing	Automatic planer	Planing up in fixed thickness (1/4" to 3/8").
I.	Cutting	Cut off saw	Cutting in fixed length (2' to 3').
J.	Cutting	Trim saw	Cutting in fixed width (1 1/4" to 1 1/2").
K.	First gluing	Glue press	Gluing 4 or 5 pieces in a block urea rosin.
L.	Drying	Dry kiln	Keep in kiln until glue is dry.
M.	Finishing (plane)	Automatic finishing planer	Planing square of fixed measurement (1" to 1 1/4")
N.	Second Gluing	Metal glue press	Gluing the blocks together to form a proper parquet according to design, mainly like mosaic.
O.	Drying	Dry kiln	Kept in kiln until glue is dry.
P.	Third Gluing	Metal glue press	Pressing together the larger block with the second and glued blocks.
Q.	Drying	Dry kiln	Until glue is dry.
R.	Finishing surface (Plane)	Automatic planer	Plane the cut block to form a parquet ware according to intended use and design.
S.	Polishing surface	Automatic polishing machine	Sanding & polishing.

T.	Side Finish	Side finishing machine	Sanding & polishing.
U.	Painting	Painting machine	Spray booth.
V.	Drying	Drying machine	Until thoroughly dry.

III. Machinery required for the bamboo laminating process is ordinary wood-working equipment with some modifications. Depending upon the nature of the product desired, the various machinery and equipment needed would be that listed in the forsgoing table.

Manufacturers of such wood-working machinery and equipment include the firms listed below:

Ekstrom, Carlson & Co.
1400 Roadrail Avenue
Rockford, Illinois

Shapers, sanders, routers, saws, and infeeders.

The G. M. Dishl Machine Works, Inc.
1940 Collins Avenue
Wabash, Indiana

Precision saws, moulders, veneer splicers, veneer jointers and edge gluers, glue jointers and edge moulders, and glue pots.

Fay and Egan Company
2024 Eastern Avenue
Cincinnati 2, Ohio

Shapers, tenoners, surfacers, scrapers, routers, and borers.

Williams-White & Co.
700 Third Avenue
Moline, Illinois

Presses and special machinery.

Ericsson-Merritt, Inc.
514 Pine
Lockport, New York

Lathes, clippers, dryers, jointers, presses, and reeling and unreeling systems.

IV. Best kind of bamboo for the processing for products now being made is Japanese plant called "Moso." Its scientific name is Phyllostachysnitis. "Moso" of 4 or 5 years of age is found to be most satisfactory for laminating.

It is usually cut out of the bamboo grove in Autumn.

V. Information about places where technical help in this type of enterprise can be obtained is available from the following sources.

Akita Mokusai Co., Ltd.
15, 3-Chome
Fukagawa - Kiba, Koto - ku
Tokyo, Japan.

Manufacturers wood working machinery.

Marusan Shoji Co., Ltd.
5, 2-Chome
Nihombashi - Edobashi, Chuo - ku
Tokyo, Japan

Manufactures wood working machinery.

Federation of Economic Organizations
Koggo Club Building, Marunouchi
Tokyo, Japan

A clearing house for information about the economic and technological resources of Japan.

VI. There are other uses of bamboo that should be considered, in addition to those of lamination, and of direct use in furniture. Bamboo is also entering the building trades where it has been used successfully to reinforce concrete. Information about additional commercial and industrial possibilities of bamboo is available from:

Clemson Agricultural College
Clemson, South Carolina

Has done research in the commercial and construction uses of bamboo.

Forest Products Laboratory
Forest Service
U. S. Department of Agriculture
Washington 25, D. C.

REFERENCES

1. "Wood Technology". Harry Donald Tiemann. 1951.
396 pp. $6.00.
Pitman Publishing Company
2 - 6 West 45th Street
New York 36, N. Y.

Deals with the physical and chemical properties of wood, effect of temperature and kiln-drying, plywood, glues, and adhesives.

2. "Wood Handbook". United States Forest Products Laboratory. 1955. 528 pp. $2.00.
U. S. Government Printing Office
Washington 25, D. C.

Contains information on: gluing of wood, glued structural members, plywood and other crossbanded products, modified woods and laminates.

3. "Modern Wood Adhesives". Thomas Doane Perry. 1944. 208 pp. $4.50.
Pitman Publishing Company
2 - 6 West 45th Street
New York 36, N. Y.

A discussion of the manufacturing processes, properties, and applications of the different types of glues used in the development of plywood and veneers.

4. "ElBambu Como Material de Construccion". Organisation of American States. 1956. Pages not given. $0.75.
Publications Division
Organization of American States
17th & Constitution Avenue, N. W.
Washington, D. C.

5. "Bamboo Reinforcement in Portland Cement Concrete". Howard Emmitt Glenn. 1950. 171 pp. Bulletin No. 4.
Clemson Agricultural College of South Carolina
Clemson, South Carolina

Describes results achieved in using bamboo in construction work.

6. "Seasoning, Preservative and Water-Repellent Treatment, and Physical Property Studies of Bamboo". Howard Emmitt Glenn and others. 1956. 186 pp. Bulletin No. 8.
Clemson Agricultural College Engineering Experiment Station.
Clemson, South Carolina.

Covers methods employed to make bamboo a suitable material for construction and other related purposes.

INTERNATIONAL COOPERATION ADMINISTRATION
OFFICE OF INDUSTRIAL RESOURCES

TECHNICAL INQUIRY SERVICE

IN COOPERATION WITH
U. S. DEPARTMENT OF COMMERCE OFFICE OF TECHNICAL SERVICES (OTS)

IR 23997

SUBJECT: Sawdust

INQUIRY: Information is requested on possible uses of sawdust in pressed boards or similar purposes, particularly on a small scale.

INFORMATION SUBMITTED:

The American technical literature on the manufacture of wall board, insulation board, and other by-products utilizing sawdust and wood waste materials almost always concerns medium or large size operations. Small industries in the U.S. often cannot operate at prices competitive with large firms, except in a few specialized industries. The term "small industry" may also have a quantitatively different meaning in different countries. What is small in the U.S. may well be considered relatively large elsewhere.

Planning of a "small" industrial plant for the manufacture of insulation board and hardboard is described in reference (1) of the bibliography below. The daily output capacity is estimated at 50 tons or 150,000 square feet of cooked wood fiber board. The article describes the types of machinery needed for this scale of production, the forming and drying methods for the board, wet and dry hardboard manufacture, heat treating, and tempering. A brief cost consideration is also included. Another more comprehensive treatise on wall board manufacture from wood wastes is a collection of papers presented at a conference at Cambridge, Massachusetts, September 16, 1949 (reference 2). Various processes and board products are covered, though the production may not be suitable for small scale plant in every case.

New technical developments and research are opening other ways of utilizing sawdust and wood waste. The chemical industry already consumes large quantities of such materials. Humus has been produced from sawdust in large digesters, concrete has been mixed with sawdust as its aggregate, mushrooms are being grown on sawdust, and even food for cattle can be produced from sawdust. Selected references below illustrate the various actual and theoretical possibilities for commercial and domestic exploitation of sawdust and wood waste.

REFERENCES

1. Depan, R. T.
Small plant set-up for insulation and hardboard manufacture
Paper Trade Journal 131(16):36, 38, 40-42, October 10, 1950

INTERNATIONAL COOPERATION ADMINISTRATION
OFFICE OF INDUSTRIAL RESOURCES

TECHNICAL INQUIRY SERVICE

IN COOPERATION WITH
U. S. DEPARTMENT OF COMMERCE OFFICE OF TECHNICAL SERVICES (OTS)

IR 25434

SUBJECT: Bent Wood Chairs

INQUIRY: Information is requested on the manufacture of bent wood chairs, and of the machinery and equipment used therein.

INFORMATION SUBMITTED:

The chair back is made of one piece of wood, 1-1/2" square. It is ripped to size and then run through a molder to produce a 1-1/4" round. It is then tapered to about 1" diameter at the ends, while in the center it is tapered to 7/8" diameter. This operation can be done in a turning lathe by hand, or automatically in a knife turning lathe.

The stretcher, back rest, and side braces are all ripped to size and run through the molder. The wood is 1" material turned and finished to 3/4".

All these parts are then bent in special presses. The seat frame is also run through the molder. The frame is made from 1-1/2" lumber, ripped to 1-1/4" before being put through the molder.

If a cane seat is to be used, it is routed as a part of the molding operation. If a plastic or composition seat is to be used, it is not so routed.

The front posts are also run through the rip saw and molder. They are made from 1-1/2" stock, tapered top and bottom by the same methods that are used on the back posts, and tapered down to 1" top and bottom. A dowel is then made on the front posts using a chucking machine. The seat frame, after bending, is cut to size diagonally, glued, nailed together, and two holes are bored for fastening the seat frame to the front posts. Four holes are bored in each side brace for assembly purposes, and four holes are bored in the back rest - two at each end and two at the top. The back rest is

7

then assembled to the back posts with two screws, the assembly being done in a simple form to hold both posts in place. The front legs and the stretcher are then assembled to the frame. Holes are not drilled in the stretcher prior to assembly since these must be fitted in place. An electric drill is used to drill the holes and the stretcher is fastened to the front legs by one wood screw for each leg.

The back is then assembled to the seat frame and stretcher with heavy wood screws for fastening the back posts to the seat. Smaller wood screws are used for fastening the stretcher to the back posts. The back rest also is fastened to the seat frame with wood scrs .s.

The side braces are then assembled to the back post and the seat frame with two wood screws at each end. The seat cover is usually made of cane, plastic, or fiber composition. If cane is used, the seat frame is caned before the assembly. If the others are used, they are nailed on after the assembly has taken place.

After complete assembly, the chair is leveled by cutting off a part of the longest leg or legs until the chair sets solidly on the floor. The chair is then painted in a spray booth any color desired. Usually two coats are applied. First is the primer and next the finish coat, which is generally lacquer. The chairs then are packaged to the bundle by placing the seats together, one chair being inverted. As many as ten or twelve chairs are put into one crate, if shipped in that manner. In some instances, two chairs are placed in a corrugated carton, which eliminates wrapping of the legs and back to prevent damage to the paint.

Every piece of wood in a bent wood chair is bent. The seat and stretcher are bent into a complete circle. The chair back and the back rest are bent into a U-shape. The side braces are bent at an angle for attaching to both the seat and the back posts. The front posts are bent to flair out at the bottom, to make the chair solid and for appearance. Each part of the chair will require bending equipment. Therefore, bending equipment will be required for the following chair parts.

Back posts
Back rests
Front posts
Seats
Stretchers
Side braces

Most bent wood furniture in the United States is made from hickory, maple, birch, beech, elm, and some species of soft woods.

The principle machinery required is as follows. The number of machines needed will depend on the volume of production.

a. Banding equipment for every part of the chair
b. Cut off saw
c. Rip saw
d. Four head molders
e. Chucking machine for dowels
f. Mattison turning machine
g. Upright and horizontal boring machines
h. Table belt sander
i. Mattison sanding machine
j. Single drum sander

For assembly work the plant will need:

a. Electric screw driver
b. Electric drill
c. Ratchet screw driver
d. Glue pots
e. Assembly presses (usually hand made in the shop, they operate by foot power)

If the seat is composition, plastic or any material other than cane, special large-headed nails are required to fasten the seat to the frame.

Catalogs for the above equipment are available from the companies listed below.

Curtis Machine Division
The Carborundum Company
1030 Gibson Street
Jamestown, New York

Abrasive belt grinding, polishing and sanding machinery.

Oliver Machinery Company
450 - [illegible]th Street, N. W.
Grand Rapids 2, Michigan

General line of woodworking machinery.

G. M. Diehl Machine Works, Inc.
1940 Collins Avenue
Wabash, Indiana

Woodworking machines, rip saws, cut-off saws, molders, glue joiners, edge cutting machines, glue pots.

Mattison Machine Works
200 Blackhawk Park Avenue
Rockford, Illinois

Woodworking machinery, surface grinders, grinding and polishing machinery.

The DeVilbiss Company
296 Phillips Avenue
Toledo 1, Ohio

Painting and spraying equipment.

Handy Manufacturing Company
2432 West Lawrence Avenue
Chicago 25, Illinois

"Hot Roll Bonding Presses." Handy Bulletin No. 802. 6 pp. Gratis.

Bonding equipment.

McKnight Machinery Company
Gardner, Massachusetts

Furniture wood bending equipment.

Industron Corporation
55 Needham Street
New Highland 61, Massachusetts

Wood bending equipment.

J. R. Richardson Company
Sheboygan Falls, Wisconsin

Wood bending machinery.

REFERENCES

1. "Principles of Woodworking." Herman Hjorth. 1948. 445 pp. $4.50.
Bruce Publishing Company
400 North Broadway
Milwaukee 1, Wisconsin

Hand and machine tools, planing and squaring to dimensions, gluing, clamping, wood turning and finishing.

2. "Cutting Techniques for Woodworkers." Thomas D. Perry. 1955. 53 pp. Price not given. Reprint No. 107.
The Hitchcock Publishing Company
Wheaton, Illinois

Outlines principles with regard to saws, rotating cutters, bits, stationary knives, abrasives, etc.

3. "Furniture Finishing." Harold B. Gatslick, Ph.D. 1956. 82 pp. Price not given. Reprint No. 108.
The Hitchcock Publishing Company
Wheaton, Illinois

Contains articles on modern materials and procedures in wood furniture finishing.

Mention of the name of any firm, product, or process in this report is not to be construed as a recommendation or endorsement, but merely as a citation that is typical in its field. Commercial directories generally list names of additional companies and products.

Prospectus

TIMBER INDUSTRY TRAINING CENTRE ROTORUA

Published by N.Z. Forest Service in association with N.Z. Timber Merchants' & Sawmillers' Federations.

TRAINING COURSES OFFERED

Sawdoctoring
bandsaws.
circular saws.
advanced sawdoctors.
carbide tipped circular saws.

Timber Machining
planer machine.
planer-moulder.
timber machining (sales staff).

Sawmilling
sawmill machinery operators.
sawmilling (sales staff).
band resaw operators.

Other Courses Available
Chainsaw operation and maintenance, heat tensioning & argon arc welding, use & maintenance of carbide cutters.

Instructors:
K. Bergseng, (Principal)
G.L. Hayes,
J. Macdonald.

Training course available at the TIMBER INDUSTRY TRAINING CENTRE P.O. BOX 511 ROTORUA, NEW ZEALAND

Danish
Foreign Office Journal

Many small factories

The term 'mass production' should not be overstressed. Denmark is a country of small-scale industries. Our industrial strength lies in the fact that we have a specialized production of high quality in many small factories (or large workshops). The furniture industry is a typical example of this. Of the approximately 400 members of the Danish Furniture Manufacturers Association, only about 15 employ over 50 workers. The annual production value of Danish furniture factories is about 800 million kroner, of which about 320 million is exported. Clearly there is no question of 'industry' on the scale of the major industrial countries, but in Denmark we have learnt that, as a country poor in natural resources, we cannot compete in price, only in quality. For this reason it is the processing industries which shape our industrial image.

ANNEX 11

Statistics of Singapore Timber Industry.

Details of Sales of Woodworking & Furniture Manufactu
Employing More Than 10 Workers, 1968 - 1970

Description of Industry	No. of Establishments			SINGAPORE																
				Wholesalers			Retailers			Direct Consumption			Others			Total				
	'68	'69	'70	'68	'69	'70	'68	'69	'70	'68	'69	'70	'68	'69	'70	'68	'69	'70		
1. Sawmilling	94	96	98	47971	53127	53094	7287	7795	14195	3937	6009	6724	73	591	42	59268	67523	74855		
2. Manufacture of Plywood & Veneer	6	6	8	5554	5913	4825	1006	1130	-	132	375	5903	-	282	61	6692	7699	10790		
3. Joinery Work	16	21		580	875		208	92		2330	3838		718	-		3836	4805			
4. Manufacture of wooden boxes, packing cases & crates	13	14	15	861	1119	1006	116	124	144	2519	1828	2425	-	-	-	3496	3071	3574		
5. Manufacture of wooden furniture	29	32	30	1565	1518	7223	2530	3614	2423	5682	8091	9205	4	131	901	9781	13354	19752		
6. Other manufacture of furniture & furniture fixtures, furniture finishing & repairing (incl. upholstery & mattress manufacturing	12	12		3158	4088		57	1065		2223	1501		-	-		5438	6654			

Working & Furniture Manufacturing Establishments
Than 10 Workers, 1968 - 1970

('000)

Others			Total			West Malaysia		East Malaysia			Overseas			Grand Total		
'68	'69	'70	'68	'69	'70	'68	'69	'68	'69	'70	'68	'69	'70	'68	'69	'70
73	591	42	59268	67523	74855	111	76	-	-	2879	66	16242	19407	42525	75621	89886	97466
-	282	61	6692	7699	10790	112	133	5	23	41	25129	33036	42370	31938	40891	53290
718	-		3936	4805		161	174	42	52		5737	12234		9776	17264	
-	-	-	3496	3071	3574	-	-	-	-	-	-	-	-	3496	3071	3574
4	131	901	9781	13354	19753	353	417	291	356	310	1058	950	1445	11483	15077	21876
-	-		5438	6654		460	-	-	-		568	741		6466	7395	

Selected Economic Statistics on Woodworking & Furnitu[illegible]
[illegible] 10 Workers, 1968 - [illegible]

Description of Industry	No. of Establishments			No. of Workers**			No. of Workmen*			Work Given Ou[illegible]	
	1968	1969	1970	1968	1969	1970	1968	1969	1970	1968	1969
1. Sawmilling	[illegible]	[illegible]	[illegible]8	3,123	3,[illegible]	3,51[illegible]	2,[illegible]81	2,7[illegible]2		6	12
2. Manufacture of Plywood & Veneer	6	6	6	2,038	2,712	3,683	1,789	2,36[illegible]		-	[illegible]
3. Joinery Work	16	21		732	1,044		652	[illegible]12		124	170
4. Manufacture of wooden boxes, packing cases and crates	13	14	15	371	361	3[illegible]	330	33[illegible]		1	1
5. Manufacture of wooden furniture	29	32	30	1,127	1,308	1,564	969	1,156		609	435
6. Other manufacture of furniture and fixtures, furniture finishing and repairing(including upholstery) and mattress manufacturing	12	12		337	337		280	280		283	283

*Workmen - refers to persons employed directly in the process of production. [illegible] include [illegible] other paid personnel employed indirectly in production, [illegible] u[illegible] remuneration, those on piece rate and those under contract labour. The proportio[illegible] high in sawmilling, joinery work and wooden furniture manufacturing.

**Workers - include all persons engaged directly or indirectly in the industrial activity of [illegible] and unpaid family workers.

-lsc

SECTION 1

...working Furniture Making Establishments Employing
... 10 Workers, 1968 - 1970

...f Workmen*		'000											
		Work Given Out			Output			Value Added			Capital Expenditure		
1969	1970	1968	1969	1970	1968	1969	1970	1968	1969	1970	1968	1969	1970
...,782		6	12	11	71,826	38,310	96,508	18,647	21,107	23,706	1,083	2,...10	2,860
2,36		-	...	33	31,855	41,633	42,501	17,154	21,568	25,497	5,987	6,534	
...12		12	170		9,52...	17,628	56,...18	3,464	6,155		1,363	3,092	16,057
... 33		1	1	2	3,...55	3,0...3	3,555	1,238	1,152	1,275	84	77	213
1,156		600	435	766	11,530	15,239	21,920	5,553	7,...17	9,9...1	574	2,501	1,075
... 280		283	283		6,523	6,523		2,104	2,104		312	312	

...duction. They include all skilled, semi-skilled or unskilled workmen, but exclude all ...ing proprietors and unpaid family workers. They were subdivided into those on fixed ...t labour. The proportion of workmen engaged under piece rate and contract labour is ...facturing.

...Principal activity of the establishment, i.e. workmen, other workers, working proprietors

SECTION 2

Details of Sales of Wooden Furniture

$'000

Year	No. of establishments	Singapore					West Malaysia	East Malaysia	Overseas	Grand Total
		Wholesalers	Retailers	Direct Consumption	Others	Total				
1965	14	92	216	6,206	-	6,514	979	276	106	7,877
1966	17	1,241	201	6,747	2	8,191	669	127	1,317	10,305
1967	18	696	161	5,278	1,560	7,695	286	152	1,038	9,170
1968	29	1,565	2,530	5,682	4	9,781	353	291	1,058	11,483
1969	32	1,518	3,614	8,091	131	13,354	417	356	950	15,077
1970	30	7,223	2,423	9,205	901	19,753	369	310	1,445	21,876

Source: Census of Industrial Production, 1965 - 1970

Selected Economic Statistics on Woodworking & Furniture Manufacturing
Establishments, Employing 5 - 9 Workers, 1968

Description of Industry	No. of Establishments	No. of Workers**	No. of Workmen*	$ '000 Output	$ '000 Value Added
1. Sawmilling	6	47	38	555	140
2. Manufacture of Plywood and Veneer	-	-	-	-	-
3. Joinery Work	5	40	30	220	150
4. Manufacture of wooden boxes, packing cases and crates	11	78	52	580	244
5. Manufacture of wooden furniture	33	228	166	1597	759
6. Other manufacture of furniture and fixtures, furniture finishing and repairing (including upholstery) and mattress manufacturing	27	171	110	1324	565

Workmen - refers to persons employed directly in the process of production. They include all skilled, semi-skilled or unskilled workmen, but exclude all other paid personnel employed indirectly in production, working proprietors and unpaid family workers. They were subdivided into those on fixed remuneration, those on piece rate and those under contract labour. The proportion of workmen engaged under piece rate and contract labour is high in sawmilling, joinery work and wooden furniture manufacturing.

Workers - include all persons engaged directly or indirectly in the industrial activity of the establishment, i.e. workmen, other workers, working priprietors and unpaid family workers.

.../2

Principle Statistics on the Manufacture of Wooden Furniture

£'000

Year	No. of Establish-ments	No. of Workers	Total Input	Work Given Out	Other Cost of Production	Output	Value Added	Employees' Remune-ration	Capital Expenditure
1965	14	704	3,862	137	474	7,970	3,971	2,365	349
1966	17	814	4,755	242	390	10,488	5,490	3,170	139
1967	18	909	4,504	167	901	9,338	4,668	3,381	466
1968	29	1,127	5,368	609	1,025	11,530	5,553	3,941	674
1969	32	1,308	7,387	435	1,655	15,239	7,417	3,740	2,501
1970	30	1,564	11,213	766	2,459	21,920	9,941	5,167	1,075

Source: Census of Industrial Production, 1965 - 1970

Principle Statistics on Joinery

$'000

Year	No. of Establish-ments	No. of Workers	Total Input	Work Given Out	Other Cost of Production	Output	Value Added	Employees' Remune-ration	Capital Expenditure
1965	14	429	3,667	18	382	5,850	2,165	1,136	311
1966	15	520	3,811	157	375	6,298	2,330	1,387	602
1967	18	629	4,838	94	852	7,665	2,733	1,646	1,891
1968	16	732	5,936	124	909	9,524	3,464	1,828	1,363
1969	21	1,044	11,303	170	1,852	17,628	6,155	2,790	3,092

Source: Census of Industrial Production, 1965 - 69

Details of Sales on Joinery

$'000

Year	No. of establishments	Singapore					West Malaysia	East Malaysia	Overseas	Grand Total
		Wholesalers	Retailers	Direct Consumption	Others	Total				
1965	14	1,651	102	1,970	968	4,691	171	4	958	5,823
1966	15	1,024	129	2,352	552	4,058	227	33	1,920	6,238
1967	18	2,114	89	2,105	858	5,166	241	58	2,715	8,180
1968	16	580	208	2,330	718	3,836	161	42	5,737	9,776
1969	21	875	92	3,838	-	4,805	174	52	12,234	17,264

Source: Census of Industrial Production, 1965 - 69

EXPORT OF GRADED TIMBER FROM SINGAPORE FROM 1965 - 1971

Type of Timber	1965		1966		1967		1968		1969		1970		1971	
	Total Tonnage	%	Total Tonnage	%	Total Tonnage	%	Total Tonnage	%	Total Tonnage	%	Total Tonnage	%	Total Tonnage	%
Heavy Hardwood	1,754	1	5,364	3	2,038	1	2,004	1	6,240	2	3,783	1.2	1,620	0.7
Medium Hardwood	30,791	20	53,417	31	70,206	37	59,745	24	142,571	37	73,182	22.8	36,679	16.2
Light Hardwood	119,736	79	110,100	66	116,460	62	182,757	75	238,775	61	243,055	76.0	187,242	83.1
TOTAL :	152,281	100	168,881	100	188,704	100	244,506	100	387,586	100	320,020	100	225,820	100

Source : Timber Office, Ministry of Finance

Main Species of Malayan Timber Imported and Their Uses

Type of Timber	Standard Name	Botanical Name	Main Utilization						
			Sawing	Peeling & Slicing	Mouldings & Machined	Kiln Drying	Parquet Flooring	Pre-fabricated	Impregrated preservative
Heavy Hardwood	Balau	Shorea	X						X
	Chengal	Balanocorpus heimii	X						
	Merbau	Intsia palembanica	X		X	X	X		
	Resak	Vatica spp. & Cotylebium spp.						X	
Medium Hardwood	Keruing	Dipterocarpus ..	X	X	X	X		X	X
	Kempas	Koompassia Malaccensis	X	X	X	X		X	X
	Kapur	Dryobalanops ..	X		X	X			X
	Keledang	Artocarpus lanc	X						
	Mengkulang	Heritiera ..	X	X				X	
Light Hardwood	Meranti	White / Light Red / Dark Red Shorea	X	X	X	X		X	X
	Jelutong	Dyera Costulata ..	X		X	X			
	Mersawa	Anisoptera ..	X	X					
	Sepetir	Sindora ..	X	X	X				
	Nyatoh	Sapotaceae ..	X	X		X			
	Lurian	Bombacaceae ..		X	X				
	Ramin (Melawis)	Gonystylus bancanus	X	X	X	X			
Soft Wood	Damar Minyak (Malayan Kauri)	Agathis spp. ..			X	X			
Others	Teak	Tectona grandis L.f.					X		

COMPARISON OF ANNUAL EXPORTS OF GRADED SAWN TIMBER FOR THE EIGHT MAJOR BUYERS
(TON/50 CU. FT.)

Country	1965	1966	%	1967	%	1968	%	1969	%	1970	1971
South Africa	56, 678	31, 634	-44	44, 293	+40	51, 004	+15	46, 298	-10	55, 527	57, 869
United Kingdom	25, 215	23, 218	-8	24, 935	+70	35, 279	+42	30, 273	-14	10, 402	20, 956
U. S. A.	6, 041	16, 385	+171	6, 299	-62	13, 255	+110	25,634	+93	9, 181	18, 252
France	18, 500	27, 145	+47	23, 822	-12	44, 408	+87	69, 278	+56	43, 674	27, 006
Japan	41	5, 874	+14,329	19, 056	+224	22, 115	+12	19, 378	-12	37, 612	13, 640
Australia	20, 644	9, 643	-53	13, 064	+31	17, 296	+32	17, 459	+1	23, 200	16, 490
Holland	2, 034	7, 774	+282	12, 807	+65	18, 928	+48	21, 606	+14	22, 714	14, 288
Belgium	4, 288	5, 396	+26	5, 520	+2	8, 700	+58	18, 870	+117	9, 117	3, 213
Sub-total :	133, 441	127, 069	-5	149, 796	+18	210, 985	+41	248, 796	+18	211, 427	171, 714
Other countries	18, 840	41, 811	+69	38, 908	-70	33, 521	-14	49, 179	+47	109, 593	54, 106
T o t a l :	152. 281	168, 880	+11	188, 704	+12	244, 506	+30	297, 975	+22	320, 020	225, 320

(*1970 = Timber Export Industry Board)

Source : Timber Office, Ministry of Finance

COMPARISON OF VOLUMES AND VALUES OF SAWN TIMBER EXPORTED

Year	Volume (tons of 50 cu. ft.)	Difference tons	Yearly Percentage Difference	Value $ million	Difference $ million	Yearly Percentage Difference
1965	242,683	50,278	26.0%	41.5	8.2	24.6%
1966	265,477	22,794	9.5%	54.5	13.0	31.0%
1967	279,603	14,126	5.3%	57.1	2.6	4.8%
1968	355,000	75,397	27.0%	78.5	21.4	37.5%
1969	388,870	33,870	9.6%	91.7	13.2	16.7%
1970	432,041	43,170	11.0%	84.0	6.7	7.3%
1971	385,967	46,074	10.7%	86.6	2.6	4.0%

Source : Timber Office, Ministry of Finance

TIMBER PRODUCTION, EXPORTS AND LOCAL CONSUMPTION 1965 - 1969
(tons)

Year	Graded Sawn Timber		Upgraded Export	Stocks and Local Consumption of Graded Timber	Total Production
	Local	Export			
1965	2,495	152,281	90,402	80,822	326,000
1966	2,722	168,880	95,597	107,801	375,000
1967	1,378	188,703	90,900	92,900	373,981
1968	659	245,000	110,000	97,341	453,000
1969	-	298,000	90,870	127,530	516,400
1970	-	320,020	112,021	186,241	618,282

Source : Timber Office, Ministry of Finance

COMPARISON OF QUANTITIES OF GRADED AND UNGRADED TIMBER EXPORTED FROM SINGAPORE FROM 1965 - 1971

Year	Graded, Ungraded and Total	Yearly Increase/ Decrease	Percentage	Total for Singapore
1965	Graded	33.4%	62.5	152,281
	Ungraded	16.8%	37.5	90,402
	Total :	22.0%	100	242,683
1966	Graded	10.0%	65.0	168,880
	Ungraded	6.8%	35.0	95,597
	Total :	9.5%	100	265,477
1967	Graded	11.7%	64.0	188,703
	Ungraded	-5.0%	36.0	90,900
	Total :	5.3%	100	279,603
1968	Graded	30.0%	69.0	245,000
	Ungraded	21.0%	31.0	110,000
	Total :	27.0%	100	355,000
1969	Graded	22.0%	77.0	298,000
	Ungraded	-17.0%	23.0	90,870
	Total ;	5.0%	100	388,870
1970	Graded	7,4%	74.0	320,020
	Ungraded	23.3%	26.0	112,021
	Total :	10.6%	100	432,041
1971	Graded	- 29.4%	69.5	225,820
	Ungraded	43.0%	30.5	160,147
	Total :	10.7%	100	385,967

Source : Timber Office, Ministry of Finance

S= Small size (diameter 16" & below
M=Medium size (diameter 16" - 19")
L=Large size (diameter 20" & up)

LIST OF AVERAGE PRICES OF ROUND LOGS

(Per ton of 50 cu. ft. based on delivery to saw-mill in Singapore)

1967 - 1970

Species \ Year	1967			1968			1969			1970		
Sizes	S	M	L	S	M	L	S	M	L	S	M	L
Dark Red Meranti	53	83	98	75	105	120	75	105	125	75	105	125
Dark Red Meranti (Nemusu)	63	95	110	-	-	-	75	105	130	75	105	130
Meranti Tembaga	53	78	83	-	-	-	75	85	110	75	85	110
Seraya	53	83	98	-	-	-	75	85	110	75	85	110
Sinkawang	-	-	-	-	-	-	75	85	110	75	85	110
Light Red Meranti	58	83	93	65	80	95	65	80	95	65	95	100
Red Meranti	53	88	100	75	105	120	75	105	125	75	95	105
Red Meranti (with pin holes)	-	-	-	-	-	-	40	50	60	40	60	75
Kapur	85	95	105	85	95	105	95	105	115	95	110	120
Keruing	65	75	80	63	73	73	69	75	80	75	85	90
Kempas	50	55	60	55	60	65	55	60	65	55	60	65
Balau	65	75	85	70	80	90	70	90	108	70	90	100
Chengal	120	140	170	105	135	165	105	135	165	105	135	165
Merbau	65	75	85	75	100	110	85	110	120	85	110	120
Jelutong	65	80	90	75	85	95	75	95	105	75	95	105
Mixed Light Hardwood	48	53	58	50	55	60	50	55	60	50	55	60
Ramin	-	-	-	85	85	85	-	-	105	-	-	105
Damar Minyak	-	-	-	130	130	140	130	130	140	130	130	140
Yellow Meranti	50	60	70	50	55	60	50	55	60	50	55	60
Mengkulang	55	65	75	80	100	110	80	100	110	80	105	115
Mersawa	50	60	70	60	75	85	60	75	85	60	80	95

Source : Singapore Sawmillers Association

Details of Sales of Plywood & Veneer

$'000

Year	No. of Establishments	Wholesalers	Retailers	Direct Consumption	Others	Total	States of Malaysia	Sabah & Sarawak	Overseas	Grand Total
1965	6*	2,749	1	127	-	2,875	123	161	6,317	9,477
1966	6**	5,027	-	552	-	5,579	52	-	12,198	17,829
1967	6	5,899	-	-	-	5,899	19	14	14,924	20,966
1968	6	5,554	1,006	132	-	6,692	112	5	25,129	31,938
1969	6	5,913	1,130	375	282	7,699	133	23	33,036	40,891
1970	8	4,825	-	5,903	61	10,790	90	41	42,370	42,501

urce : Census of Industrial Production, 1965 - 1970

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Plywood & Veneer Production 1965 - 1969

Year	TIMBER INPUT		PLYWOOD & VENEER OUTPUT	
	Quantity (Tons)	Value ($'000)	Quantity (sq. ft.)	Value ($'000)
1965	Not available	Not available	Not available	Not available
1966	"	"	"	"
1967	89,000	8,063	211,272,000	20,556
1968	127,000	10,669	335,960,000	32,349
1969	162,000	14,067	409,791,000	41,292

Source : Census of Industrial Production

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Total Imports of Veneer & Plywood From Singapore
1965 - 1970

Commodity Item Showing Unit of Quantity	1965		1966		1967	
	Quantity	Value FOB	Quantity	Value FOB	Quantity	Value
Veneer sheets max 1/5" thick sq. ft.	98,419,316.40	6,190,358	137,119,447.97	8,087,406	163,202,066.24	8,133
Plywood ETC plain sq. ft. 5mm	13,156,695.25	2,197.821	51,472,112.41	7,525,680	77,189,015.08	12,34
Plywood veneered panels sq.ft. 5mm	8,002,971.64	1,874,061	9,371,056.36	1,842,981	9,006,282.75	1,69
Plywood ETC faced with plastic sq. ft. 5 mm	66,767.00	22,735	85,992.00	29,500	188,122.00	5
Plywood ETC faced with other materials sq. ft. 5mm	1,795.00	665	,568.00	1,880	1,655.00	
Total	119,647,545.29	8,285,640	198,056,176.74	17,487,447	249,587,181.07	22,23

Foot Note: Other materials include Galvanised Iron & Steel, Alumium or Zinc
Source : Statistics Department.

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SECTION 1

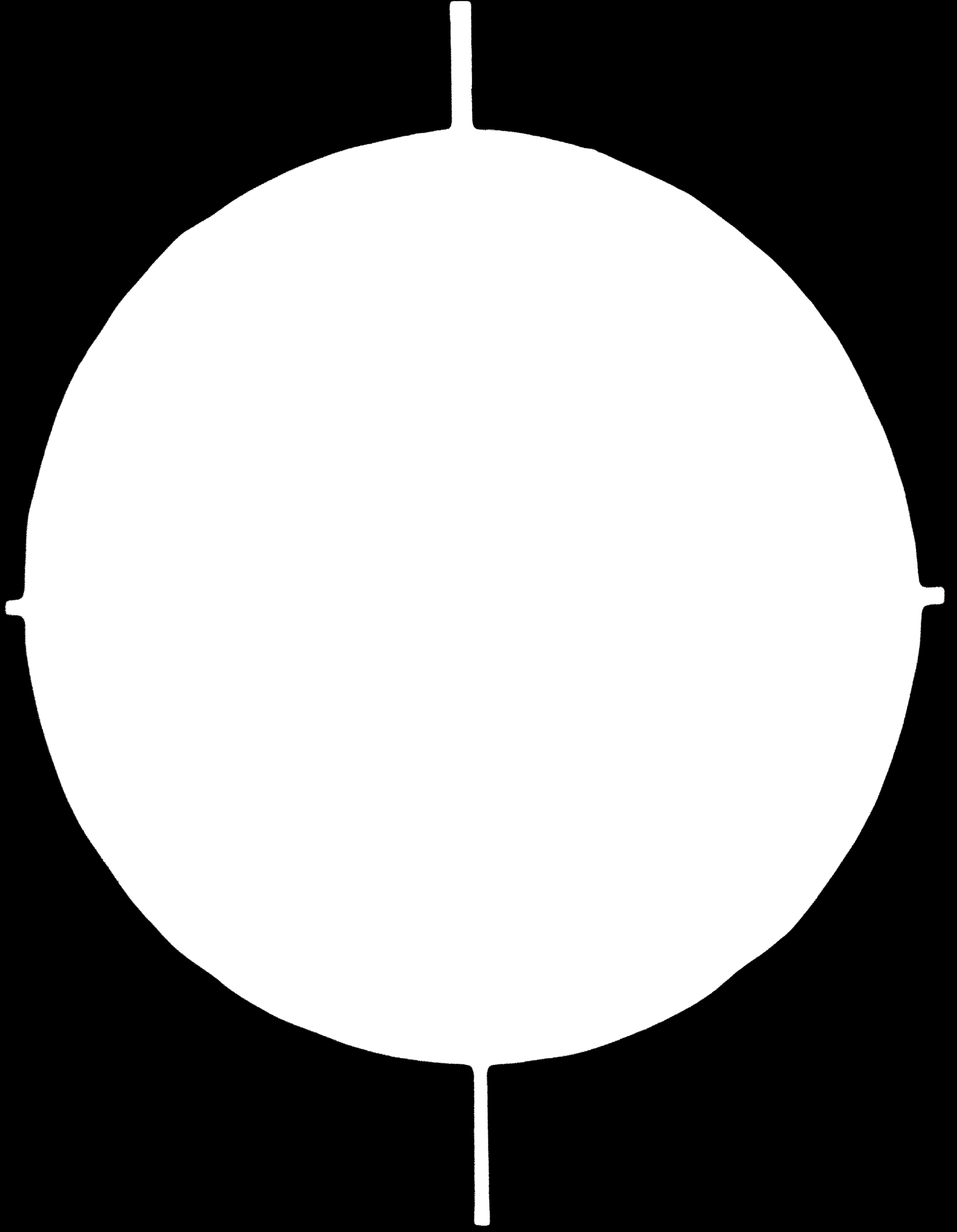
Plywood From Singapore
1970

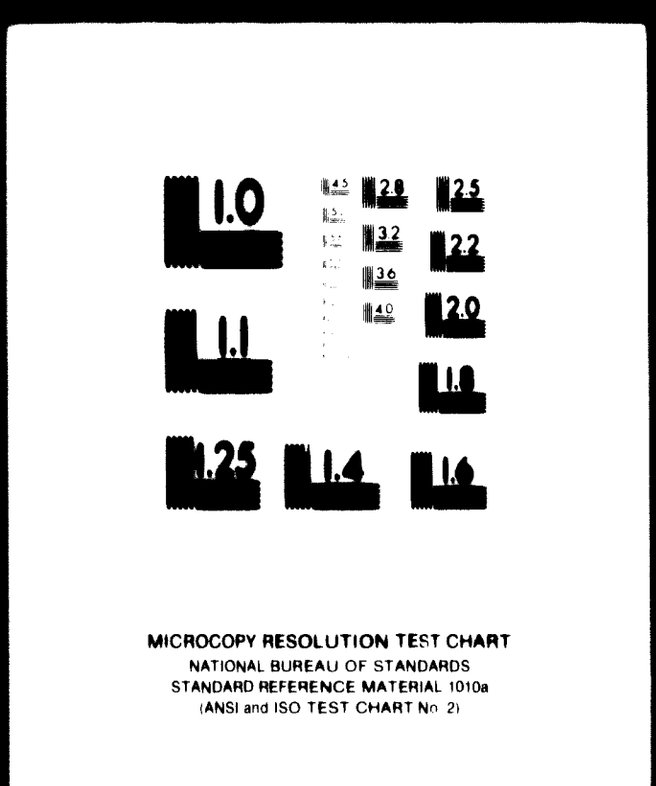
1967		1968		1969		1970	
Quantity	Value FOB	Quantity	Value FOB	Quantity	ValueFOB	Quantity	Value FOB
163,202,066.24	8,133,846	253,314,368.45	11,557,696	191,107,872.19	9,316,096	132,878,235.02	7,631,911
77,189,015.08	12,346,995	120,844,732.96	19,352,636	191,105,777.63	30,045,670	257,199,754.81	41,055,043
2,006,222.75	1,696,638	28,053,004.68	4,599,296	44,707,772.07	6,928,955	25,244,254.36	4,301,456
188,122.00	59,450	75,089.93	31,673	569,645.00	289,094	1,130,553.13	342,242
1,655.00	858	2,739.70	2,154	3,301.72	826	250.20	219
249,587,181.07	22,237,787	402,289,935.72	35,543,455	427,821,368.61	46,520,643	416,453,047	53,330,871

SECTION 2

C-846

85.10.21
AD.87.04
ILL 5.5+10




1.0
1.1
1.25
1.4
1.6
2.0
2.2
2.5
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

TIMBER PRESERVATION PRODUCTION FROM 1965 - 1969

Preservations Used	Annual Production (tons)				
	1965	1966	1967	1968	1969
Water borne preservation	3,960	5,980	6,000	4,435	5,194
Celcure	3,285	3,170	2,229	2,678	930
Tanalith	1,800	794	3,746	7,197	3,403
Total :	9,045	9,944	11,975	14,310	9,527

Source : Timber Office, Ministry of Finance

IMPORT OF LOGS INTO SINGAPORE
(tons)

Countries	1965	1966	1967	1968	1969	1970	1971
Indonesia	-	negligible	16,607	28,950	47,804	73,646	117,007
Elsewhere	445	1,954	304	92	-	472	
Total overseas ..	445	1,954	16,791	29,042	47,804	74,118	
W. Malaysia	573,689	773,046	736,771	818,948	947,237	1,072,000	750,000
Total Import ..	574,134	775,000	753,562	848,990	995,121	1,146,118	
Less Export ..	17,024	31,036	7,878	4,342	9,600	5,969	
Total net import ..	557,110	743,964	745,684	836,648	985,521	1,140,149	
Tonk Import	10,812	8,909	10,925	13,247			

+ Estimated figure

Principle Statistics on the Manufacture of Plywood & Veneer

$'000

Year	No. of Establishments	No. of Workers	Total Inputs	Work Given Out	Other Cost of production	Output	Value Added	Employees' Remuneration	Capital Expenditure
1965	6*	878	5,723	24	1,265	10,523	4,776	2,652	3,273
1966	6**	1,682	10,315	1	2,808	17,811	7,496	3,974	2,321
1967	6	1,742	10,666	-	3,306	19,774	9,107	4,676	817
1968	6	2,038	14,..01	-	3,217	31,855	17,454	5,524	5,917
1969	6	2,712	20,061	4	4,397	41,633	21,..68	9,076	6,534
1970	8	3,683	30,881	33	9,805	56,411	2[illegible],497	10,640	16,057

Source : Census of Industrial Production, 1965 - 1970

**Activities of 4 establishments in the manufacture of plywood are grouped with 2 establishments in general and jobbing carpentry.

* Activities of 5 establishments in the manufacture of plywood and veneer are grouped with 1 establishment in general and jobbing carpentry

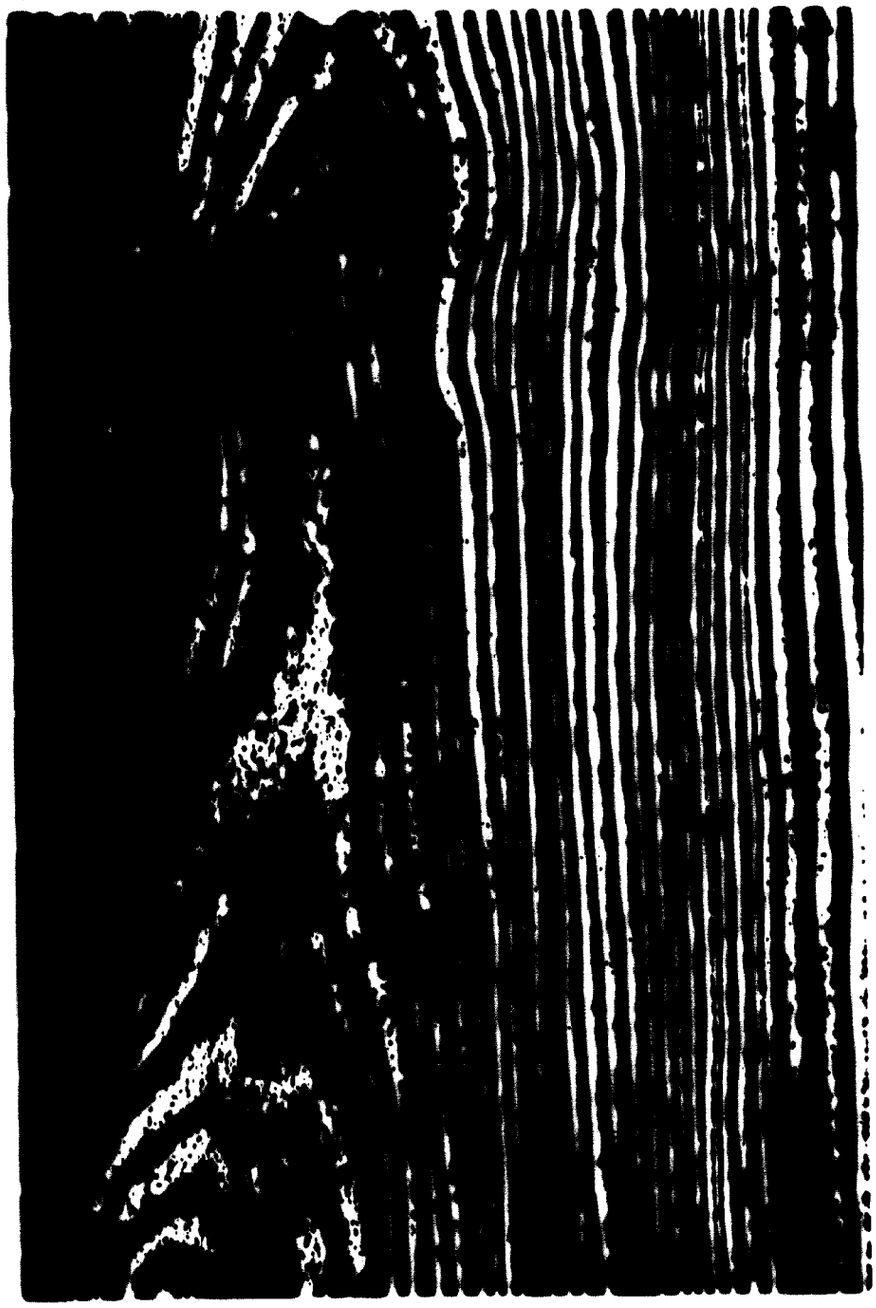
-lsc

manual of production control procedures for the small scale furniture industry

prepared by

light industries services · edb

1972



小型木製工業生產管理程序手冊

輕工業服務處

ANNEX A

FOREWORD

Furniture manufacturing is one of the oldest traditional industries in Singapore. While retaining the unique ingenuity and craft skills, most of our manufacturers have unfortunately also retained to a large extent, organisation systems and working procedures which are outdated. Such functional shortcomings must be overcomed if the industry is to increase production geared for the export market. As one of the functions of Light Industries Services, a division of Economic Development Board, in assisting and stimulating development in the light and small industries sector, various services have been provided to the woodworking industry.

In this context, particular attention has been drawn to assist firms in improving efficiency in their operation. This would enable firms of progressive outlook to compete in the international markets. Since 1969, several furniture manufacturers have made use of the services of a special LIS/UNIDO unit, the Woodworking Team to fulfill the role as mentioned above. A wide range of subjects have been covered by the Team in their assistance programme ranging from plant layout to selection of machinery, processing methods, maintenance, production control and product design.

In view of the lack of adequate appreciation among the furniture industry of proper working procedures, great emphasis has been given by Light Industries Services in providing assistance in this respect and in elaborating, in a systematic form, suitable reference materials. The Manual of Production Procedures is the result of the Team's efforts and it gives me great pleasure to introduce it to the furniture industry.

Michael Yap
Ag. Director
Light Industries Services

30 May 1972

INTRODUCTION

The Manual originated from the need of providing the small scale furniture industry and relevant training institutions with a suitable reference in Production Control Procedures, in order to facilitate the transition of this sector of the industry from the handicraft system to the factory system. In fact, the single major problem in the development of the furniture industry is that it tends to retain the working methods and the human approach of the handicraft system which are basically conflicting and inconsistent with the nature of the factory system.

In the custom production of handicraft shop, management is very simple as the worker is left largely to his own initiative and the planning of fabrication methods depend mostly on his handiwork and ingenuity. Here the skilled craftsman generally carries out on his own all the tasks related to the processing of the goods, from the raw material stage to completion.

The factory system replaces the custom production with the fabrication and assembly of the standard interchangeable parts, carried out by adopting a strict division of labour and transferring skill from the worker to the machine. This results in an increase of the proportion of semi-skilled workers utilised in the output of the goods and makes it possible to manufacture economically standard products in large quantities. On the other hand, the factory system brings about the managerial problem of co-ordinating and controlling men, materials, and machines in order to attain the desired quantity and quality of goods.

Hence the necessity to establish Production Control Procedures, designed mainly to define "what" the activities of the manufacturing operations are and "how" the activities, duties and responsibilities are to be carried on.

Such written procedures are necessary not only for the guidance of employees performing the work - so that it is done according to instructions - but also because many of the

important procedures are related to several centres of responsibilities. For example, the procedure related to the 'Day-Rate Processing Schedule' Form serves to: record the time spent by workers on each job; check off completed work from production schedules; make up worker's payroll; charge working time to particular products in order to get actual cost and to record the data for future estimating.

Unless standard procedures are developed for contacts between and within departments, executives are overburdened with details and do not have time to deal with broader problems of the operation. Standard procedures, beside relieving executives of the routine duties, also provide a means for systematic management and control. In fact, once the procedures have been developed and authorised by management, common activities do not come to the executives attention again until a precedural change is necessary. This principle is known as MANAGEMENT BY EXCEPTIONS.

By introducing method and order, the procedures reduce cost, improve control and help to identify responsibilities for mistakes. In addition, they provide a ready-reference in respect to executives instructions and decisions.

The Production Control Procedures proposed in this Manual are intended to serve as guide only. There is no such a thing as a standard procedures system which can fit, without necessary adaptations, into the specific requirements of any one manufacturer. The type of production, the number of products made, the size of the operation, and the capabilities and attitude of individuals involved will have a part in determining how to adapt the proposed procedures.

Wide use was made of flow charts to complement the text and as a means of getting across the essence of the procedures. The layout of Forms was thoroughly studied in a systematic way so as to facilitate the adaptation of the procedures. The Manual was devised in such a way as to allow for additions and changes without upsetting the overall order

and usefulness of the Manual itself. To this end, the pages of each section as well as each appendix are numerated separately. This arrangement will also permit insertions in the Manual from time to time of revised and additional materials and further elaboration of the existing topics.

The preparation of the Manual was undertaken as a Development Project by the Woodworking Team LIS/UNIDO, during my 2½ years assignment with the Government of Singapore and was elaborated to fulfill the specific needs of the small scale furniture industry in Singapore, but it may also serve as a standard reference for the furniture industry elsewhere. In fact, the Manual is believed to be the first of its kind and I hope that it may constitute a valuable, even if modest, contribution towards the rationalisation of the small scale furniture industry.

To conclude these introductory notes, I would like to emphasise the important part played by the LIS counterparts in the implementation of the Manual. In particular, I would like to mention the contributions by Mr. Foo Siew King and Mr. Lim Chin Heng.

Pietro Borretti
United Nations (UNIDO) Woodworking Adviser

30 May 1972

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1 - ORGANISATION STRUCTURE

1.1 Objectives & Guidelines for Plant Operation

Any industrial enterprise, regardless of its size, must be based on a well designed organisation structure in order to achieve effective co-ordination, and control of the policies and functions of the firm.

The main objectives in the development of a sound organisation structure may be defined as follows :

i) Definition of scope of the business operation.

ii) Separation of the activities logically and set up distinct functional units.

iii) Delegation of authority and responsibility.

iv) Assignment of specific duties to executive personnel.

v) Preparation of a functional Organisation Chart.

vi) Selection of Production Supervisor.

1.2 Scope of the Business Operation

1.2.1 For the purpose of this Manual it is assumed that the organisation structure will be suitable to carry out two types of production programmes :

i) Production programme which caters for the need of Standard Furniture.

ii) Production programme which caters for Non-Standard Furniture.

1.2.2 The first programme does not involve an immediate customer but it is designed to appeal to a wide cross-section of local and/or export markets. In this case furniture is produced for stock and it is subsequently delivered to customers when specific orders are placed. This programme can be carried out by making use of mass production methods and employing unskilled and semi-skilled labour under the direct supervision of the company.

1.2.3 The second programme is based on specific customers' requirements and it is meant to be strictly complementary to the production of Standard Furniture. This is an expensive form of manufacture which is best left to small shops because it cannot be carried out by taking advantage of mass production methods. Therefore, the plant shall try to avoid the manufacture of individual items. However, in many cases, manufacture of individual items must be accepted and cannot be totally avoided. Normally this programme will be carried out by "Factory Sub-contractors" employing their own team of workers (ref. Section 9 paragraph 9.2.4).

1.2.4 Other assumptions in respect to business operation relevant to the Manual are :

i) The company will acquire Standard Designs from external sources, rather than set up its own design facilities. In fact, it is hardly possible for a small scale plant to employ a fully qualified designer.

ii) In order to operate with the lowest possible overhead, the administrative side of the company should be located in the same premises as the plant. Both Administration and Production will share the

same office space so that common files may be used to reduce paper work to a minimum.

1.3 Separation of Activities

1.3.1 All the activities of any industrial enterprise are to be clearly separated on the basis of primary functions according to the character and needs of the business activities of the firm. The organisation structure must be built around functions rather than around individuals. An organisation built on individuals, no matter how competent they may be, will lack permanence and cannot perform at a meaningful level of efficiency.

1.3.2 Once the separation of functions and their logical sub-divisions are definite then it may be possible for a small firm to group two or more related sub-functions so that they may be handled by one person.

1.3.3 The company is so organised that a Department is set up to perform each function. Each Department, in turn, is broken down into sub-divisions which executes phases of functions (sub-functions).

1.3.4 The primary functions may group as follows :

i) Top Management sets the overall policy of the business and is responsible for the control of the overall operation.

ii) Production Department covers all plant activities directly and indirectly related to the manufacturing process.

iii) Administration Department includes all the activities of administrative nature related to the company as a whole. Sales is also considered as a sub-division of the Administration function although it is not strictly related to it.

1.4 Delegation of Authority & Responsibility

1.4.1 No industrial establishment can operate efficiently unless authority and responsibility are clearly defined and inter-related. Authority should be delegated as far down in the organisation structure as possible, and responsibility should go together with the authority necessary to control the relevant activities.

1.4.2 An important factor in organisation is to determine the respective levels of executive ranks, although fine shades of distinction in rank are unnecessary as well as impossible. In larger plants there are many levels reflecting the complexity of the organisation. For the purpose of small plants it may be practical to limit the rank of Manager to the entrepreneur himself or to the Managing Director. The rank of authority at departmental level will be that of Supervisor. At sub-function level the rank denomination will be that of Foremen and, at one step down, Group Leader. For other sub-functions, such as Stores/Delivery, Purchasing, Personnel etc. the rank of authority may be that of Section Head depending on whether the corresponding activities involve the supervision of subordinates, otherwise the denomination 'Clerk' will apply.

1.5 Assignment of duties to executive personnel

1.5.1 Duties are assigned to the various departments and their sub-divisions on the basis of the functional activities. In larger plants, the duties of every individual officer should be confined to a single leading activity. However, in small plants it may be necessary for one officer to handle two or more related functions.

1.5.2 When the organisation structure has been developed, titles of positions at each level of authority must be standardised and specific duties (Job Description) should be assigned to each position.

1.5.3 In small plants of the type envisaged in this Manual the executives range of personnel may be defined as follows :

i) Top executive, that is, the Entrepreneur-cum-Manager or alternatively the Managing Director.

ii) Senior executives or head of departments, including Administration Supervisor and Production Supervisor.

1.5.4 Top executives are individuals who discharge major responsibilities[1] and exercise a wide range of authority[2]. They are directly

---

1 Authority = The right of one person to require another to fulfil specific duties. Duties are the activities a person is required to perform.

2 Responsibility = The obligation and accountability for the performance of duties.

concerned with the formulation and application of the basic policies of the company. They establish the control and co-ordination between principal activities of the company, that is, in our case, Administration and Production.

1.5.5 Senior executives, on the other hand, carry heavy responsibilities and exercise full authority in their respective areas of action. They are rated as executives head of departments of which they are in charge. Their task is to break down the company's basic policies, particularly the ones governing their lines of work, into directive regulations and to develop the fundamental procedures for their respective departments.

1.5.6 In the procedures elaborated in this Manual, various activities such as production scheduling and control - which are related to sub-functions of the Production Department - are performed by the Production Supervisor himself. The reason being that in smaller plants the Production Supervisor, or his Assistant, are bound to get involved in these activities. However, in the functional type Organisation Chart, presented in the Manual, all sub-functions are charted separately so that the performance of the relevant activities may be assigned according to the requirements of specific plants.

1.5.7 Similarly, the Manager of smaller firms may possibly supervise the Administrative function until the expansion of the business justify the employment of an Administration Supervisor.

1.6 Preparation of Functional Organisation Chart

1.6.1 It is essential, even in small companies, to draw up Organisation Charts (ref. appendix 021) so that all persons may know how they fit into the overall set up and see the relationship of their groups to the remainder of the company.

1.6.2 As said earlier the organisation must be built around function, not individuals. Consequently the Chart will tell "where" in the company a function or sub-function is placed and show graphically the breakdown into Departments and Sections. It also indicate the space of executive control and the level of authority.

1.6.3 The proposed Chart is intended as a guideline only, and modifications may be introduced to adapt it to the particular company. It should be noted that there is no such thing as a standard chart; there are chart patterns but none can be applied directly without changes.

1.7 Selection of Production Supervisors

1.7.1 A good Production Supervisor is the best production tool to be found. Larger plants can afford elaborate organisation structure with highly specialised and highly paid professionals. But this type of personnel is seldom within the reach of the small scale industry.

1.7.2 In small scale industry the Production Supervisor is the backbone of the factory. The planning co-ordination and the maximum utilisation of labour, materials and plant

facilities depend mostly on his skill, knowledge and also his ability to motivate and lead. He is a highly versatile individual who is not only concerned with the actual making of products but also with the activities of the plant related to processing. He must be a highly responsible person fully familiar with woodworking technology and plant management. He should also have an appreciation of certain management functions which are not of direct concern to him. Cost Accounting, in particular, is a very important area of modern management. Therefore, the Production Supervisor should also be acquainted with its functions, purposes and procedures, so that he may be cost-conscious in the planning and control of production activities.

SECTION 2 - SALES FORECAST

2.1 Sales Data

2.1.1 Before production can be planned and scheduled, Sales must be forecasted to determine "what", "how much" and "when" to manufacture. The larger the period for which Sales can accurately be forecasted, the easier it is to plan production and achieve a uniform level of output.

2.1.2 For repetitive manufacture of Standard Furniture the Sales will prepare an Estimate/Sales Budget showing the quantity that should be marketed in the next period, say quarter or half year.

2.1.3 As for the requirements of Non-Standard Furniture manufactured to customer's requirements, the Sales will usually prepare a Sales Budget listing Orders received (backlog) and expected Orders (forecast).

2.2 Co-operation [illegible]

Sales forecasts and customers' Orders provide the information for scheduling. Therefore, close co-operation should exist between the Production Department and the Sales. For instance, the Production Supervisor should, when necessary, make special provisions to fill "rush" Orders and thus help in gaining additional business. On the other hand, the Sales should forecast sufficiently far in advance to enable the Production Department to plan steady production, employment and procurement of materials.

3 - PRODUCT & PROCESSES SPECIFICATIONS

3.1. Objectives

3.1.1 'Product & Process Specifications' consist of instructions on "how" to make goods and perform operations. The manufacture of parts and the assembly of products, whether to stock or to customer's Order require the preparation of some basic 'Product & Processes Specifications' which convey essential information for production control and are also needed for the compilation of Estimated Costs of products.

3.1.2 Without a minimum of pre-established specifications no rational planning and control of the manufacturing process can be accomplished. For example, without an estimated breakdown of materials requirements for each Order, it is not possible to anticipate needed parts accurately. This results in delay in the availability of materials and indiscriminate usage of materials regardless of actual requirements.

3.1.3 On the other hand, the absence of pre-established processing flow and processing times, results in inflated labour costs and delay in completion schedules.

3.1.4 In the instance of Non-Standard Furniture the availability of adequate specifications will have an important bearing on quoting the right price and getting the contract to manufacture the goods.

3.2 [illegible]

3.2.1 The following documents are related

to 'Product & Processes Specications' :

i) Full Size Drawings (appendix 033)

ii) Scale Drawings (appendix 031)

iii) Isometric Drawings (appendix 035)

iv) Part Drawings (appendix 032)

v) Perspective Drawings (appendix 034)

vi) Bill of Materials (appendix 041)

vii) Operation Sheets (appendix 036)

3.2.2 For the case of Standard Furniture the documents are prepared under the responsibility of the Production Supervisor, but if original designs are acquired from outside sources, it is likely that drawings will also be obtained. When designs are acquired on licence basis all the relevant 'Product & Processes Specifications' will usually be provided as part of a package deal. The documents for Standard Furniture, once established, will become standard reference so long as products or processes are not modified.

3.2.3 'Scale Drawings' for Non-Standard Furniture will usually be supplied by the customer. From this reference 'Bill of Materials' and possibly 'Full Size Drawings' will be prepared by the Factory Sub-contractors and approved by the Production Supervisor. The three production documents mentioned above are, in most cases, the only ones required, in connection with the production of Non-Standard Products unless substantial quantities are ordered.

3.3 Drawings

3.3.1 Definition

Drawings show the design of the product in graphic form and are generally confined to depicting physical dimensions and tolerances (acceptable deviations from exact measurements, shapes and contours which the product is to have). It is a basic rule not to attempt to read drawings by scaling them. In fact, the only valid reference in this respect shall be obtained by the dimension figures given on the drawings.

3.3.2 Full Size Drawings (ref. appendix 033)

They depict products in full scale (1.1) and are necessary when designs involve complex shapes and contours, but they are otherwise dispensed with in normal cases.

3.3.3 Scale Drawings (ref. appendix 031)

'Scale Drawings' constitute the minimum indispensable reference in the production of any product. They reproduce the design according to a given reduced scale (for instance 1:2.5, 1.5, 1:10) with critical details possibly shown in 1:1 scale.

3.3.4 Isometric Drawings (ref. appendix 035)

'Isometric Drawings' are especially necessary in the instance of complex piece of furniture involving several sub-assembling and a great number of component parts. They present the product in a "exploded" view showing the relationship among parts identified by code numbers.

3.3.5 Part Drawings (ref. appendix 032)

'Part Drawings' will complement 'Scale Drawings' by showing on separate sheets each component part of the product with detailed dimensions. The back of the 'Part Drawing' shows the 'Part Process Flow' which will illustrate for reference of Foremen and workers, the modifications the part is expected to undergo at each processing station. The pre-established sequence, according to which the processing steps are listed will, among other things, provide reference for the move of materials between processing stations. Depending on the complexity of the product, data on required tools and attachments will be listed, which in large plants are usually indicated in elaborate Route Sheets. The record of parts completed and rejected at each machining station will be entered on the back of the 'Part Drawing' by the Machine Operator while the Foreman will investigate sources of spoilage and arrange for replacement of spoiled parts (ref. paragraph 8.7.6-3).

3.3.6 Perspective Drawings (ref. appendix 034)

'Perspective Drawings' represent products in a 3 dimension view and are essential when designs of complex nature are manufactured. They are an essential aid in conveying the designer's conception of new designs before prototypes may be prepared.

3.3.7 Bill of Materials (ref. appendix 041)

-1. The main function of the 'Bill of Materials' is to anticipate Direct Materials quantities, sizes and cost and to authorise and control materials issued to production.

-2. There are two types of 'Bill of Materials'. One for Standard Furniture (ref. appendix 041, Form 041-A) and the other for Non-Standard Furniture (ref. appendix 041, Form 041-B).

-3. The 'Bill of Materials' for Standard Furniture is made of a "master" copy and two "variable" copies. The former contains information on material size and cost for one unit of product. The "master" copy is prepared whenever new standard products are designed, and it is filed for permanent reference. Subsequently, when new 'Production Orders' are issued for the particular product, the "variable" copies are compiled by extracting materials requirements data from the "master" copy.

3.3.8 Operation Sheets (ref. appendix 036)

This production document constitutes an essential tool for the scheduling and control of work in progress of Standard Furniture. Through the 'Operation Sheet' the Production Supervisor and the Foremen will provide the following data :

i) Processing sequence, through the various processing stations, of each part of a given product.

ii) Arrangement of the flow of each part in order of priority in respect to each other, in order that parts and sub-assemblies requiring more time for processing are started at an earlier date.

iii) Indication of when two or more parts of the same product take the same operation in processing so that these items may be machined at the same time thus saving machine set-up time.

iv) Estimated processing time (including machine running time and machine set-up time) for each operation related to each part of the product. Estimated times usually refer to the production of a given product lot, that is, a given quantity of product units.

v) Estimated processing time for tasks other than machining, such as assembly, finishing etc.

vi) Records of actual times as against estimated times.

For Standard Furniture, the 'Operation Sheet' will constitute an important reference for performance of the manufacture process, in that it provides the breakdown of actual time spent on each operation. These data are critical in the establishment of past performance reference and for process analysis.

4 - ANALYSIS OF PLANT CAPACITY AND LOAD

4.1 Objectives

4.1.1 The Manager and Sales personnel will revise periodically the pre-established Sales Estimates. The revision will be based on current sales prospects and the 'Periodical Production Report' (ref. 7.4.) showing current stocks on hand, orders on hand and deliveries. But, before projected Sales Estimates are approved and adopted as the plan of operation, the Production Supervisor shall compute the capacity needed and check it against the capacity available under normal circumstances. Overall capacity figures will determine whether there is need for overtime work, additional shifts, and whether additional equipment should be purchased and the plant expanded. The "Load and Capacity" data will provide the Sales with information on the kind of plant capacity available for new work which might be negotiable with customers.

4.1.2 The capacity must be expressed in some general overall measure such as Man-days (or Man-hours) and Machine-hours. The Man-hours measure will be used to estimate the processing requirements related to assembly, finishing and upholstery tasks. The Machine-hours measure will be adopted to estimate the machining-time tasks.

4.2 Man-hour Capacity/Load

4.2.1 In the instance of Man-hours Capacity/Load, the number of Direct Labour Man-hours needed to assemble, finish and upholster one finished unit of each product,

can be obtained from past records, which in the instance of Standard Furniture are recorded in the 'Operation Sheets' (ref. 3.4.8 & appendix 036). The Man-hours are multiplied by the quantity required by the Sales. The sum of these requirements for various products each month shows the number of total Man-hours required.

4.2.2 The number of worker's Man-hours available per week on a shift of 8 hours per day (allowing half day on Saturday and holiday on Sunday) is theoretically equal to 44. However, we will not get 8 hours production per day because it will take time for the worker to start up in the morning. Similarly, time losses will occur before and after lunch break and at the end of the day. Therefore, the weekly effective Man-hours per worker will be taken as 40. A specimen of 'Man Capacity/Load Record' is shown below. The Record serves to tabulate the total estimated load of assembly, finishing and upholstery tasks, against the available Man-hours capacity. It will also show the unallocated capacity available for use.

'MAN HOURS CAPACITY/LOAD RECORD' — PERIOD:

Task	Order No. product & quantity / Weekly man/hrs. capacity	004 CHAIR MODEL [illegible] 1000pcs.	010 TABLE MODEL T-2 100pcs.		Total Load	Available Capacity
Assembly	[illegible] men x 40 = [illegible] hrs.					
Finish	20 men x 40 = [illegible] hrs.					
Upholstery	10 men x 40 = 400 hrs.					
Sub-Contractor	6 men x 40 = 240 hrs.					

4.3 Machine-hours Capacity Load

4.3.1 Similarly to Man-hours requirements, the number of Machine-hours needed to machine one unit of each Standard Product will be derived from past performance records, or time study where feasible. Specific reference on Machine-hours requirements is contained in the respective 'Operation Sheets' of each item of Standard Furniture.

4.3.2 The sum of Machine-hours requirements for various products each month will show the respective needed capacity for each machine. In order to arrive at a realistic evaluation of the load, the 'Operation Sheet' should indicate separately both the expected machine running time (necessary to perform the operation) and the set-up-time (or change time) needed to change over and adjust the machine for the operation. This will serve as a guide in determining the "optimum batch quantity" (ref. 5.4) as balanced against the total units of products required per month. For example, the machining of a 50 unit batch product requires 50 minutes of 'running time' plus 10 minutes set-up-time, equals 60 minutes for 50 pieces. On the other hand, by increasing the production batch size of the same product to 200, the operation will take a total of 210 minutes - not 240 as in the case of 4 batches of 50 units.

4.3.3 The available weekly capacity of Machine-hours per machine can be set at 40, that is, the same as for the Man-hours capacity. However, an additional allowance of 10% should be applied to compensate for time loss due to maintenance work on the machine.

4.3.4 A specimen of the 'Machine-hours Capacity/Load Record' is shown below. The Record serves to tabulate the total estimated machine load against the available Machine-hours capacity and shows the amount of unallocated capacity available for use.

'MACHINE CAPACITY/LOAD RECORD'					PERIOD:		
Machine	Order No. product & quantity / Weekly machine hrs. capacity	[illegible] CHAIR MODEL DC-[illegible] [illegible] pcs.	[illegible] TABLE MODEL T-[illegible] 100 pcs.		Total Load	10% Allowance	Available Capacity
1. Cross cut	2 Machines [illegible]hrs.						
2. Band Saw	2 Machines [illegible]hrs.						
3. Moulder	1 Machine 40hrs.						
4. Tenoner	1 Machine 40hrs.						

5 - AUTHORITY TO MANUFACTURE

5.1 Objectives

Once the projected Sales Estimates, and specific customers' Orders are approved as the plan of operation on the basis of Plant Capacity & Load Analysis, Manufacturing Orders shall have to be prepared as starting point for scheduling activities.

Because a factory needs to make what will sell and to avoid making what will not sell, all production must be specifically authorised. In fact, the Production Department has no authority of its own to transform materials into specific products. Through due authorisation the Production is notified of items to be produced and is authorised to perform the necessary work by use of men, materials and machines. Producing authority covers the making of only one particular lot of goods. No other product than those authorised may be used without further specific authorisation.

5.2 Levels of Authority to manufacture and responsibility

Manufacturing authority comprises of two levels :

i) Producing Authority
This level refers to the authority to go ahead and make products and generally falls within the responsibility of the Manager himself acting in consultation with Sales and Production.

ii) Processing Authority
This refers to the instructions on "how" to make goods and perform operations

(ref. Section 3). This level of responsibility falls within the responsibility of the Production Supervisor.

Procedure of authorisation to manufacture covers both Standard Furniture to be made for stock and Non-Standard Furniture to be made to customer's requirements.

5.3 Producing Authority

5.3.1 Producing Authority consists of one main Form (ref. appendix 021) which may function alternatively as :

i) 'Sales/Production Order' (ref. Flow Chart appendix 013).

ii) 'Production Order' (ref. Flow Chart appendix 012).

5.3.2 The Orders provide a starting point for control, state quantities required and completion or delivery dates, and serve as a basis for compiling and allocating costs.

5.3.3 The 'Sales/Production Order' is authorised by the Manager and is based on customer's requirements and may include Non-Standard Furniture and/or final processing (finishing and upholstery) of Standard Furniture from stock. The Form has been devised as to function as Sales/Offer as well, thus eliminating the need for Quotation and Confirmation of Order (Order Acknowledgement).

5.3.4 Alternatively, the Order Form is issued as 'Production Order' for the manufacture of Standard Furniture for stock. The 'Production Order' is usually authorised by the Production Supervisor provided a replenishment of stock policy (minimum levels) has

been pre-established with the approval of the Manager. In this case, 'Stock Cards' (ref. appendix 043, Form 043-B) become the source of authority to replenish stock of Standard Furniture as they are depleted (ref. paragraph 8.8.1-1)

5.3.5 Detailed procedures related to 'Sales/Production Order' and 'Production Order' are elaborated in appendix 021. The Form is hereafter generally referred to as 'Sales/Production Order' (S/P.O.) unless in the text the Form is specifically referring to the manufacture of Standard Furniture for stock in which case the word 'Production Order' (P.O.) will be made use of.

5.3.6 In addition to 'Sales/Production Order' and 'Production Order', a 'Miscellaneous Work Order' will be issued to constitute producing authority needed for various type of re-work and repairs. The Order is normally issued by the Production Supervisor. The Form is shown in appendix 022 but its procedure is not elaborated in this Manual. The Form will be entered with the progressive record of expenses in materials and labour related to the job in order to simplify the cost determination of small Orders.

5.4 Lot Size for Production Orders

The Manager in co-operation with Production and Accounts will consider economical lot size (an optimum size to process at one time) of Standard Furniture by balancing the "preparation costs" of an Order against its "carrying charges". Small plants cannot afford detailed computation in this respect. However, it should be appreciated that, generally, the larger the lot size or quantity processed at one time, the lower the prepara-

tion cost (e.g. the machine set-up cost) and the higher the carrying charges (e.g. interest on capital tied up in inventories, storage space, insurance and deterioration). Therefore, the optimum lot size for a 'Production Order' is that quantity for which the sum of the preparation costs and the carrying charges are at a minimum.

5.5 Orders Priorities

The Orders Priorities - that is, the sequence in which new Orders are to be put into manufacture - shall be indicated by classifying the Orders as "Regular" "Rush" or "Stock" Orders. The placing of an Order in a given priority class, establishes the relative importance of the Order as compared to other Orders either scheduled or already being processed.

6 - SCHEDULING

6.1 Objectives

Scheduling may be defined as output programme based mainly on such factors as 'Sales Requirements', 'Machine & Man Load Records' and 'Operation Sheets'. The main objectives of Scheduling can be defined as follows :

i) Establish when and at what rate products will be manufactured.

ii) Determine relative times at which specific activities shall occur in the manufacture of given quantities of products.

iii) Provide the quantity of furniture required to fill specific customers' Orders and maintain Finished Goods inventories at levels pre-determined by the management.

Scheduling achieves economy in manufacturing when it establishes a steady rate of output with a minimum of working capital, that is, the shortest processing time, a rapid turnover of inventories and a minimum average inventory.

6.2 Levels of Scheduling

There are two levels of Scheduling :

i) Overall Scheduling
which refers to the scheduling of output requirements of Finished Goods for the plant as a whole.

ii) Process Scheduling
which refers to the detailed scheduling of work related to specific equipment and

processing tasks (machining, assembling, finishing, upholstery).

Both Scheduling levels shall be adaptable to the need of "mixed manufacture", that is, repetitive production of Standard Furniture for stock, and a limited amount of Non-Standard Furniture made to customer's requirements.

6.3 Overall Scheduling [illegible] Responsibility

6.3.1 Definition

-1. Overall Scheduling is the responsibility of the Production Supervisor and is formulated from Sales Forecast as well as customer's Orders. Its main purpose is to meet Sales requirements, promised delivery dates and distribute the total working load in such a way as to achieve maximum utilisation of labour and equipment.

-2. The Overall Scheduling will be arranged according to Order priority (ref. paragraph 5.5), that is, the sequence in which new Orders are to be put into production. The Overall Scheduling data will be entered as required on the Production Control Board (ref. appendix 023).

6.3.2 Overall Scheduling for the machining of Standard Furniture for Stock

-1. The Scheduling shall usually be computed on monthly basis and show quantities of each product to be machined in the given period. The Schedule will determine the priority and rate of output of the various items necessary to replenish stocks of Finished Goods. The time required for the production cycle of each product will be derived from past performance

as recorded on 'Operation Sheets'.

-2. In the production of Standard Furniture it is often necessary to get the final assembly under way as soon as possible in order to fulfil Sales requirements and maintain a balanced load of the Assembly Section. This shall be kept into account when preparing the Overall Schedule and shall be indicated by the notation EAR (Early Assembly Requirement) on the Overall Scheduling & Control Board. Details of EAR method are given in paragraph 6.4.2-4.

6.3.3 Overall Scheduling for Non-Standard Furniture and for further processing of Standard Furniture from Stock

-1. In the instance of Non-Standard Furniture and further processing (finishing and/or upholstery) of Standard Furniture to customer's requirements, the Overall Scheduling will be arranged on day-to-day basis upon issuing of the relevant 'Sales/Production Order'. The time required for processing tasks related to further processing of Standard Furniture will be taken from the relevant 'Operation Sheets' and entered on the 'Sales/Production Order' Form prior to the preparation of the Overall Scheduling. When Non-Standard Furniture is ordered, the time required for each processing task shall have to be estimated from past experience and entered as above.

-2. The man-days lead entered on the Production copies of the 'Sales/Production Order' will be first allocated tentatively according to promised delivery date of Sales-Offer sent out to the customer. Promised delivery dates should not be given until the possibility of meeting them has been established. As soon as the customer accepts

the offer (within the period specified in the offer) the load will be converted into effective schedule.

6.4 Process scheduling & its responsibility

6.4.1 Purpose, Main Procedure & Responsibility

-1. The main purpose of Process Scheduling is to fulfil the output target and the completion dates set by the Overall Scheduling. Scheduling is also meant to keep a constant supply of work ahead of each piece of equipment and direct labour of each Processing Section. It will maintain the correct sequence of work at each machine and stage of processing in the fabrication of parts and in the assembly of products. Process Scheduling shall afford sufficient flexibility to accommodate unforeseen situations and interruptions as they occur in manufacturing.

-2. Process Scheduling is the responsibility of the Foremen of the Processing Sections and of the Factory Sub-contractors. Both are given scheduled dates within which to complete the respective work assigned to them by the Production Supervisor.

6.4.2 Process Scheduling by the Foremen of Processing Sections

-1. The Process Scheduling carried out by the Foremen of the Processing Sections will include the following :

i) Scheduling of Machining & Assembly of Standard Products for Stock.

ii) Scheduling of Further Processing (Finishing & Upholstery) of Standard Furniture from Stock to customer's requirements.

iii) Scheduling of Upholstery & Finishing tasks of Non-Standard Furniture machined and assembled by the Factory Sub-conttactor.

-2. The Foremen of the Processing Sections shall arrange the detailed schedule of their respective work according to the completion dates established by the Production Supervisor in the Overall Scheduling, and stated in the Foremen's copies of the 'Sales/Production Order'. The Foremen shall use the wanted dates in processing the products in priority order.

-3. In the instance of machining tasks, the scheduling pattern remains unchanged so long as the products and processing methods are the same. In fact no detailed scheduling will be carried out to show the load of each piece of equipment at any given time. Instead the Foreman will carry out Process Scheduling by referring to Orders priorities and to the flow of operations stated in the 'Operation Sheets' of each product. From the data the Foreman will schedule labour load on the 'Day-Rate Processing Schedule & Report' (ref. appendix 051). In fact, in small plants it is not feasible to try to place the exact use of individual machines hour by hour for days ahead, if the machines are to be used for several products. Machining scheduling is more a matter of determining the sequence of jobs to be done on each machine than of machine time schedules. Knowledge of operation times is, however, necessary in order to plan the allocation of product operations to machines, since the time taken to process a part at any given machine determines when it is available for its next operation or machine and when the machine will be free for another order. Although actual operating times vary

considerably from the expected times, nonetheless estimates of expected operations times are quite useful in scheduling.

-4. The Foreman of the Machining/Assembly Section will adopt the E.R method of scheduling (ref. paragraph 6.3.2) when it is desirable to get the final assembly under way well before the cumulative completion of the machine task of the product. The method consists in machining and assembly initially only half the quantity of a given sub-assembly, of the product. The time required to machine and assemble these reduced quantities is ample for the production of all the needed parts and sub-assemblies for the whole Order. Later the balance of sub-assembly A can be made and the balance of the Order assembled.

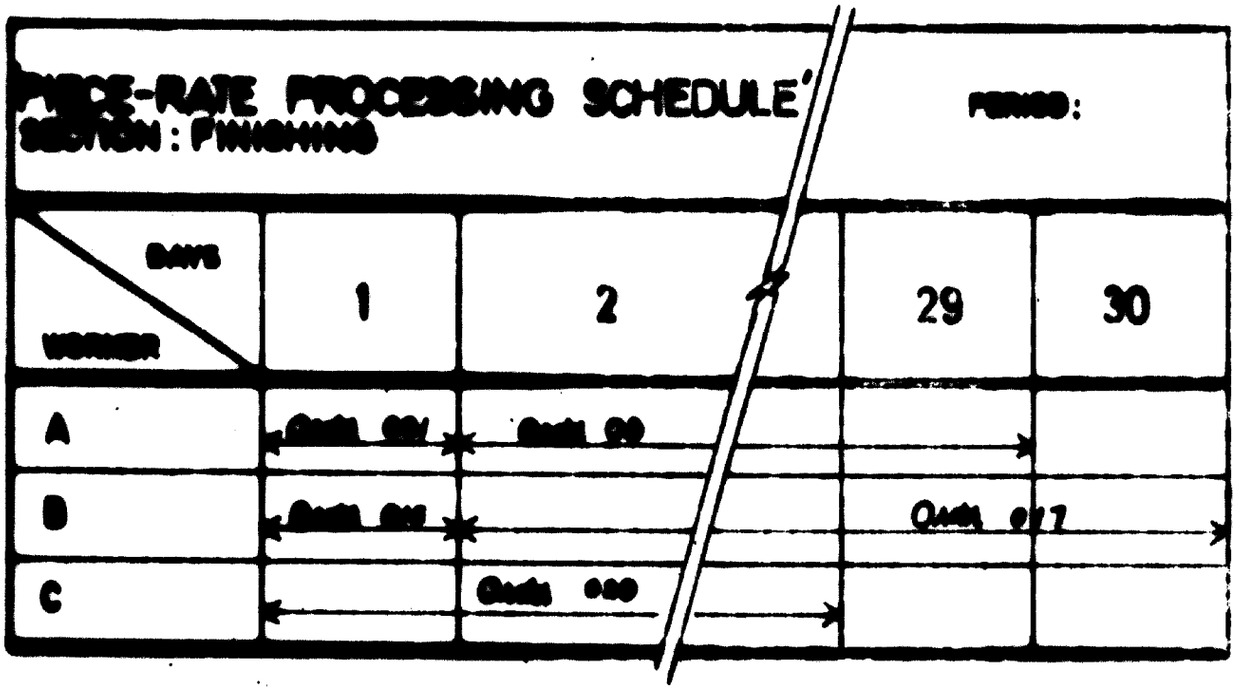
-5. Assembly tasks of Standard Furniture are closely related to the timing of machining tasks and will be scheduled accordingly by the Foreman on the 'Piece-Rate Processing Schedule'.

-6. The Form will be also used by the Foremen to arrange the schedule of individual 'Piece-Rate Assignments' related to further processing (finishing and/or upholstery) of Standard Furniture to customer's requirements.

-7. Similar procedure shall be applied by the Foremen to schedule individual 'Piece-Rate Assignments' related to Upholstery & Finishing Tasks of Non-Standard Furniture machined and assembled by the Factory Sub-contractors.

-8. The 'Piece-Rate Processing Schedule' will be similar in layout to the 'Sub-contractor Processing Schedule' (ref. appendix 053) except for the fact that in this case

the schedule will show the breakdown time expected to be taken by the Piece-Rate Worker to perform a specific task. A specimen of the 'Piece-Rate Processing Schedule' is shown below :



-9. It should be emphasised, however, that in certain circumstances, it may be advisable to adapt the 'Day-Rate Processing Schedule' to serve for the schedule of both Day-Rate and Piece-Rate Workers at the same time. This may be necessary when the workers are shifted frequently from Piece-Rate to Day-Rate work.

6.4.3 <u>Process Scheduling for Sub-contractors' work</u>

When scheduling Non-Standard Furniture to be machined and assembled by the Factory Sub-contractor, the Production Supervisor will schedule the work on the 'Sub-contractor Processing Schedule'(ref. appendix 053) but only in order to maintain

his own rough estimate of the current capacity and load of the Sub-contractor. In normal circumstances the Sub-contractor will not be expected to prepare any formal Process Scheduling but simply to keep the promised completion date for the assignment while the detailed distribution of the assignment among his workers will be left entirely to his discretion.

7 - OVERALL CONTROL

7.1 Levels of Control

Detailed control of output of the various Processing Section and the Factory Sub-contractors are carried out instead as described in the relevant paragraphs of Materials and Labour Control (ref. paragraphs 8.7.2 to 8.7.4 & 9.5.1, 9.5.2).

Overall Control refers to the control of plant performance (Output of Finished Goods) and is carried out on a centralised basis by the Production Supervisor.

7.2 Objectives

The main objectives of the Overall Control can be summarised as follows :

i) Maintain the scheduled rate of output; that is, a rate of production sufficient to satisfy Sales needs as planned in the Overall Scheduling (ref. paragraph 6.3.1).

ii) Detect, investigate and eliminate undue derivation from Overall Scheduling.

7.3 Procedure

7.3.1 The problem of Overall Control is largely one of maintaining the scheduled rate of output and of meeting delivery dates on customers' Orders. The task of the Production Supervisor will be to compare actual output with scheduled output and taking corrective actions in order to eliminate delays and interruptions before they become acute. Most of the reports, on rate of output and on various stages of manufacture, needed for the Overall

Control activity are provided by the Foremen to the Production Supervisor and posted on the 'Overall Scheduling & Control Board' as described in the Procedure of the Board (ref. appendix 023).

7.3.2 Major delays and disruptions causing production lags shall have to be corrected through the use of overtime, additional shifts, expediting procurement of materials etc. When late delivery is unavoidable customer shall be notified promptly.

7.3.3 In the manufacture of Standard Furniture, the Production Supervisor shall see to it that finished stock is not allowed to become exhausted because of a lag in production. On the other hand, finished stock of Standard Furniture shall not be allowed to pile up because of over-optimistic Sales estimates.

7.4 Production Reports to Management

7.4.1 In medium and large plants periodical reports to management may possibly show: (1) the size of production requirements or backlog; (2) the current rate of output, expressed in terms of units; (3) capacity utilisation; (4) idle machine time including causes of delays and action taken or recommended; (5) the percentage of output rejected etc. In small plants of the type envisaged in this Manual, the amount of reporting will be kept down to the minimum. However, a 'Periodical Production Report' of the type

presented below is normally considered a minimum requirement in this respect.

'PERIODICAL PRODUCTION REPORT'						Standard Furniture Period:	
Item	Unit	Quantity in Production	[illegible]	[illegible]	Quantity in Stores	Orders on Hand	Quantity [illegible] Orders

7.4.2 The Report will help identify how actual Sales (Orders on hand) compare with forecasted Sales and thus to forewarn of changes in Sales demand. The Report will also indicate the threatening depletion or the excessive accumulation of finished stock when comparing stores quantities, volume of work in progress and quantities delivered.

8 - MATERIALS CONTROL

8.1 Materials [illegible]

8.1.1 Materials may be grouped according to their nature, use or condition within the following classes :

i) Direct Materials

ii) Indirect Materials

iii) Work-in-Progress

iv) Finished Goods

8.1.2 Direct Materials

-1. Direct Materials comprise all materials which become an integral and permanent part of the finished product. This class can be sub-divided into :

i) Raw Materials

ii) Component Parts

-2. Raw Materials include materials such as timber, finishing materials and upholstery materials which are purchased to be converted into component parts and, finally, into finished products.

-3. Component Parts, that is, parts of finished products, can be purchased direct from the vendor (Purchased Parts) in completed form, e.g. moulded plywood parts, swivel cases for office chairs, etc. Alternatively, they are produced in the plant from raw materials.

-4. Usage of Direct Materials is related to specific 'Sales/Production Orders' and their cost is charged in its entirety to the

relevant 'Cost Sheet'.

8.1.3 Indirect Materials

-1. Indirect Materials (also known as Supplies or Expense Materials) include all materials other than Direct Materials (ref. 10.7.5-2). This class can be sub-divided into :

i) Supplementary Materials

Various materials which are used on the product but do not become a substantial or permanent part of it such as nails, paint diluents, screws, sanding paper etc.

ii) Consumable Tools

Materials which are used in connection with the operation of production and maintenance equipment, or materials other than direct used in the production process. They include: cutting tools (saws blade, knives, drilling bits) grinding wheels, spare parts, lubricant oils, painting brushes, hand tools etc.

iii) Factory General Supplies

Materials used for the genoral operation of the factory, such as kiln fuel and maintenance materials.

iv) Selling & Administrative General Supplies

Materials used for general purpose not strictly related to plant operation, such as office supplies, vehicle fuels, prototype and materials related to general delivery expenses.

-2. Items (i), (ii) & (iii) are charged to 'Cost Sheets' on a percentage basis as

part of the manufacturing overhead (ref.10.7.5). Item (iv) is charged as part of the selling and administration overhead. (ref. 10.7.6)

8.1.4 Work-in-Progress

Work-in-Progress (or Work-in-Process) include all materials, parts, sub-assemblies which are being processed or assembled into finished products. These items are actually undergoing productive operations or in temporary storage between processes.

8.1.5 Finished Goods

-1. Finished Goods comprise of products carried in stock in various degree of completion (such as semi-completed furniture without upholstery and/or finishing) and completed furniture ready for delivery to customers. They are items which have been manufactured by the company (Standard Furniture) or items purchased in completed conditions (e.g. Imported Goods) for purpose of resale.

-2. Semi-completed Finished Goods issued from the Stores for further processing according to specific customer's requirements are charged to the 'Cost Sheet' as indicated in paragraph 024.3.5.

8.2 Objectives of materials control

For the purpose of this Manual, Materials Control cover the following fundamental objectives :

i) Determining materials requirements, that is, the planning of what materials and parts are needed to fulfil Orders for Stock of Standard Furniture and for Non-Standard Furniture.

ii) Maintain adequate Stock Level of Direct, Indirect Materials and Finished Goods to fulfil manufacturing and sales schedules.

iii) To avoid excessive capital tie-up in inventory.

iv) To provide protection against loss due to deterioration, damage and pilferage during storage and waste during processing activities.

v) To reduce material handling costs to a minimum.

vi) Purchase, Receive, Storing and Issuing Direct and Indirect Materials, and Finished Goods.

vii) To accumulate Direct Material Cost for each 'Sales/Production Order'.

viii) To accumulate Indirect Materials usage as part of the Overhead Cost.

ix) To provide a basis for the payment of materials purchased.

x) To provide a basis for analysis of material price, usage and expenditure.

8.3 Materials Control Forms

8.3.1 The basic system of Materials Control requires the implementation of the following Forms :

i) 'Bill of Materials' for Standard Furniture (ref. appendix 041-A).

ii) 'Bill of Materials' for Non-Standard Furniture (ref. appendix 041-B).

iii) 'Purchase Order' (ref. appendix 042).

iv) 'Stock Cards' for Direct Materials (ref. appendix 043-A).

v) 'Stock Cards' for Finished Goods (ref. appendix 043-B).

vi) 'Delivery Order' (ref. appendix 044).

vii) 'Operation Sheet' (ref. appendix 036 & Section 3 paragraph 3.4.8).

viii) 'Part Drawing' (ref. appendix 032 & Section 3 paragraph 3.4.5).

ix) 'Indirect Materials Receiving Book'

x) 'Indirect Materials Issuing Book'

xi) 'Out-In Tools Book'

xii) 'Progress Record of Sales/Production Order'

8.3.2 Various standard Forms, which are part of Materials Control in large and medium size plants, have been excluded from this Manual in order to reduce to a minimum paper work requirements. However, the functions of the discarded Forms have been generally retained and incorporated in other Forms as follows :

i) 'Receiving Report' data are entered on to the supplier's 'Delivery Order'.

ii) 'Materials Requisition' functions are incorporated in the 'Bill of Materials'.

iii) 'Purchase Requisition' is discarded because the 'Purchase Order' itself is prepared by the Storekeeper.

iv) The function of the 'Finished Goods Report' is fulfilled by posting processed goods on to the 'Sales/Production Order' and/or the 'Job Assignment'.

v) The functions of the 'Finished Goods Requisition' are fulfilled by entering the issue of 'Finished Goods' from Stores on the Storekeeper's copy of the 'Sales/Production Order'.

8.4 Centres of Responsibility for Production Control

8.4.1 Production Responsibility

-1. The Production Department will be responsible for determining materials requirements and controlling materials from the ordering stage to the delivery of Finished Goods to the customer.

-2. The determination of materials requirements will be worked out by the Production Supervisor and the Foremen of the respective Processing Sections, based on sales forecast and specific 'Sales/Production Orders'.

-3. The Storekeeper has an overall caretaking of the Stores. He will be responsible for checking and handling the physical receipt and issuing of materials and Finished Goods to and from Stores. The Storekeeper will see that materials are properly arranged and protected in storage against loss due to deterioration, damage and pilferage while in Stores. In addition he is also responsible for maintaining the formal control of Direct Materials and Finished Goods which in larger plants are delegated to separate centres of responsibility.

-4. Once the Direct Materials are issued to the Processing Sections they become Work-in-Progress. At this stage the Foremen take over the responsibility from the Stores and maintain the physical control of materials throughout the processing cycle until they are converted into Finished Goods.

-5. The Stores will then resume its control and either receive the Finished Goods into Permanent Stores or arrange for delivery

to customer as scheduled by the Production Supervisor.

8.4.2 Accounts/Purchasing Responsibility

-1. Basically, the Accounts responsibility consists in accounting for Materials Purchase and Payment, Materials Usage, Delivered Goods. The Accounts will also maintain Materials Records required for cost analysis and financial statements purposes.

-2. In order to account for Purchase of Materials and issue relevant payments, the Accounts will process data provided by the Stores.

-3. To charge Direct Materials and/or Finished Goods to any 'Sales/Production Order', the Accounts will process issuing records entered by the Stores respectively on the 'Bill of Materials' and/or the 'Sales/Production Order' (ref. 10.6.1).

-4. The Accounts will also be responsible for invoicing customers (on the authority of the 'Delivery Order') for goods delivered and to prepare cost analysis and financial statements as and when required.

8.5 Direct Materials Control

8.5.1 Determining and Maintaining the Inventory of Direct Materials

-1. The first step in determining materials requirements will be taken at Management level in selecting a Standard Line of Products, based on sales requirements, and estimating the average demand for a given period.

-2. Subsequently, the Production Supervisor will provide the Stores with 'Master Bill of Materials' showing breakdown requirements of materials (including spoilage allowance) for each Standard Furniture. From this source the Stores will open and maintain individual 'Direct Materials Stock Cards' for each size and type of material required.

-3. In order to place the initial 'Purchase Order', and determine the point at which the original stock should be replenished (minimum stock level), the Stocks will consider the rate of turnover of Direct Materials and the usual time interval between dates of Order and the receipt of material. It is important that the Stock of Direct Materials should be replenished before the supply falls to a point which may cause interruption in production activities. On the other hand, the tie-up of excessive working capital by overstocking materials should be avoided.

-4. Materials requirements for Non-Standard Furniture cannot be determined in advance as they become known only when customer's Orders are received and accepted. In this instance, special material requirements will be listed in the 'Bill of Materials' for Non-Standard Furniture (ref. appendix 041-B) which is usually prepared by the Sub-contractor and approved by the Production Supervisor.

-5. Stock Materials shall be allocated to production in advance so that materials shortage may be eliminated. For this purpose the 'Direct Materials Stock Card' (ref. appendix 043-A) shows appropriate entries so that materials may be allotted to current Orders in advance of production. This method

avoids running short of materials, which may happen when the records show only the balance on hand of the needed items.

8.5.2 Purchase of Direct Materials

-1. Based on the requirements of 'Bill of Materials' for specific 'Sales/Production Orders' the Stores shall allocate materials and request purchase when the allocation of stock materials bring the stock balance to the pre-determined minimum level. Also based on the requirements of the Bill, the Stores will request purchase of non-stock materials as required.

-2. The relevant 'Purchase Order' (ref. appendix 042) will be prepared by the Stores and authorised and issued by the Administration which will also handle the actual purchasing. Alternatively, purchasing of materials from the Petty Cash Fund will be delegated on a 'Purchasing Authorisation Slip' by Departmental Heads within a maximum amount established by the Manager.

8.5.3 Receiving Inspection & Storage of Purchased Materials

-1. Upon delivery of the goods to the Stores, the Storekeeper will check the goods received against the 'Purchase Order' to ensure that the quantities, qualities and types of goods delivered conform to specifications. Receipt of goods will be entered on the supplier's 'Delivery Order' for reference of the Accounts. If the materials are not of the required specifications, the Storekeeper may return the goods to the supplier. Alternatively, he will remark any discrepancies when acknowledging receipt on the supplier's 'Delivery Order'.

-2. In the case of goods purchased from Petty Cash Fund, the Storekeeper, on receiving the goods will sign the supplier's cash receipt, enter on it the 'Sales/Production Order' reference number (if applicable) and forward it to the Accounts together with the 'Purchasing Authorisation Slip'.

-3. The date of receipt of stock materials will be entered on the appropriate 'Stock Card'. Materials received shall be properly arranged and protected in storage by the Storekeeper to avoid loss due to deterioration and pilferage.

-4. On receiving the copy of supplier's 'Delivery Order', Invoice or Cash Receipt and other relevant documents, the Accounts Section will make the appropriate entries and arrange for payment.

8.5.4 Issuing of Direct Materials

-1. Direct Materials will be made available by the Stores to the Processing Sections on the authority of the 'Bill of Materials' and within the schedules indicated in it.

-2. The Stores will enter on the 'Bill of Materials' the quantity and cost of materials issued. The Foreman, Worker or Subcontractor will sign for receipt of the materials. A similar entry will be made for stock materials on relevant 'Stock Cards'.

-3. When all the materials required for any given 'Sales/Production Order' are issued, the 'Bill of Materials' will be transferred to the Accounts for the necessary recording. The total quantity and cost for each type of material (timber, fittings, paints etc.) related to a given 'Sales/Production Order'

will be accumulated by the Accounts on the 'Cost Sheet'.

-4. Issuing of materials in excess of requirements shall be listed in the 'Bill of Materials' and authorised by the Production Supervisor.

-5. No specific 'Bill of Materials' will be required usually for the issue of Direct Materials needed for 'Miscellaneous Work Order' (ref. paragraph 5.3 and appendix 022) issued for maintenance, prototypes, etc. In this case the materials will be entered on the Form, and the Production Supervisor shall remark, for the reference of the Accounts, whether the materials are to be accounted for as Direct or Indirect Material.

8.6 Indirect Materials Control

8.6.1 Determining Requirements of Indirect Materials

-1. To determine Indirect Materials (ref. paragraph 8.1.3(i) & (ii)) requirements, the Stores will review the quantity purchased during a given previous period, say three to six months.

-2. The method of posting of receipts, issues, balances and allocation adopted for Direct Materials is not practical in the case of Indirect Materials. Instead, the 'Double Bin' method (also known as 'Last Bag' or 'Sealed Quantity') will be used. By this method a quantity sufficient to last during the "lead time" (that is, the time necessary to get a replacement Order and allow a suitable reserve) is bundled into a separate bin, or in some way identified clearly as being the re-order stock.

8.6.2 Purchasing of Indirect Materials

When the first part of the 'Double Bin' quantity is used up, the re-order point is reached and the Stores will request a replacement by compiling a 'Purchase Order'.

8.6.3 Receiving of Indirect Materials

Receiving procedures of Indirect Materials are similar to those of Direct Materials (ref. paragraph 8.5.3). However, no 'Stock Card' record will be used. Instead an 'Indirect Materials Receiving Book' will be adopted whereby the materials received are entered according to materials group classification (screws and nails, paint diluents, sanding paper etc.). The record data such as supplier's name and address, price per unit etc. which will be used as reference in subsequent purchasing.

8.6.4 Issuing of Indirect Materials

-1. In normal cases, Indirect Materials are issued from Stores without specific authorisation. For the control purpose the usage of these materials will be recorded in the 'Indirect Materials Issuing Book' with the receiver signing the record. Some Indirect Materials of normal usage such as sanding paper, paint diluents etc. may be issued in bulk to the Foreman for re-distribution to workers.

-2. The issuing of maintenance and cutting tools (such as spanners, saw blades, cutters, boring bits etc.) from the Tool Room will be controlled by the Tool Room Technician by making use of the 'Out-In Tools Book' where the worker will sign for receipt of tools and

where subsequently, the Technicians will record the return of the tools from the worker.

-3. From the accounting point of view, the Indirect Materials at the time of purchase are treated and recorded as Overhead Expenses. Stock taking to determine the quantity and amount issued will be carried out before the books are closed. The amount issued will be written off and the balance on hand will be recorded as opening inventory.

8.7 Work-in-Progress

8.7.1 Determining Work-in-Progress Requirements

The amount and type of Work-in-Progress (ref. paragraph 8.1.4) at any given time is determined by the overall plant capacity and Sales requirements from which an Overall Scheduling is worked out.

8.7.2 Responsibility for Work-in-Progress

-1. The overall control of Work-in-Progress of all the Processing Sections and Factory Sub-contractors is carried out by the Production Supervisor (ref. paragraph 7.1). The detailed control of Work-in-Progress is the responsibility of the Foremen, while the Factory Sub-contractor will be normally responsible for the detailed control of the carpentry work of Non-Standard Furniture.

-2. It is the Foremen's responsibility to see that right equipment is properly used for the job and that necessary instructions accompany the parts in process at each processing station. They shall see that the work progresses according to schedule.

8.7.3 Control Flow of Work-in-Progress

-1. The first step in the actual manufacturing process will be the withdrawal of materials from the Stores based on the authority of the 'Bill of Materials' (ref. paragraph 3.4.7 & appendix 041). The Foreman will then arrange to put parts into production according to Orders priorities and also to pre-determined sequential Order of fabrication - as indicated in 'Operation Sheets' (ref. paragraph 3.4.8) so that parts and sub-assemblies requiring more time for processing are started at an earlier date. Relevant Process Scheduling Procedures are discussed in paragraph 6.4.2.

-2. Workers handling parts between processing stations will move them according to the Order shown on the "Machining Sequence" column of the 'Bill of Materials' and also on the 'Part Drawings' (ref. paragraph 3.4.5 & appendix 032). The pre-determined flow-sequence will ensure that parts are timely available at subsequent processing stations.

-3. 'Bill of Materials', 'Operation Sheets' and 'Part Drawings' will provide Foreman with the basic specifications needed for the control of parts in fabrication. The Foreman will see to it that all the proper cutting tools and devices such as cutters, blades, jigs, templates, patterns and gauges are used in conjunction with each processing operation. The 'Part Drawing' (and whenever practicable a sample part) should follow, as reference and identification, the respective stocks of parts in process up to the assembly stage.

8.7.4 Progress Record of Work-in-Progress

-1. The record of parts completed and rejected at each processing station will be entered by the machine operator. In order to keep track of the Work-in-Progress related to the machining operations of Standard Products, the Foreman will tick off from the relevant 'Operation Sheet' the operations performed. Progressive record of units processed at each Processing Section, will be entered on the respective Foreman's copy of the 'Sales/Production Order' and reported daily to the Production Supervisor for posting on the Progress Record of the 'Production Order' copy of the Production Control Board (ref. appendix 023 paragraph 023.4.1 & appendix 021 paragraph 021.3.4-5). Progressive record of units processed by the Factory Sub-contractor will be entered by the Production Supervisor on to the relevant 'Job Assignment' (ref. appendix 052 paragraph 052.3.6) and from there to the 'Sales/Production Order' copy of the Control Board.

-2. Transferring of Work-in-Progress, including parts, sub-assemblies and semi-completed items from one Processing Section to another will be entered on the Progress Record of the Foreman's copy of the relevant 'Sales/Production Order'. The Receiving Foreman will acknowledge the quantity received on the 'Production Order' copy of the issuing Foreman.

8.7.5 Accounting for Work-in-Progress

From the accounting point of view, at the end of financial periods the cost of Materials-in-Progress added to the Labour-in-

Progress and the related overhead, will represent the total cost of the Work-in-Progress which is generally treated as an inventory item in the financial statement.

8.7.6 Inspection of Work-in-Progress

-1. Unlike large plants, which are usually provided with a Quality Control Department, the inspection of Work-in-Progress of small factories is the responsibility of the Foreman of the respective Processing Sections. As first requisite, the Foreman shall ensure that the right man, the right materials and the right tools are employed in the Work-in-Progress.

-2. In the mass production of Standard Furniture it is most important to maintain a uniform quality of work necessary for the interchangeable-parts method of manufacture. It is Foreman's responsibility to see that parts are fabricated within specific limits of variability tolerance - in order that they may fit properly during assembly. Sample parts and some of the documents mentioned in paragraph 8.7.3 will provide the Foreman with the necessary source of reference for the inspection of the Work-in-Progress. Various types of gauges are also used to verify critical dimensions of component parts being fabricated.

-3. An inspection system shall be maintained by the Foremen whereby sub-standard work is detected both during processing and at the close of the respective processing task. It is important that the Foremen should be able to detect and withdraw defective parts from production before additional machine time and labour is wasted on them. The main points at which the inspection of Work-in-Progress may

be required are: (1) after key operations where there is a high probability of defects; (2) before costly operations. Whenever practicable there should be a 'first-piece' inspection after each machine set-up. Parts spoiled during process shall be posted by the Foreman on the back of the 'Part Drawing' in order to keep record of source of spoilage and arrange for replacement of spoiled parts.

-4. The Factory Sub-contractor will be responsible for the quality control of the Work-in-Progress handled by their own workers. However, the Production Supervisor shall make occasional inspections to ensure that the goods are manufactured as specified, and the materials provided by the company are properly utilised.

8.8 Finished Goods Control

8.8.1 Determining and Maintaining Finished Goods Stock of Standard Furniture

-1. A quantity of completed goods must be maintained as finished stock to serve as a reserve from which Sales are to be made. This stock is continually replenished by current 'Production Orders' when minimum stock levels are reached (ref. paragraph 5.3.3). If the finished inventroy stocks are too large, unproductive capital is tied up; if it is too small, some deliveries cannot be made and Sales will be lost. The ideal amount of finished stock is a quantity small enough to avoid needless use of working capital, but large enough to cover sales deliveries and counterbalance the delays and interruption that normally occur in the manufacture of goods. The quantity to be carried in inventory can often be determined on the basis of past records.

-2. In order to control the inventory of Finished Goods a 'Stock Card' record (ref. appendix 043 Form 043-B) will be maintained. The cards will control the movement of each item as it goes in and out of stock and shows the current balance on hand, quantities allocated to outstanding Sales/Orders and quantities available for new Sales/Orders.

8.8.2 Receiving Standard Finished Goods into Stores

When the processing of products is completed, the Storekeeper will receive the goods into Stores from the Foreman of the Processing Section. In order to acknowledge receipt, the Storekeeper will countersign the transfer of goods on the Foreman's copy of the relevant 'Production Order' (ref. appendix 021 paragraph 021.3.4-6). The quantity received will be posted by the Storekeeper on his copy of the 'Production Order' and on the 'Finished Goods Stock Cards'.

8.8.3 Receiving Non-Standard Finished Goods in Temporary Storage

Finished Goods made to customer's requirements (Non-Standard Furniture) by Subcontractors are received and kept in temporary storage by the Storekeeper until they are delivered to the customer. The items shall also be entered on the Storekeeper's copy of the relevant 'Sales/Production Order'.

8.8.4 Re-issuing Standard Finished Goods for further processing

Standard Furniture is issued back from Stores to Processing Sections for further processing (upholstering and finishing) on the authority of specific 'Sales/Production Orders'.

The issuing will be recorded by the Storekeeper on the 'Stock Cards' for Finished Goods (ref. appendix 043 & Form 043-B) and also posted on the Stores' copy of the 'Sales/Production Order' with the Foreman signing for receipt of the goods (ref. appendix 021 paragraph 021.3.4-6). On leaving the Stores for further processing, the furniture should be provided with Identification Tags.

8.8.5 Delivery of Finished Goods

-1. The Stores will arrange for the delivery of Finished Goods to customer within Due Delivery Date indicated in the 'Sales/ Production Order' or as otherwise instructed by the Production Supervisor. The authority for the delivery of goods is given by the 'Delivery Order' which is compiled by the Stores and approved by the Production Supervisor. On issuing the goods for delivery the Stores will post accordingly the relevant 'Stock Card' and the Progress Record of the 'Sales/Production Order'.

-2. If goods are delivered without 'Sales/ Production Order', for example on loan, one copy of the 'Delivery Order' will be kept in a separate file by the Stores until the goods are returned to the factory.

-3. The Accounts will raise the Invoice based on the 'Delivery Order' acknowledged by the customer on receipt of the Finished Goods. The delivered Finished Goods will be invoiced by the Accounts based on the copy of the 'Delivery Order' countersigned by the customer on receipt of the goods.

8.8.6 Inspection of Finished Goods

-1. In the case of Standard Furniture, the Foreman will be responsible for the final inspection of the goods before it is received into Stores. If the goods delivered to Stores are damaged, the Storekeeper will make the necessary notation, to this effect, when posting the receipt of goods on his copy of the 'Production Order' (ref. appendix 021 paragraph 021.3.5-1). The issuing Foreman will countersign the notation. Appropriate remarks shall be posted on 'Job Assignments' by Foremen or the Production Supervisor in respect of quantities of Standard and Non-Standard Furniture not cleared for 'Job Assignment' payment.

-2. Inspection of Finished Goods before delivery will be the responsibility of the Storekeeper unless otherwise delegated by the Production Supervisor.

8.8.7 Receiving Returned Goods from Customers

Goods returned by customers may be entered in a specific Form, the 'Returned Goods Receiving Note' (which is not elaborated in this Manual) and kept into "temporary storage" until instructions are received from the Production Supervisor as to whether the goods should be transferred to permanent stores or to the Processing Sections for further processing as required.

8.8.8 Accounting for Finished Goods

From the accounting point of view, the actual cost of Finished Goods will be accumulated on 'Cost Sheets' of individual products. The cost will include Direct Materials, Direct Labour and various overheads

charged at a pre-determined rate. At the end of financial periods, Finished Goods are accounted as an asset of the company and presented as an inventory item in the financial statement.

9 - DIRECT LABOUR CONTROL

9.1 Personnel classification

9.1.1 Personnel include all persons engaged in factory and office work. For costing and control purpose they are divided into three categories :

i) Direct Labour

ii) Indirect Labour

iii) Administrative and Sales Personnel

This Manual is concerned only with the Control of Direct Labour, nevertheless a description of all three items is given because it is relevant to the computation of 'Cost Sheet'.

9.1.2 Direct Labour

Direct Labour includes all workers directly involved in the manufacturing process of materials into Finished Goods. It consists of workers such as Wood Machinist, Assemblers, Finishers, Upholsterers etc. The working time spent by Direct Labour is related to specific jobs and its cost is charged in its entirety to the relevant 'Cost Sheet'. Payments made to Direct Labour are known as Direct Wages (ref. paragraph 10.7.3.).

9.1.3 Indirect Labour

-1. Indirect Labour comprises of all factory personnel which is not directly necessary in the manufacture of Finished Goods. This category include personnel such as Timber Yard and Shop Labourers, Kiln Operators, Stores

Keepers, Maintenance Workers, Inspectors, Production Supervisors, Foremen, Draftsmen etc. The working time spent by Indirect Labour cannot be charged to any particular job and is entered on 'Cost Sheets' on a percentage basis as part of the Manufacturing Overhead. Payments made to Indirect Labour are known as Indirect Wages and Salaries (ref. paragraph 10.7.5-2).

-2. There are some workers who spend most of their time working directly on the product, and part of it as Indirect Labour on task such as maintenance, packing etc. In this case, it is necessary to split the total time and charge only the time spent on processing activities as Direct Wages.

9.1.4 Administrative and Sales Personnel

-1. This category include personnel concerned with management, selling, or occupied in an executive or a clerical capacity such as Managers, Salesmen, Accounts Clerk etc.

-2. The expenses related to this category of personnel are charged on the 'Cost Sheet' on a percentage basis as part of the Administrative and Selling Overheads (ref. paragraph 9.7.6).

9.2 Classification of Direct Labour

9.2.1 Wages are the earnings by employees for the performance of services.

Direct Labour is classified in two main groups according to wage systems :

i) Day-Rate Labour

ii) Piece-Rate Labour

9.2.2 Day-Rate Labour

-1. This is the simpliest and most common method of compensation whereby employees are paid a definite wage-rate per hour or day regardless of their output. Wages, in this case, are equal to the product of an hourly rate times the number of hours worked.

-2. There is very little incentive in this method of wages payment since the workers will be paid just as much for the time they are at work regardless of whether they work or merely idle about.

-3. The use of time payment is satisfactory where close and intimate supervision is practical, as in small shops. It is generally recommended for machining operations where the rate of output is generally determined by the machine.

9.2.3 Piece-Rate Labour

-1. This payment system compensates on the basis of output, that is, of units of work produced. In this case, wages are equal to a fixed rate per piece times the number of pieces produced.

-2. The employee gains or loses in direct proportion to his performance, hence the incentive impetus is very strong.

-3. Piece-Rate payment is recommended for processing tasks such as Assembly, Finishing and Upholstery.

9.2.4 Factory Sub-contractors

-1 In addition to Piece-Rate Workers, who are individually employed by the company,

there is another category of Piece-Rate employees typical of woodworking industry of Singapore and other countries of South East Asia. This category may be called Factory Sub-contractors to whom the company assigns jobs on Piece-Rate basis.

-2. The Sub-contractor employs his own group of workers to whom he distributes the jobs assigned by the company. The company has no control on the Sub-contractors' workers. For the purpose of this Manual, it is assumed that Sub-contract work is limited to the machining and assembly tasks of Non-Standard Furniture made to customer's requirements.

-3. The peculiarity of this arrangement is that Sub-contractors' work is carried out within the company's plant, making use of the company's equipment and with raw materials supplied by the company.

-4. Because of its many disadvantages the system should gradually be discarded. Until this is achieved, the necessity remains to improve the control of Sub-contractors' work. Procedure to this effect is included in this Manual.

9.2.5 Combination Time-Piece Payment

-1. A combination Time-Piece Payment may be adopted through Wage Incentive Systems whereby the rate of pay is based on the combination of time and output e.g. a guaranteed hourly rate plus a bonus ordinarily based on the amount of extra work put out (or time saved) beyond a standard requirement.

-2. Maximum employee efficiency is achieved where men are assigned a definite task for a given time and are stimulated financially by compensation according to their performance. Incentive plans are not discussed here as they fall outside the scope of this Manual.

9.3 Objectives of Direct Labour Control & Related Forms

9.3.1 Objectives

The objectives of Direct Labour Control can be summarised as follows :

i) To assign work to Day-Rate Workers, Piece-Rate Workers and Sub-contractors.

ii) To keep track of progress of jobs assigned.

iii) To accumulate Direct Labour Cost for each job and provide a basis for the direction of production and selling policy.

iv) To provide a basis for payroll disbursement to Piece-Rate Workers and Sub-contractors.

v) To control weekly attendance and unproductive time of Day-Rate Labour.

vi) To provide a basis for analysis of Labour Performance.

9.3.2 Forms

The basic system of Direct Labour Control requires the implementation of the following Forms :

i) 'Day-Rate Processing Schedule & Report' (ref. appendix 051) for jobs assigned to Day-Rate Workers.

ii) 'Job Assignment' (ref. appendix 052) for jobs assigned to Piece-Rate Workers and Sub-contractors.

9.4 Centres of Responsibility

9.4.1 Production Responsibility

-1. The Production Supervisor and the Foremen will be responsible for assigning jobs and follow the progress of work of Sub-contractors, Day-Rate Workers and Piece-Rate Workers. They will also be responsible for the quality standard of the work performed by the Direct Labour.

-2. At times Piece-Rate Workers may be assigned Day-Rate work, and Direct Labour assigned to Indirect Labour tasks. Records provided by the Production Department to Accounts shall reflect these variations in wage classification.

9.4.2 Accounts Responsibility

In order to charge Direct Wages to any job, the time spent by Direct Labour has to be traced. The Accounts Clerk is responsible for processing Direct Labour data provided by the Production Department and posting Direct Labour Cost to relevant 'Cost Sheets'. He will also make use of the data for payroll disbursement and payroll recording of Day-Rate Workers, Piece-Rate Workers and Sub-contractors.

9.5 Procedure

9.5.1 Assignment of Jobs to Direct Labour

-1. When 'Sales/Production Orders' are issued, the Production Department will determine the breakdown of man-days requirements for each processing task of each item of the 'Sales/ Production Order'.

-2. Non-Standard Furniture is assigned by the Production Supervisor to Sub-contractors based on the existing load which is shown on the 'Sub-contractor Processing Schedule' (ref. appendix 053). Jobs are given out by using the 'Job Assignment' Form (ref. appendix 052).

-3. Jobs are similarly assigned by the Foremen of the respective Processing Sections to Piece-Rate Workers based on the existing load of 'Piece-Rate Processing Schedule' (ref. paragraph 6.4.2-8) and making use of the 'Job Assignment' Form.

-4. Tasks to be performed by Day-Rate Labour are assigned by the machining Foreman making use of the 'Day-Rate Processing Schedule & Report'.

-5. Estimation of labour rates for Non-Standard Furniture is complex and requires considerable experience. Piece-Rates for Assembly, Upholstery and Finishing of Standard Furniture should be based on pre-set rates which in small plants are usually worked out from records of past performance.

9.5.2 Performance Control of Direct Labour

-1. Quantity and quality of output related to job assigned to Sub-contractors will be checked by the Production Supervisor. Progress of item completed will be entered on the Progress Record of the 'Job Assignment'. The Production Supervisor will see to it that the estimated completion date of the job assigned is maintained.

-2. Similar control will be maintained by workshop Foremen for jobs assigned to Piece-Rate Workers.

-3. Control of output, quality and completion schedules of tasks assigned to Day-Rate Workers, which applies generally to the machining workshop, is maintained by the Foreman. The productive time, the unproductive time and overtime spent by Day-Rate Workers is entered by the Foreman on to the 'Day-Rate Processing Schedule & Report'.

-4. As mentioned earlier, the production time and the output performance of Day-Rate Workers of the machining workshop is generally determined by the capacity of each particular machine. Therefore, the workers' performance depends mainly on the ability of the Foreman to plan and co-ordinate the production within his workshop. However, rigid control should be exerted on the performance of the worker to use the right tools and techniques in order to obtain the right quality and avoid material wastage.

9.5.3 Accounting for Direct Labour

-1. In order to account for Direct Labour, the Accounts will use as source of reference the 'Job Assignment' and the 'Day-Rate Processing Schedule & Report' and will post the total labour cost on the 'Cost Sheet' when the processing of goods is completed. (ref. paragraph 10.6).

-2. Productive time of Day-Rate Workers which is recorded daily by the Foreman on the 'Day-Rate Processing Schedule & Report' will be added up weekly for each job by the Accounts. The cost is worked out by multiplying worker's rate per hour times the productive time spent on each job. For the purpose of payroll disbursement, the Accounts will arrive at the

gross earning per worker by multiplying the hours worked (regular and overtime), leave period and sick leave by the relevant rate. The labour cost of individual workers will be entered on the worker's earning record.

-3. Labour cost related to Piece-Rate and Sub-contractors is worked out by the Accounts on the basis of the Progress Record of the 'Job Assignment', which will show the record of the items completed as entered by the Production. The Accounts will accordingly calculate, disburse and record all the progressive payments. The total quantity completed will be cross-checked against the quantity assigned before preparing the payslip for the final payment.

10 - ESTIMATING AND COSTING OF PRODUCTS

10.1 Objectives of Estimating

10.1.1 Estimating is a special type of forecasting concerned with the prospective cost of manufacturing. The main objective of the estimating function is to arrive at "Pre-established Costs" which are referred to as "Cost Estimates" or as "Cost Standards". The distinction between the two consists in the degree of effort which goes into their determination.

10.1.2 Cost Estimates are generally the result of the estimator's projections based on past experience and a minimum amount of product and process specifications. This is especially the case of Non-Standard Furniture to be made in limited quantities to customer's Order, in which instance the cost of preparing detailed product and process specifications would be prohibitive.

10.1.3 The term "Standard Costs", on the other hand, usually refers to a set of pre-established costs which have been arrived at by means of a thorough study of maximum utilisation of materials, of time motion studies, of labour operations, and of equipment.

10.1.4 For the purpose of this Manual, the term "Estimated Cost" has been adopted together with the term "Actual Cost" which refers to the cost of product accumulated at the completion of the manufacturing process. Here the term "Estimated Cost" is taken to stretch to the purpose of "Standard Cost" as well.

10.1.5 Cost Estimating is basically the computation of Direct Materials, Direct Labour and Overhead Costs for a particular Order or product. In practice, however, Standard Furniture also calls for an analysis of specifications, determination of parts to buy and parts to make, consideration of units lots to be produced and the competitive situation. In fact, under competitive conditions, estimating goes beyond mere Cost Estimating and extends into product design and processing alternatives in order that competitive prices may be offered. The estimator shall have to determine how a product can be made within a pre-determined cost. The design of new Standard Products and their quality standards shall be set in accordance to the expected selling price. Should production costs exceed expectation, serious loss could result even when Sales are satisfactory.

10.1.6 For Non-Standard Furniture, it is necessary to estimate costs ahead of time in order to set prices because price bids must be submitted to customers before getting Orders. In fact, 'Sales Orders' for Non-Standard Furniture are seldom placed unless a price is quoted. When a 'Sales Offer' is accepted by the customer, the price is already set and the company profit or loss dependson whether the actual costs run below or above the estimate.

10.2 Estimating Procedure

10.2.1 The first criteria to determine pre-established costs, when first introducing new Standard Furniture, or estimating for Non-Standard Furniture, depends heavily on past experience. For this purpose it is important

that records be kept on past performance of costs of existing products. Whenever possible a tabulation should be maintained of costs of past periods broken-down by elements, processes and products. Basic records to this respect include 'Operation Sheets', 'Bill of Materials' and 'Cost Sheets' related to products similar to proposed new Standard Furniture.

10.2.2 If cost records of past operations are not sufficient to provide a basis for determination of Estimated Costs, then the procedure shall consist of relating systematically Direct Materials and Labour to processes applying the current prices and rates. Wherever practicable and economically feasible, assistance shall be sought to make time and motion studies of labour tasks.

10.2.3 A thoroughly and methodical Estimated Cost is imperative when studying the possibility of launching new products involving the purchasing of expensive specialised equipment. This will serve to determine whether the anticipated machine load for the new product is substantial enough to justify the investment. Similiarly, detailed estimating studies shall be carried out for large contract jobs for Non-Standard Furniture.

10.2.4 Periodic examination should be made of Estimated Costs of Standard Furniture. If materials, prices, and overhead costs have changed substantially, pre-established costs shall be revised. Revisions shall be made if the accuracy of established standards has proved incorrect or if production techniques have changed to make existing standard inappropriate.

10.2.5 Estimated Costs of a given Standard Product will generally increase in accuracy after several batches have been manufactured, until they will reflect with high approximation the true cost of producing the product. Because of this, the estimates will be increasingly useful in the control of Actual Costs and in planning future production and selling policies.

10.3 Relationship between Estimating and Costing

10.3.1 While product estimating is concerned with the prospective or anticipated cost of products, product costing consists of accumulating and studying the Actual Cost chargeable to the product. If the Actual Cost of the product is rising as compared to Estimated Cost, detailed cost informations may indicate poor production planning to excessive wastage of material or machine time etc.

10.4 Responsibility for Estimating & Costing

10.4.1 In large plants, estimating is either assigned to a special department or is a part of the Engineering Department. In small plants, however, estimating shall be conducted under the responsibility of the Production Supervisor working closely together with the Foremen and the Accounts. Because estimating of new Standard Furniture is closely related with Sales forecast, close co-operation is also required between Production, Sales and top management.

10.4.2 With the exception of pre-determined overheads, practically all data needed to arrive at the "estimated" 'Cost Sheet', prepared by the Accounts, are supplied by the

Production Supervisor. Again, the Actual Cost incurred in the manufacturing of products is accumulated by the Accounts on the 'Cost Sheet' with the relevant data on actual cost of materials and labour being provided by the Production Department.

10.5 "Estimated Cost" Reference

10.5.1 When estimating new Standard Products the following documents (ref. Section 3) covering product and process specifications shall be prepared by the Production :

i) Various types of drawings as required.

ii) 'Bill of Materials' showing breakdown of Estimated Costs and quantity of materials required.

iii) 'Operation Sheets' showing estimated processing times of various tasks, that is, machining, assembly, upholstery and finishing.

10.5.2 For Non-Standard Furniture, item (iii) shall usually be omitted unless the Order is of substantial volume and replaced by a plain tabulation of man-days requirements estimated on past experience.

10.6 "Actual Cost" Reference

10.6.1 Reference in determining Actual Costs of given Standard and Non-Standard Products consistsof :

i) 'Bill of Materials' (ref. appendix 041) showing breakdown of quantities and costs of materials actually issued from the Stores (ref. paragraph 8.5.4).

ii) 'Day-Rate Processing Schedule & Report' (ref. appendix 051) showing the time spent on the job by Day-Rate Workers (ref. paragraph 9.5.2-3 & 9.5.3).

iii) 'Job Assignment' (ref. appendix 052) showing cost of Piece-Rate and Sub-contract work (ref. appendix 052.3.7 & paragraph 9.5.3-1).

iv) 'Sales/Production Order' (ref. appendix 021) copy of the Storekeeper showing quantity of semi-completed Standard Furniture issued for further processing to customer's requirements (ref. paragraph 8.8.4).

10.6.2 Cost data derived from the above documents will be accumulated on the "Actual" column of the 'Cost Sheet' together with various overhead charges.

10.7 Elements of Cost

10.7.1 Objectives & Classification of Cost Elements

i) Enables management to know the different types of cost by elements that have entered into the Finished Products.

ii) Serves as a basis for meaningful comparison.

iii) Useful for purpose of cost analysis and reporting.

iv) Provides proper classification of cost items in the 'Cost Sheet'.

For the purpose of this Manual the total cost is divided into four elements :

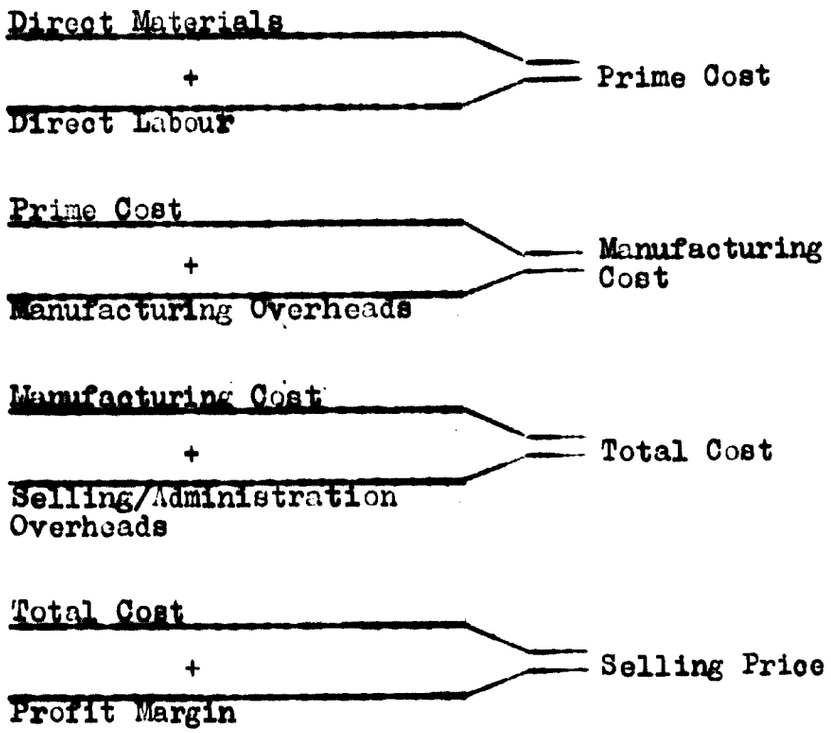
i) Direct Materials

ii) Direct Labour

iii) Manufacturing Overheads

iv) Selling and Administrative Overheads

The elements are listed in the above sequence on the 'Cost Sheet' (ref. appendix 024) and their costing relationship is presented diagramatically as follows :



10.7.2 Direct Materials

Direct materials comprise of all materials which become an integral and permanent part of the Finished Product (ref. paragraph 8.1.2). For the furniture industry, Direct Materials can be classified as follows :

1) Teak Wood

2) Other Timber (include all types and sizes of timber other than teak wood).

3) Veneers

4) Composite Board (plywood, block board, chip board etc.)

5) Plastic Laminates

6) Fittings (brass, mirrors, handles, hinges, castors etc.)

7) Finishes (lacquer, shellac, varnish etc.)

8) Glues

9) Upholstery Cover (cotton, vinyl, leather etc.)

10) Upholstery Fillings and Foams (cotton, rubber and plastic foams, hair and rubberised hair etc.)

11) Upholstery Spring and Webbing (metal, rubber or plastic springs)

12) Purchased Component Parts (ref. paragraph 6.1.2)

13) Semi-Finished Goods from Stores

14) Others (all other Direct Materials not classified in the above list)

10.7.3 Direct Labour

This element refers to the Cost of Direct Labour, that is, all workers directly involved in the manufacturing process (ref. paragraph 9.1.2). Direct Labour is classified according to the various processing tasks as follows :

1) Machining

2) Assembly

3) Finishing

4) Upholstering

5) Metal Work

6) Factory Sub-contracting (ref. paragraph 9.2.4)

10.7.4 Overheads

-1. The terms "Overhead"or "Burden" are used to refer to the many types of Manufacturing, Selling and Administrative Costs which unlike Direct Materials and Direct Labour cannot be readily associated directly with specific processes or units of products.

-2. In order that the products manufactured may absorb the Overhead Costs, these are charged to individual 'Cost Sheets' on the basis of pre-determined rates.

-3. Overhead Costs are divided into two categories: Manufacturing Overhead and Selling & Administrative Overhead.

10.7.5 Manufacturing Overhead

-1. This category refers to costs involved in production activities. Small plants must recognise the significance of Manufacturing Overhead Costs and the importance of keeping a tight control over them. Plant Foremen are inclined to be conscious of the control of Direct Material and Direct Labour Costs because of the obvious connection between them and the number of units of goods being produced. They are not always equally conscious of the control of Overhead Costs (use of Indirect Labour, tools and other supplies). The accounting system should provide cost figures which show the accumulation of these costs.

-2. Manufacturing Overheads can be classified as follows :

(a) Indirect Materials (ref. paragraph 8.1.3)

1) Supplementary Material Cost
2) Consumable Tools Cost

3) General Supplies

(b) Indirect Labour (ref. paragraph 9.1.3)

1) Salary and Indirect Wages
2) Medical and Annual Leave
3) Payroll Tax and C.P.F.
4) Bonuses and Allowances

(c) Factory Expenses

1) Factory Rent
2) Factory Repairs and Maintenance
3) Power, Lighting and Water Rates
4) Insurance (fire, Workman Compensation etc.)
5) Depreciation (factory building, plant, equipment etc.)
6) Other Expenses

10.7.6 Selling and Administrative Overheads

-1. The fourth element of cost classification is the Selling and Administrative Overheads. The costing procedure is similar to that of the Manufacturing Overheads except that the pre-determined rate to be used is generally based on the total Manufacturing Cost or the Selling Price of the product.

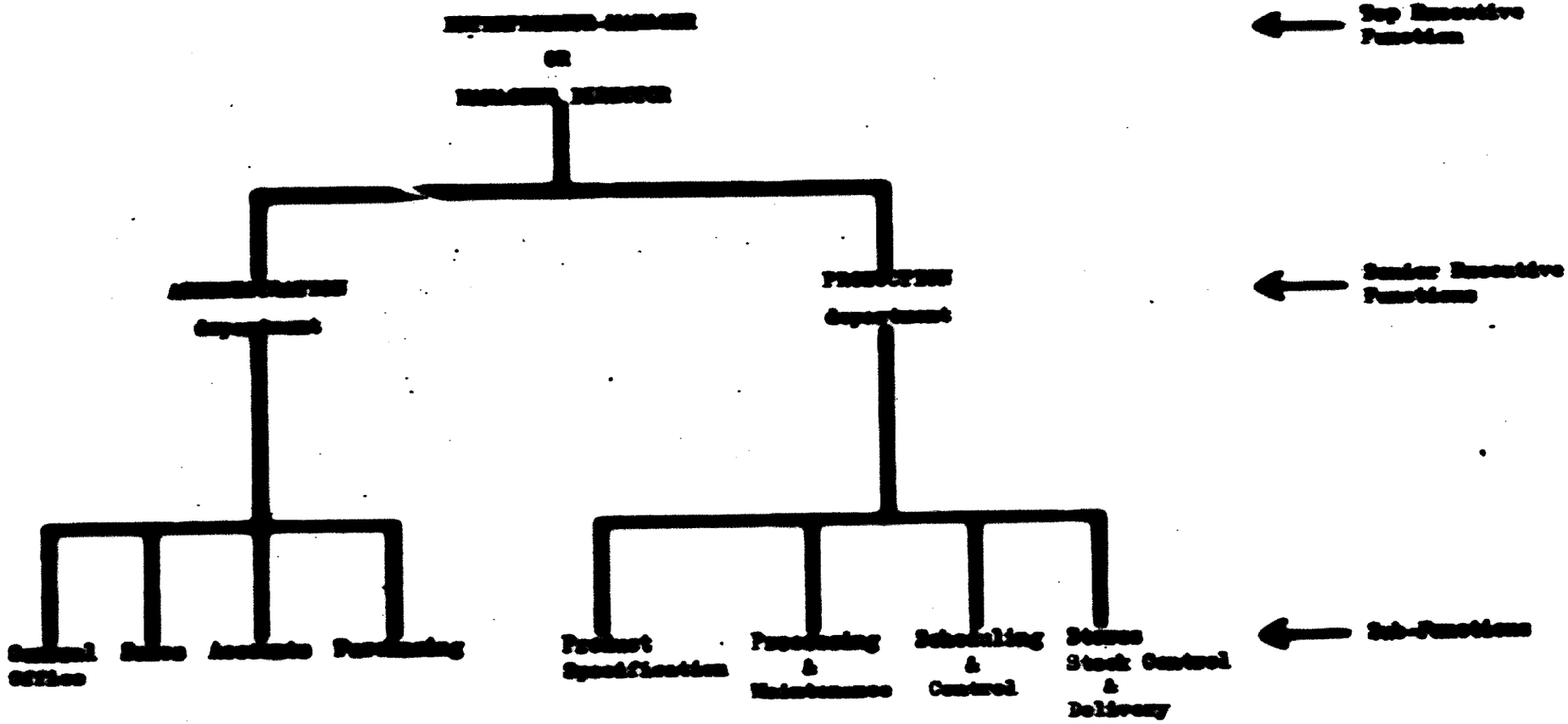
-2. This element of cost can be classified as follows :

1) Salary and Wages of Selling and Administrative Personnel
2) Bonuses and Allowances
3) Medical and Annual Leave
4) Payroll Tax and C.P.F.
5) Delivery Expenses
6) Advertising and Publicity Expenses

7) Sales Commission
8) Loss on Bad Debts
9) Travelling and Entertainments
10) Discount Allowed
11) Insurance (fire, vehicles etc.)
12) Printing and Stationery
13) Telephone, Telegram and Postage
14) Audit, Secretarial and Legal Fees
15) Bank Charges and Commission
16) Depreciation (building, vehicles, equipment etc.)
17) Tax and Assessments
18) Other Expenses

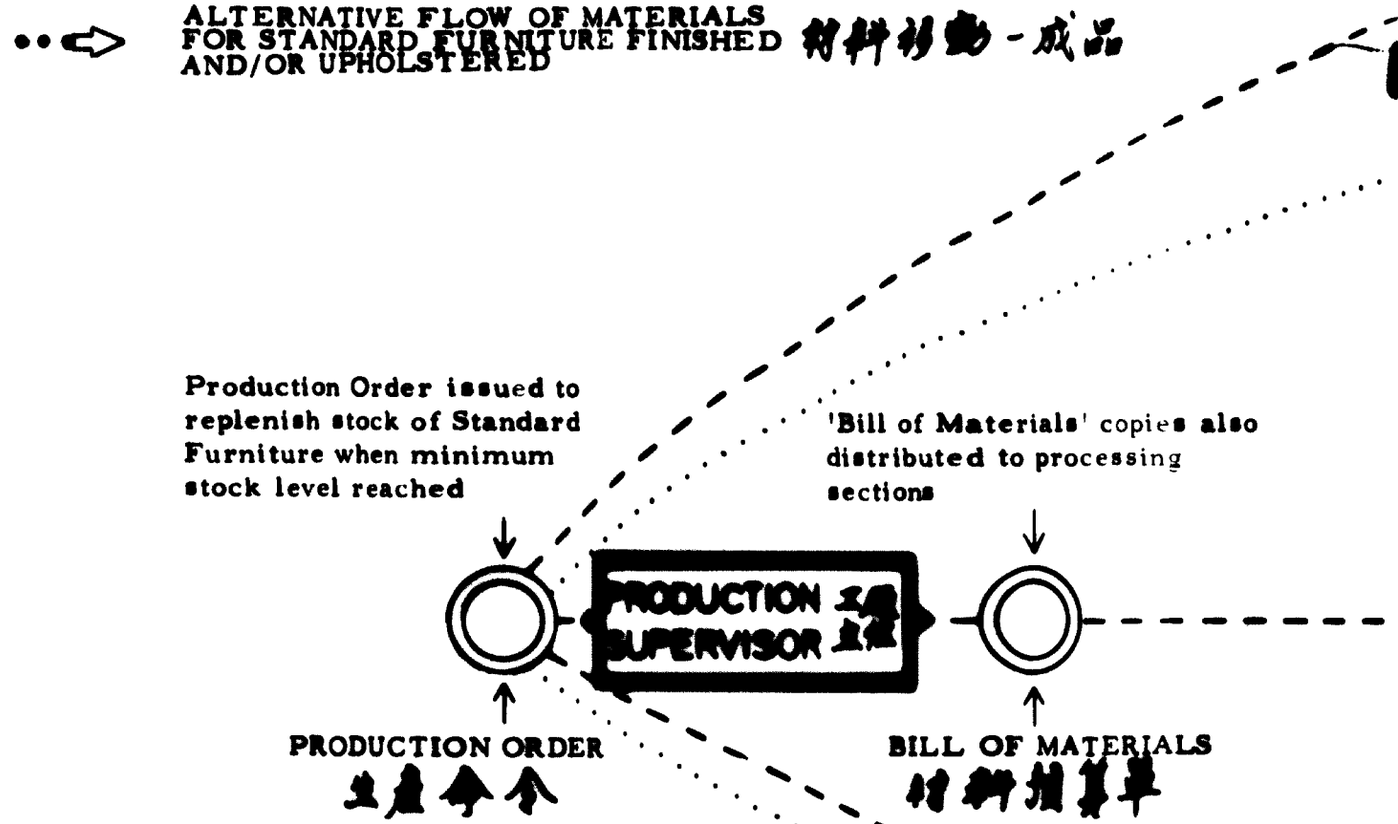
APPENDICES

FUNCTIONAL ORGANIZATION CHART



SYMBOLS 符號

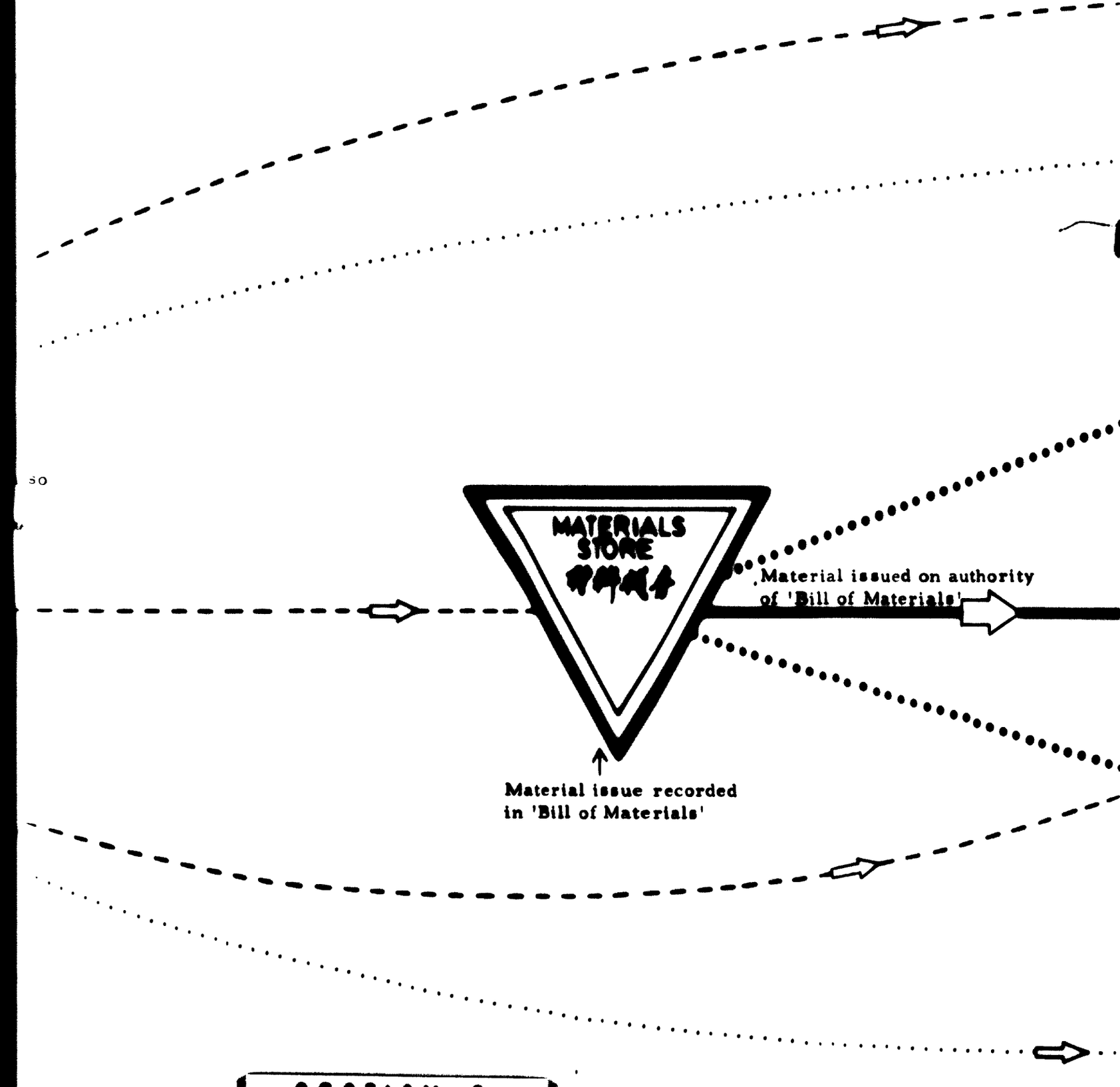
◎	ORIGINATION OF FORM 填發表格
○	PROCESSING SECTIONS 製造部門
--⇨	FLOW OF FORM 表格移動－標準製品
····⇨	ALTERNATIVE FLOW OF FORM WHEN STANDARD FURNITURE FINISHED AND/OR UPHOLSTERED 表格移動－成品
➡	FLOW OF MATERIALS 材料移動－標準製品
••⇨	ALTERNATIVE FLOW OF MATERIALS FOR STANDARD FURNITURE FINISHED AND/OR UPHOLSTERED 材料移動－成品



▽	PERMANENT STORE 標倉
➡	FLOW OF PROCESSED STANDARD FURNITURE TO BE DELIVERED TO STOCK IN SEMI-COMPLETED FORM 標準製品移動
●⇨	ALTERNATIVE FLOW OF STANDARD FURNITURE TO BE DELIVERED TO STORES IN COMPLETED FORM 成品移動
P.O.	PRODUCTION ORDER 生產命令

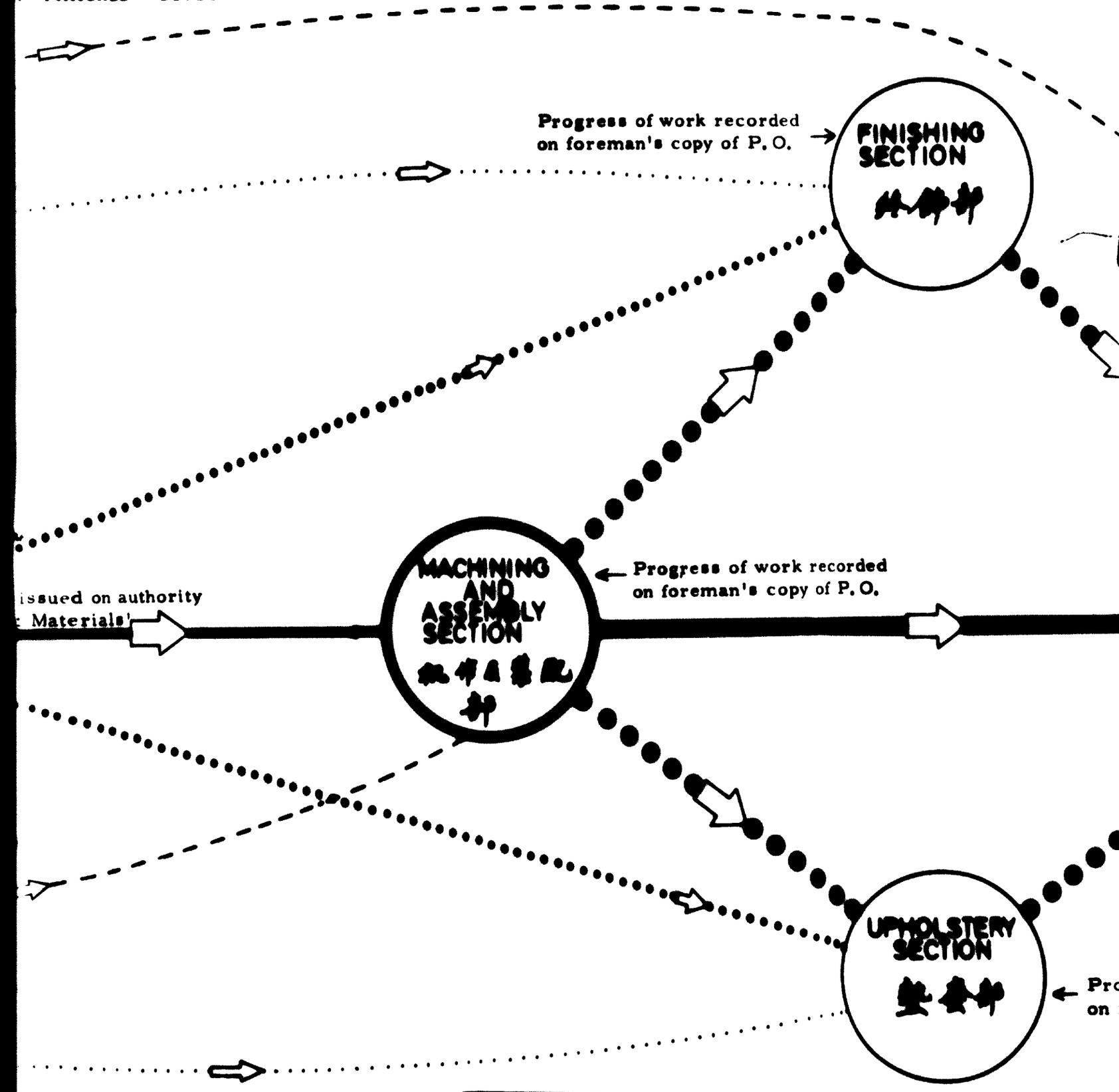
PRODUCTION OF STANDARD FURNITURE FOR S

FLOW CHART OF MATERIALS, WORK-IN-PROCESS, FINISHED GOODS AND

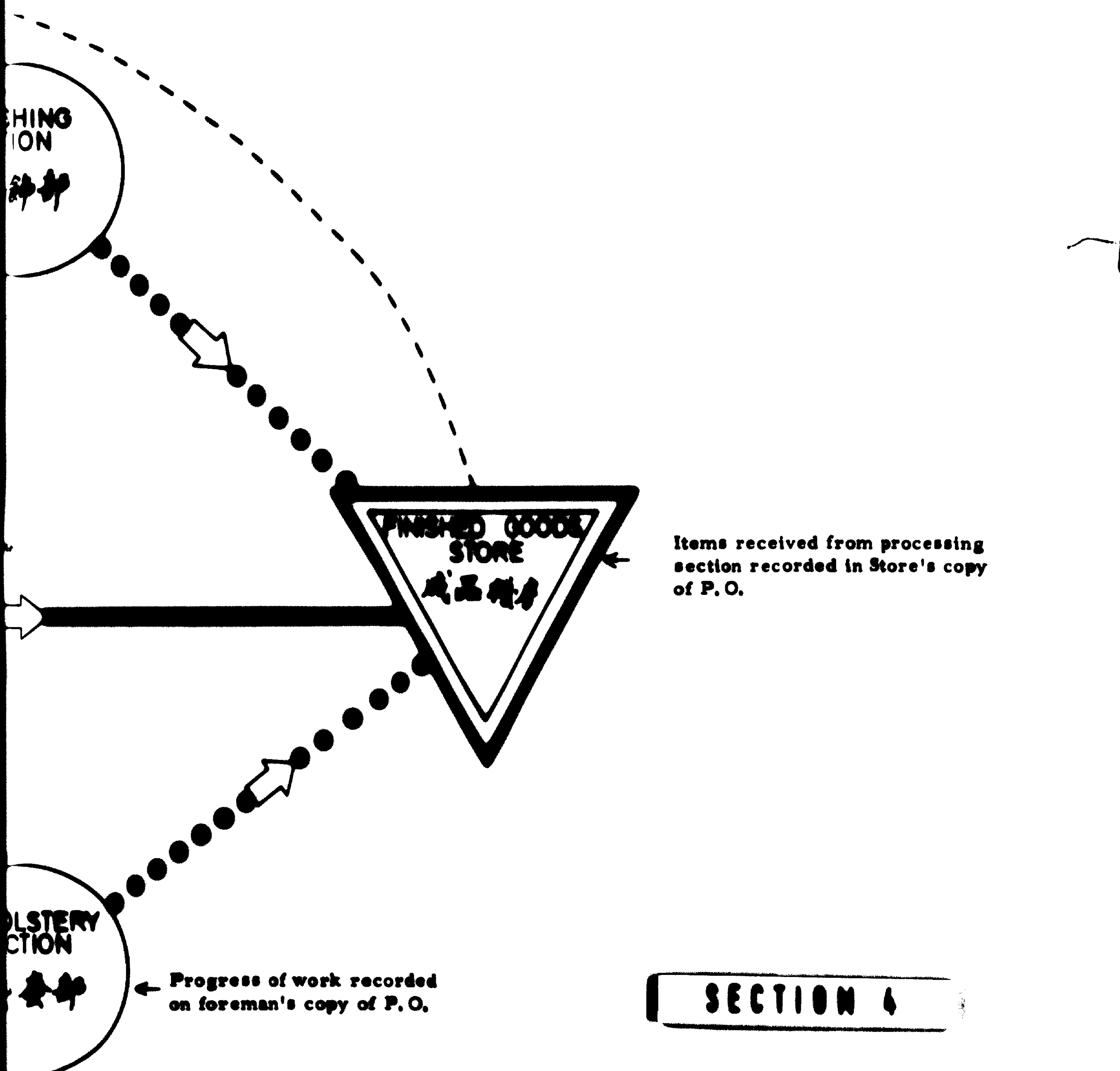


NITURE FOR STOCK (PRODUCTION ORDERS) 標準木器生產程序

. FINISHED GOODS AND RELATED FORMS 成品及有關表格



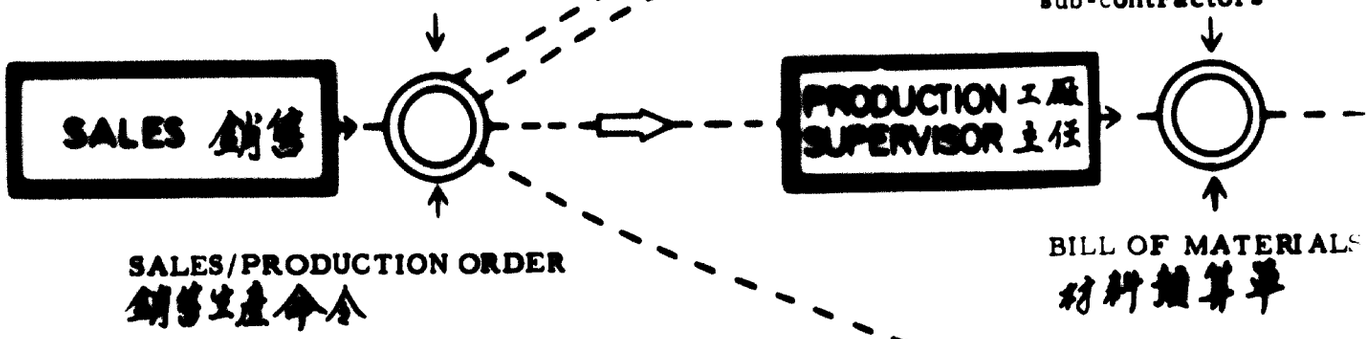
生產 程序



SECTION 4

SYMBOLS 符號

ORIGINATION OF FORM	填發表格
PROCESSING SECTIONS	製造部門
PERMANENT STORE	棧房
FLOW OF FORM	表格移動
FLOW OF MATERIALS	材料移動
FLOW OF SEMI COMPLETED FURNITURE FROM STORES TO FURTHER PROCESSING	標準製品加工移動
FLOW OF PROCESSED FURNITURE	在製品及成品移動
S/P.O. SALES/PRODUCTION ORDER	銷售生產命令



NOTES

1. Non-Standard Furniture required by S/PO will be machined and assembled by factory sub-contractors
2. Standard Furniture required by S/PO will be further processed from semi-completed items (indicated by thick broken lines)
3. Alternatively if Standard Furniture sold does not require further processing, it will be delivered direct from Finished Goods Stores to customers

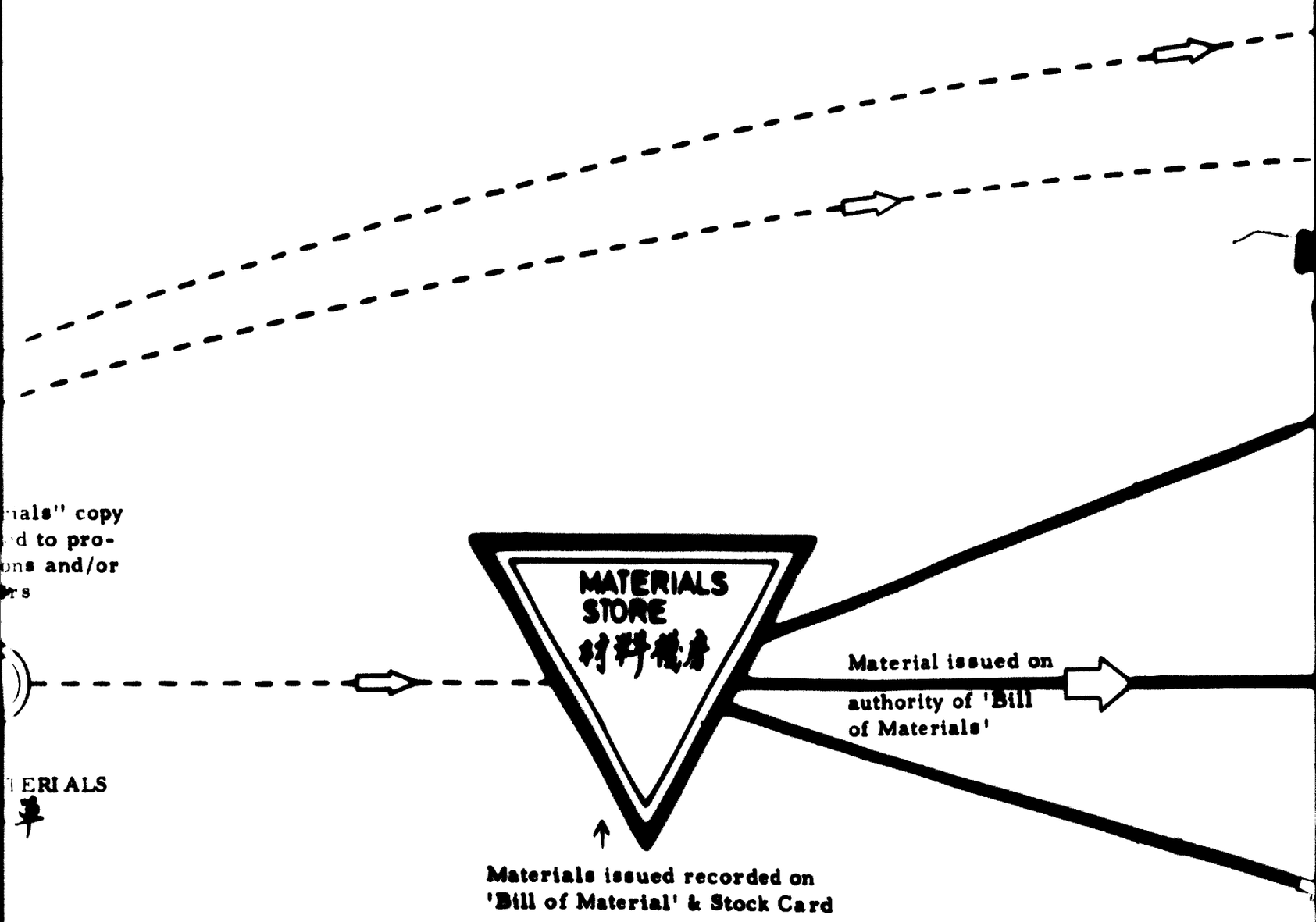
非標準傢俬：製造，由廠內包工員責執作及裝配工作

標準傢俬，根據產銷命令所須由半完成品加工製造

標準傢俬若不須加工製造，可由成品倉直接發送

PRODUCTION TO CUSTOMER'S REQUIREMENTS (SALES/PRO

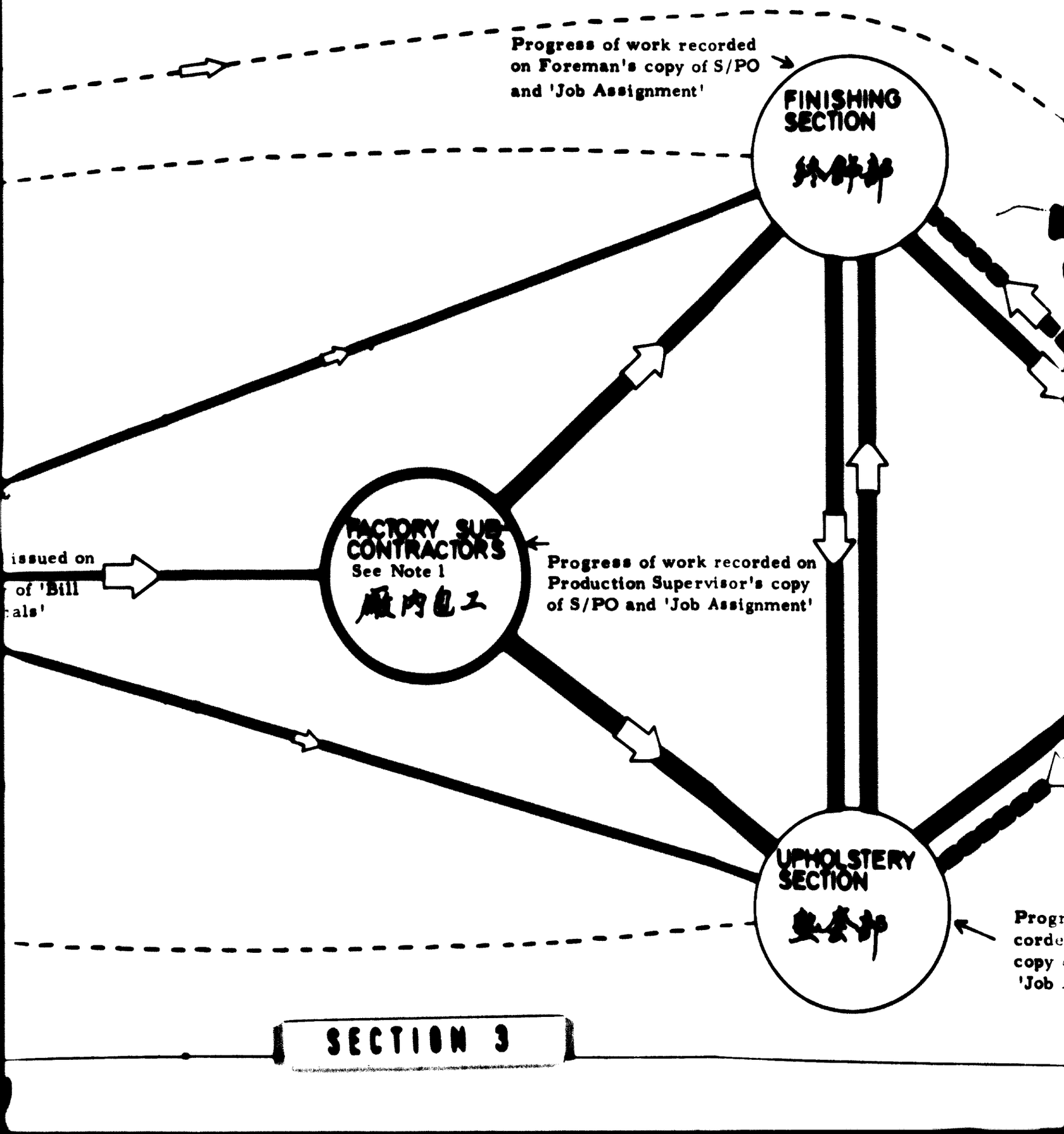
FLOW CHART OF MATERIALS, WORK-IN-PROGRESS, FINISHED GOODS AND RELAT



SECTION 2

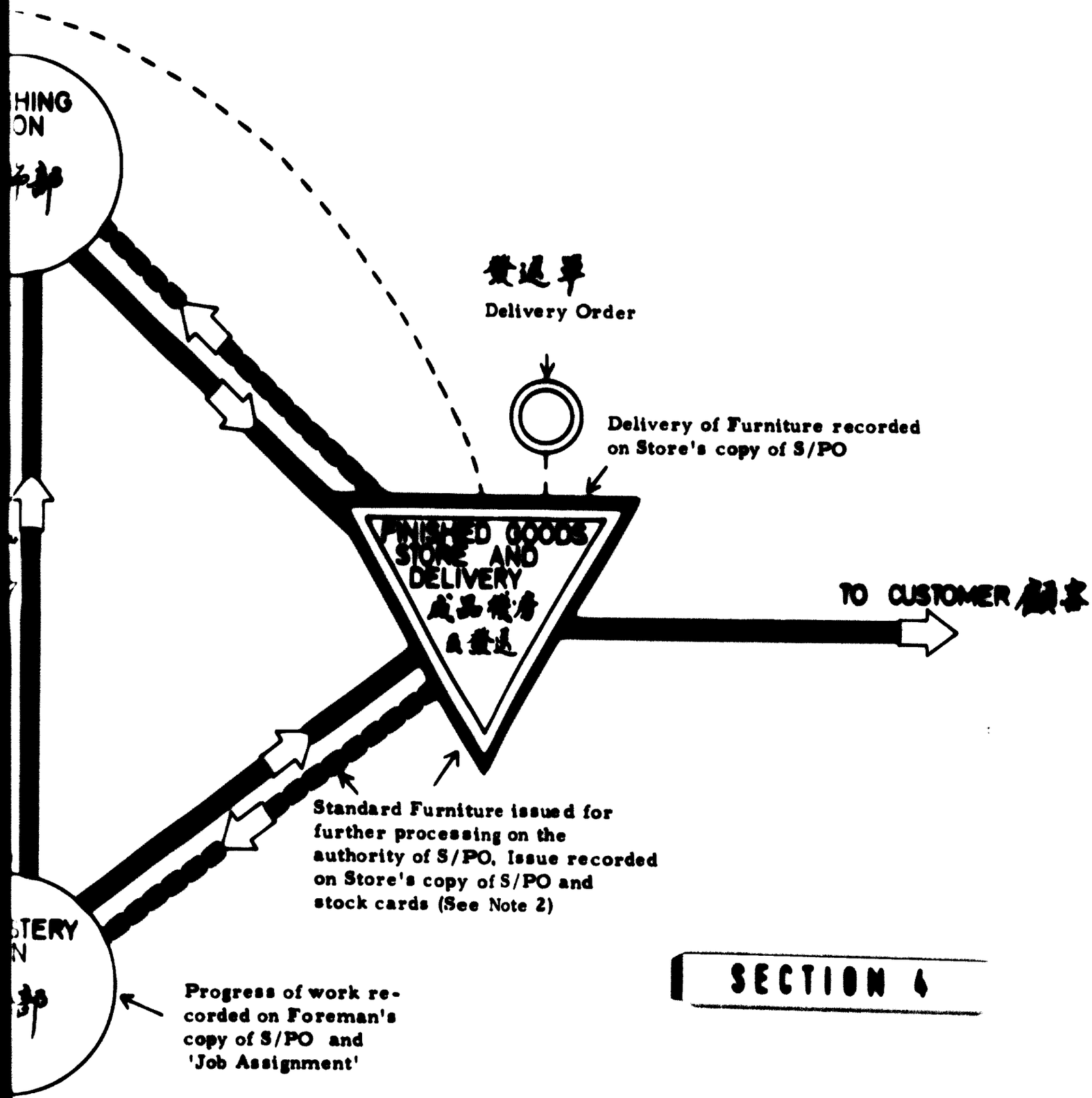
UIREMENTS (SALES/PRODUCTION ORDER) 訂貨生產程序（銷售生產命令）

NISHED GOODS AND RELATED FORMS 原料在製品成品及有關表格移動圖

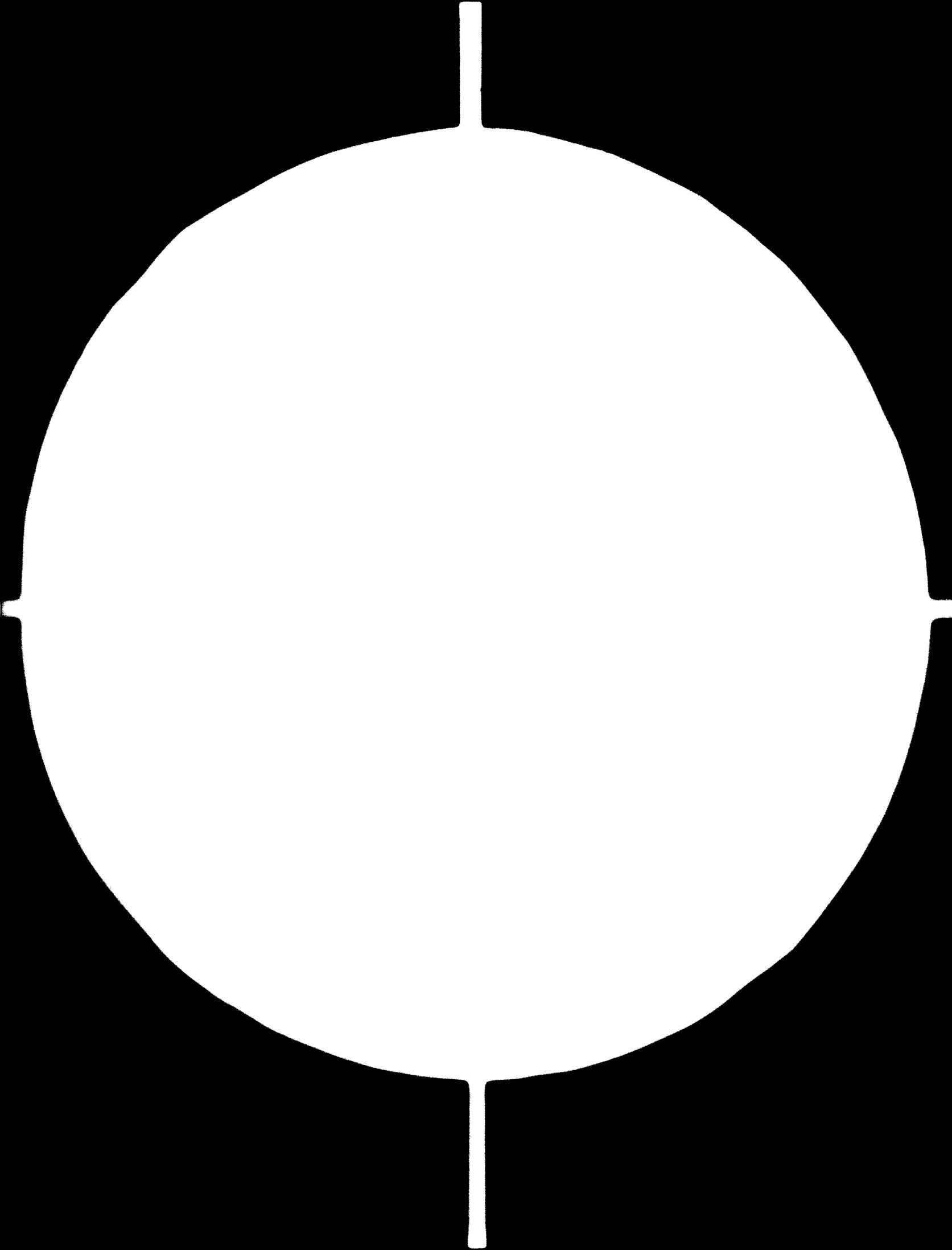


(生產命令)

格移動圖



SECTION 4



估價銷售單 OFFER/SALES ORDER

星木器公司
STAR FURNITURE CO.

SALES/ACCOUNTS COPY
銷售/會計部存本

To ....
致 ....

Offer/Sales Order No. ....
估價/銷售單編號

Customer's Ref : ....
顧客索引

Due Delivery Date : ....
應當交貨日期

Item 項目	Quantity 數量	Description & Progress Record of Delivery 貨物詳述及發送進展記錄	Unit Price 單價 $	¢	Amount 金額 $	¢
		Please sign & return this copy within ...... days 請簽名及於......天內將此存本寄回	TOTAL 總共			

Deliver to : ....
發送至 ....

Deposit 定額
Balance 尚欠
Terms 條例

For STAR FURNITURE CO. 星木器公司

Date .... 日期
.... Signature 簽名

For

....
Buyer's Signature
日期 買主簽名

Copy received back on ......
For Terms & Conditions, see reverse side

Manual of Basic Production Procedures
1972 LIS-UNIDO Ass. 064-D/SIS

估價/銷售單 OFFER/SALES ORD...

星木器公司
STAR FURNITURE CO.

顧客副本 CUSTOMER COPY

To 致 ....

Offer/Sales Order No. 估價銷售單編號 ....

Customer's Ref. : 顧客索引 ....

Due Delivery Date 應當交貨日期 ....

Item 項目	Quan-tity 數量	Description 詳述	Unit Price 單價 $	¢	Amount 金額 $	¢
			TOTAL 總共			

Deliver to 送遞至	Deposit 定銀 Balance 尚欠 Terms 條款
For STAR FURNITURE CO 星木器公司 Date 日期 .... Signature 簽名	For Date 日期 .... Buyer's Signature 買主簽名

For Terms & Conditions, see reverse side

Manual of Basic Production Procedures 1972 LIS-UNIDO Ass. 064-D/SIS

銷售生產命令 SALES/PRODUCTION ORDER

星木器公司
STAR FURNITURE CO.

生產部份本 PRODUCTION COPIES

To 致 ....

....

Sales/Production Order No. 銷售/生產命令編號 ....

Customer's Ref. 顧客索引 ....

Due Delivery Date : 應交貨日期 ....

Item 項目	Quan-tity 數量	Description & Progress Record of Processing and Delivery 貨物詳述,工作進展及發送記錄	Task 工作	Man Days & Code 工數及編號	Due start & completion date 時間表

Task notations: A=Assembly, F=Finishing, U=Upholstery
[illegible]: A = [illegible], F: [illegible] U: [illegible]

Deliver to 發送至 ....
....

INSTRUCTIONS 指示

Date 日期 ....

Authorised by 批核者 ....

Manual of Basic Production Procedures
1972 LIS-[illegible] Ass. 064-D/SIS

星 星木家具公司 STAR FURNITURE CO.

銷售生產令本 SALES/PRODUCTION ORDER

儲存寫本 STORES COPY

To 致 .....

Sales/Production Order No. 銷售生產令本編號 .....

Customer's Ref. 顧客貨號 .....

Due Delivery Date 應交貨日期 .....

Item 項目	Quantity 數量	Description & Progress Records of Delivery and of items received from Processing 貨物說明、加工及發送記錄	Goods issued for further Processing 加工件數	Remarks 備注

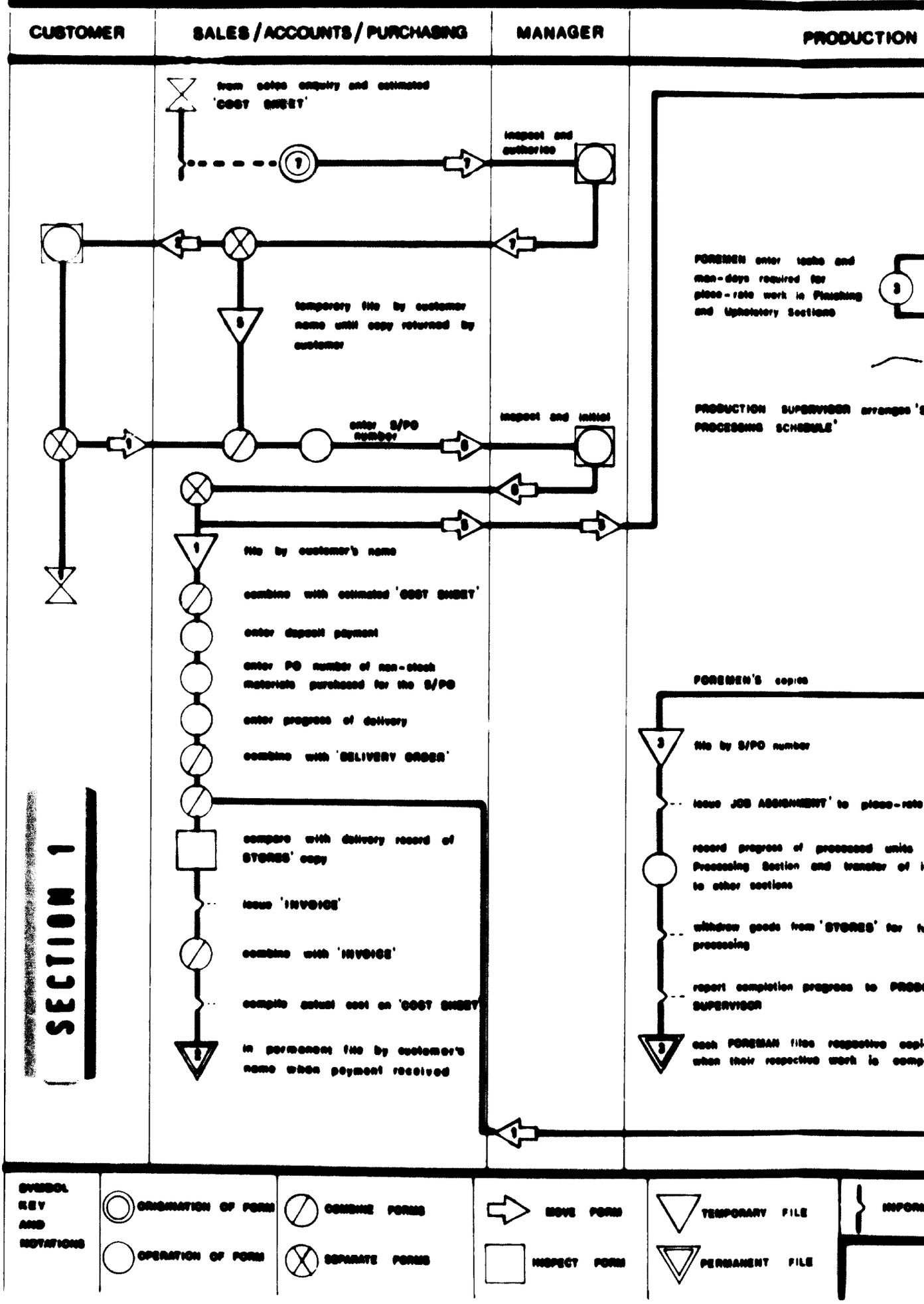
Deliver to 送貨至 .....

INSTRUCTIONS 指示

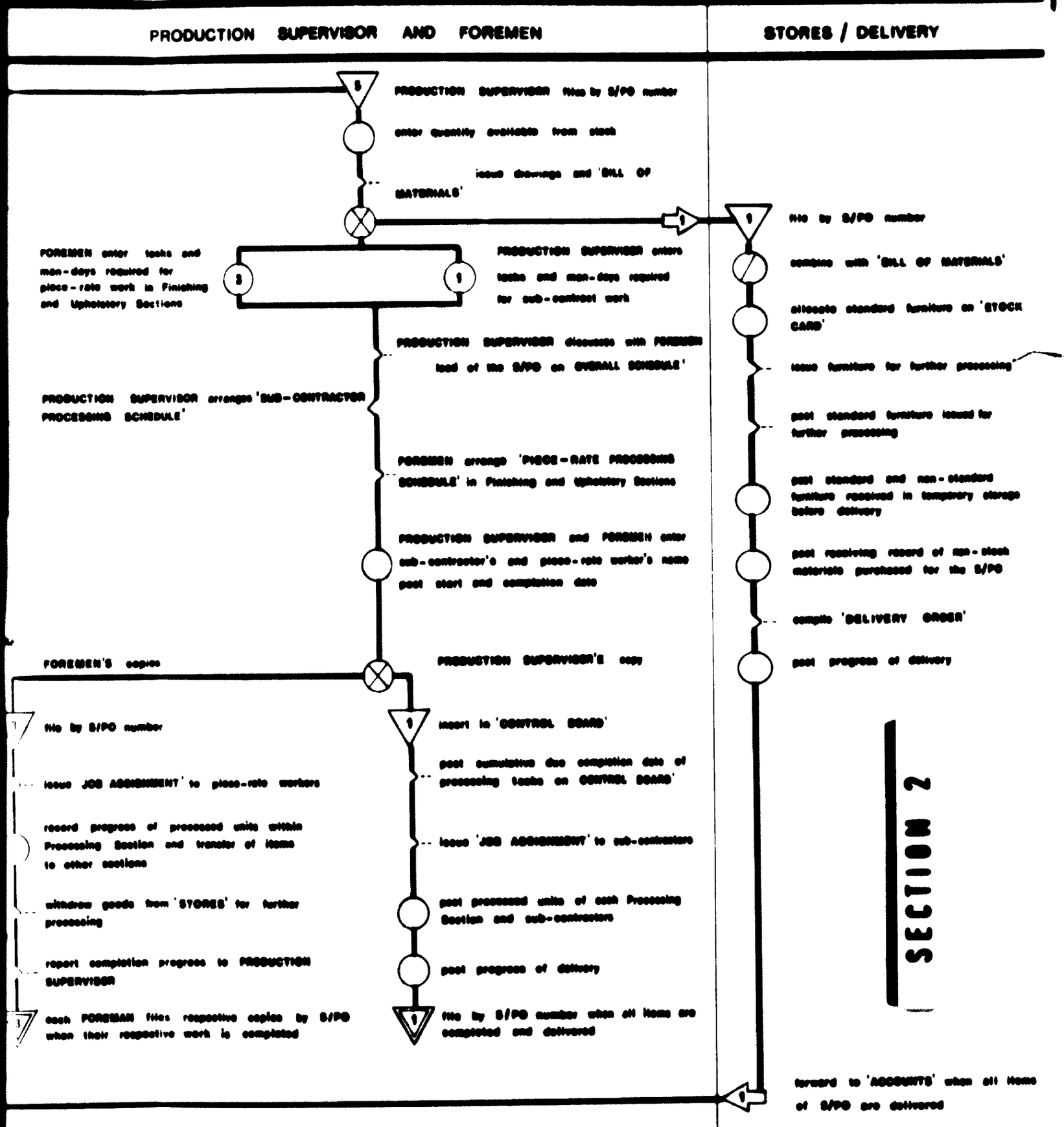
Date 日期 .....

Authorised by 批准者 .....

Manual of Basic Production Procedures
1972


CUSTOMER
SALES / ACCOUNTS / PURCHASING
MANAGER
PRODUCTION
from sales enquiry and estimated 'COST SHEET'
inspect and authorise
temporary file by customer name until copy returned by customer
enter S/PO number
inspect and initial
file by customer's name
combine with estimated 'COST SHEET'
enter deposit payment
enter PO number of non-stock materials purchased for the S/PO
enter progress of delivery
combine with 'DELIVERY ORDER'
compare with delivery record of STORES' copy
issue 'INVOICE'
combine with 'INVOICE'
compile actual cost on 'COST SHEET'
in permanent file by customer's name when payment received
FOREMEN enter tasks and man-days required for piece-rate work in Finishing and Upholstery Sections
PRODUCTION SUPERVISOR arranges 'S PROCESSING SCHEDULE'
FOREMEN'S copies
file by S/PO number
issue JOB ASSIGNMENT' to piece-rate
record progress of processed units Processing Section and transfer of to other sections
withdraw goods from 'STORES' for processing
report completion progress to PROD SUPERVISOR
each FOREMAN files respective copi when their respective work is comp
SECTION 1
SYMBOL KEY AND NOTATIONS
ORIGINATION OF FORM
OPERATION OF FORM
COMBINE FORMS
SEPARATE FORMS
MOVE FORM
INSPECT FORM
TEMPORARY FILE
PERMANENT FILE

FLOW CHART OF OFFER AND SALES / PRODUCTION ORDER (to customer's requirement)



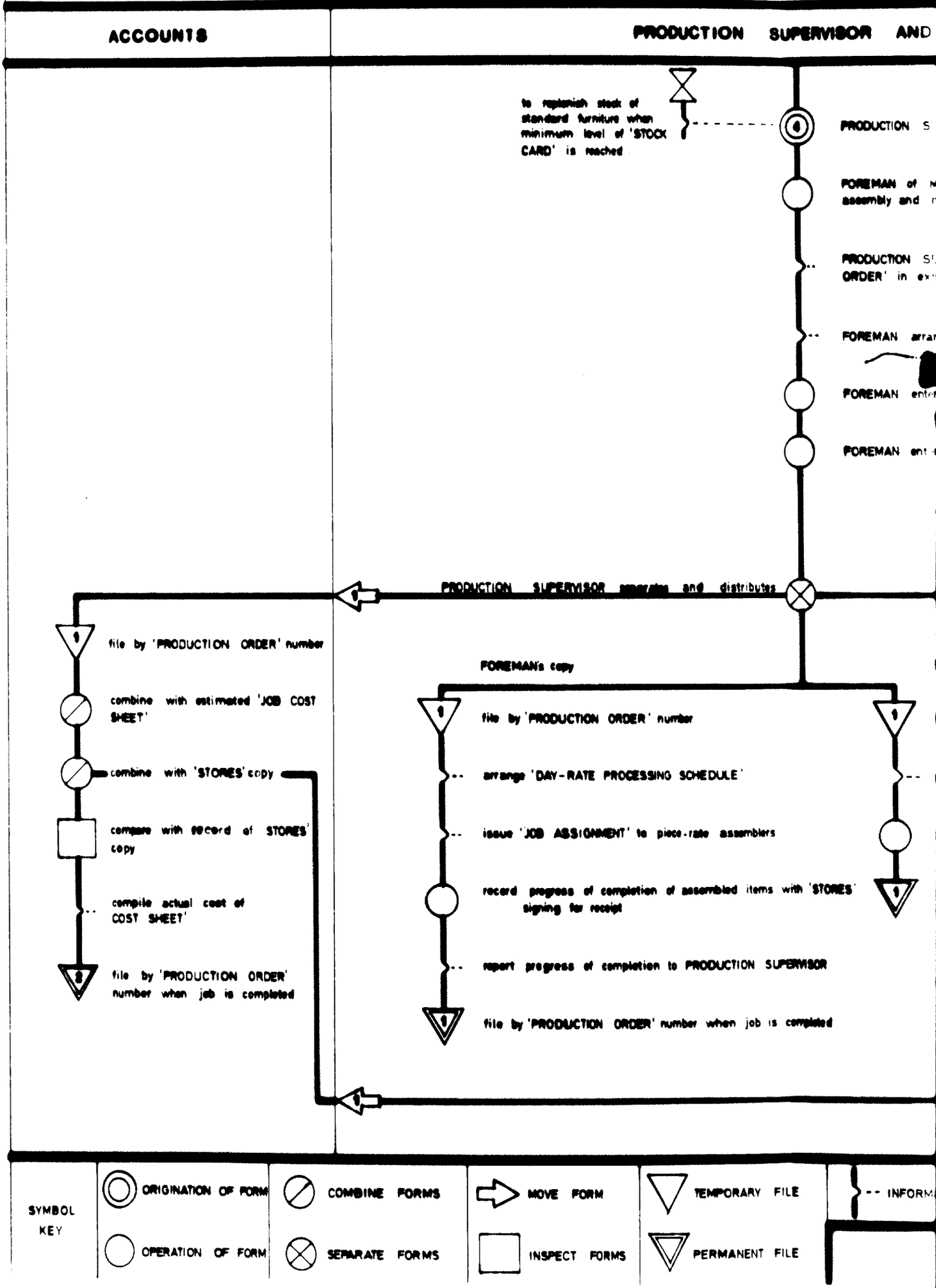
TEMPORARY FILE

PERMANENT FILE

INFORMATION TAKE-OFF

UNCHARTED ACTIVITY

DO = DELIVERY ORDER
S/PO = SALES/PRODUCTION ORDER
P.O. = PURCHASE ORDER


ACCOUNTS
PRODUCTION SUPERVISOR AND
to replenish stock of standard furniture when minimum level of 'STOCK CARD' is reached
PRODUCTION S
FOREMAN of
assembly and
PRODUCTION S
ORDER' in ex
FOREMAN arra
FOREMAN ent
FOREMAN ent
PRODUCTION SUPERVISOR generates and distributes
file by 'PRODUCTION ORDER' number
combine with estimated 'JOB COST SHEET'
combine with 'STORES' copy
compare with record of STORES' copy
compile actual cost of COST SHEET'
file by 'PRODUCTION ORDER' number when job is completed
FOREMAN's copy
file by 'PRODUCTION ORDER' number
arrange 'DAY-RATE PROCESSING SCHEDULE'
issue 'JOB ASSIGNMENT' to piece-rate assemblers
record progress of completion of assembled items with 'STORES' signing for receipt
report progress of completion to PRODUCTION SUPERVISOR
file by 'PRODUCTION ORDER' number when job is completed
SYMBOL KEY
ORIGINATION OF FORM
OPERATION OF FORM
COMBINE FORMS
SEPARATE FORMS
MOVE FORM
INSPECT FORMS
TEMPORARY FILE
PERMANENT FILE
-- INFORM

SECTION 1

FLOW CHART OF PRODUCTION ORDER FORM (for replenishment of stock of standard furniture)

PRODUCTION SUPERVISOR AND FOREMAN	STORES
PRODUCTION SUPERVISOR compiles and authorises	
FOREMAN of Machining and Assembly Section enters man-days required for assembly and machining tasks	
PRODUCTION SUPERVISOR discusses with FOREMAN insertion of 'PRODUCTION ORDER' in existing load	
FOREMAN arranges 'PIECE-RATE PROCESSING SCHEDULE' for assembly	
FOREMAN enters name of piece-rate assemblers	
FOREMAN enters due completion date for machining	
ates and distributes	file by 'PRODUCTION ORDER' number
PRODUCTION SUPERVISOR's copy	combine with BILL OF MATERIALS
number	insert in 'CONTROL BOARD'
SING SCHEDULE'	post on 'CONTROL BOARD' due completion date of machining
piece-rate assemblers	post progress completion when reported by FOREMAN
on of assembled items with 'STORES'	file by 'PRODUCTION ORDER' number when job is completed
on to PRODUCTION SUPERVISOR	
R' number when job is completed	
	enter assembled items received from FOREMAN
	post received items on 'STOCK CARDS'
	forward copy to 'ACCOUNTS' when all items received in STORES

SECTION 2

TEMPORARY FILE

PERMANENT FILE

-- INFORMATION TAKE-OFF

UNCHARTED ACTIVITY

021 - OFFER-SALES/PRODUCTION ORDER FORM Procedure

021.1
Objectives

The 'Offer-Sales/Production Order' Form is designed to fulfil the following functions :

i) As a sales and/or production authority, it gives authorisation to sell and/or start production according to customer's requirements or to replenish stock of Standard Furniture respectively.

ii) To record information on the customer, his product specifications, quantity ordered, price, due delivery date and payments terms.

iii) To constitute the basis for purchasing and issuing of non-stock materials required, or issuing of Standard Furniture for further processing (finishing and/or upholstery) as required by the particular 'Sales/Production Order'.

iv) To form a starting point for the control mechanism - determine where, how, who and when work is to be done.

v) For recording the progressive completion of products at each Processing Section, and other activities such as, transferring of Work in Progress between Processing Sections, receiving processed goods into Stores, delivery of Finished Goods.

021.2
The Form & Handling Steps

021.2.1 Sales/Production Order

-1. When the set of maximum seven copies

Forms are compiled for specific customer's requirements, it will initially constitute as 'Sales Offer', which upon receipt of confirmation from the customer will function as 'Sales/Production Order'. The flow of activities related to the 'Sales/Production Order' is shown in the Flow Chart A on page 021/5. The 'Sales/Production Order' may include Standard and/or Non-Standard Furniture. The Form will be distributed as follows :

i) Original : Customer

ii) Second copy : Sales/Accounts/Purchasing

iii) Third copy : Production Supervisor

iv) Fourth copy : Stores/Delivery

v) Fifth, Sixth and Seventh : Processing Sections as required (these copies are identical to the Production Supervisor's one).

-2. The number of copies to be distributed to the Processing Sections depends on the type of processing tasks required. For example, no copy of the Form will be required for the Foreman of the Upholstery Section, if no upholstery work is required by the particular 'Sales/Production Order'.

-3. The Form is compiled by the Sales or the Production Supervisor and approved by the Manager as required.

021.2.2 Production Order

-1. Alternatively, to replenish stock of Standard Furniture, when minimum level is reached, a set of four-copy 'Production Order' will be issued. In this case, the word "Sales" will be crossed out from the heading "Sales/Production Order" to indicate that the goods

are processed for stock. The word "Stock" will be entered in the space reserved for the customer's name. The Form is distributed as follows :

i) Original : Production Supervisor

ii) Second copy : Stores

iii) Third copy : Accounts

iv) Fourth copy : Machining/Assembly Section

-2. A fifth and sixth Foremen's copy may be required if Standard Furniture made for stock is to be finished and partly upholstered. The flow of activities related to the 'Production Order' Form is shown in the Flow Chart B on page 021/6.

021.2.3 Sales Order

-1. As a third alternative, the customer's requirements may include only Standard Furniture readily available for delivery from stock. In this instance the word "Production" will be crossed out from the 'Sales/Production Order' to indicate that no production activity is required to fill the Order. The Form will be distributed as follows :

i) Original : Customer

ii) Second copy : Sales/Accounts

iii) Third copy : Stores/Delivery

-2. The procedure for this alternative is not elaborated in this Manual.

021.2.4 Layout Features of the Form

-1. The layout of the Form has been devised to allow its use as a "visible index" card on the Overall Control Board (ref. 023.2).

-2. Another important feature is that when the Form is filled in, a blank space is left between the description of the various products required by the Order. The blank space will be utilised for the posting of Progress Record, related to the Order, by the various centres of responsibility making use of the Form.

021.3
Procedure

021.3.1 Origination of Sales/Production Order Form

-1. On the customer's request for a specific requirement, the Sales will compile the 'Offer and Sales/Production Order' in five to seven copies as required.

i) Enter Offer number the customer's name, address, reference and Offer number.

ii) File in the item(s) number(s), quantity, description and delivery date.

iii) Enter the unit price, total price of individual item(s) offered and terms of payment. These data will be posted on the Customer's and Sales' copies only.

iv) State validity period of the Offer.

-2. All the Forms are forwarded to the Manager for approval and signature. The Forms are separated by the Sales and two copies are forwarded to the customer for confirmation of order and signature. Five copies are retained temporarily by the Sales in a "Open Offer" file until receipt of the sales confirmation order.

-3. The customer will retain one copy for reference and send back the second one duly signed for confirmation if the Offer is

accepted. If the Offer is not accepted by the customer within the period specified in the Form, it may be considered void at the discretion of the company.

-4. On receipt, the Sales will combine the returned copy with the five retained ones, enter the date received back. If the customer has not accepted the Offer, the Form will be filed away while the Production and Stores copies will be destroyed. If however, the Offer has been confirmed, the Sales will enter the 'Sales/Production Order' (S/P.O.) number on the Form and separate it for distribution. The Sales will retain one copy of the Form, which will be shared with the Accounts and Purchasing and forward the remaining five to the Production Supervisor.

021.3.2 Origination of Production Order Form

Alternatively, to replenish stock of Standard Furniture, the Production Supervisor will originate and compile the 'Production Order' (P.O.) as follows : description and code of product, quantity required, due completion date and date issued. The Supervisor will normally approve the Form. The Form activities described below refer mainly to the 'Sales/Production Order' Form. Activities related to the 'Production Order' Form are shown on the relevant Flow Chart on page 021/6.

021.3.3 Form Activities by Sales/Accounts/Purchasing

-1. The copy retained by Sales/Accounts/Purchasing is filed by customer Job File. The Accounts will enter any deposit payment received by the customer. If non-stock material is purchased for the requirements of the specific Order, the number of the relevant 'Purchase Order'

may be posted on Progress Record of the Form.

-2. When receiving the Stores' copy of the 'Sales/Production Order' (together with the Stores' copy of the 'Bill of Materials') the Accounts will combine it to its own copy. From the Stores' copy the Accounts will drive, for costing purpose, the quantity of semi-completed Standard Furniture issued for further processing according to S/P.O. requirements. The Accounts will also compare the delivery record of the Stores' copy with the record of its own copy before issuing the Invoice to the customer.

-3. When customer's payment is received, the customer Job File, containing the S/P.O. Form and the other pertinent documents, is transferred to permanent records. In the instance of 'Production Orders' for replenishment of stock, the Form will be filed in numerical order and used for reference of Accounts only. Relevant 'Delivery Orders' will be attached to the S/P.O. Form.

021.3.4 Form Activities by Production Supervisor and Foreman

-1. On receiving copies of the S/P.O. from the Sales, the Production Supervisor will check with the Storekeeper whether any of the Standard Furniture required for the specific S/P.O. is readily available for delivery from stock. In the positive case, the S/P.O. will be entered accordingly in the "remark" space. On the basis of the requirements of the S/P.O., all necessary production documents such as drawings, 'Bills of Materials' etc. will be prepared under the responsibility of the Production Supervisor. The Stores' copy will be forwarded right away to the Storekeeper.

-2. As the Production Supervisor is directly responsible for assigning work to Sub-contractors, he will estimate and post on the S/P.O. Form processing tasks and man-days related to Sub-contractor's work. The Foremen will similarly enter their own copies of S/P.O. in respect to man-days required for respective Piece-Rate Work.

-3. From the estimated man-days load thus indicated, the Production Supervisor will discuss with the Foremen involved the loading of the new S/P.O. on the existing Overall Schedule. After the 'Day-Rate and Sub-contractors Processing Schedules' (ref. appendix 051 & 053) have been arranged accordingly, the name of Piece-Rate and/or Sub-contractors will then be entered on the Form as required, together with expected start and/or completion dates. In the instance of Sub-contractor's work, only the completion dates will be entered (ref. paragraph 6.4.3.)

-4. At this stage the S/P.O. copies will be separated by the Production Supervisor who will retain one copy and distribute the remaining ones to the Foremen.

-5. The Production Supervisor will insert his copy in the Control Board and will use the Form as a basis to post cumulative due completion date of each processing task on the Control Board. The Form will also constitute a source of reference when issuing 'Job Assignments' to Sub-contractors. Progress of item completed at each Processing Section will be entered on the Form as reported by the respective Foreman. Progress of delivery and number of relevant 'Delivery Order' will constitute the final entry on the Form on the part of the

Production Supervisor who will file it permanently by S/P.O. number when all items are completed and delivered.

-6. The Foremen's copies of the S/P.O. will be filed by S/P.O. number and will constitute reference for the compilation of 'Job Assignments' to Piece-Rate Workers. Record of items completed, within each Processing Section, will be posted by the Foremen on their respective copies of the S/P.O. and reported to the Production Supervisor. This entry will be countersigned by the receiving Foreman when Work in Progress is transferred from one Processing Section to another. If, instead, the completed items are transferred to temporary storage waiting for delivery, the Storekeeper will countersign the entry. The Foreman copy of the S/P.O. is finally filed by numerical order when their respective work related to the Order is completed.

021.3.5 Form Activities by Stores/Delivery

-1. The Stores will receive one copy of the Form which will be filed by S/P.O.number and used as reference in allocating, receiving, issuing and delivering Finished Goods. The Storekeeper will enter on the Form the Finished Goods which are received from the Foremen and Sub-contractors in temporary storage until they are delivered to customers. In the instance of 'Production Orders' for the replenishment of stock of Standard Furniture, the receipt of items in permanent storage will also be recorded on the Stores' copy of the Order.

-2. Where items are issued for further processing as required by the S/P.O., the Storekeeper will record such issues on the

Form with the receiving Foreman countersigning for receipt.

-3. If necessary, the Storekeeper may enter on the Form the Progress Record of materials specially purchased for the specific Order. The Form will also be posted with the progress of delivery. When all items related to the specific Order are completed and delivered, the Storekeeper will attach his copy of the S/P.O. to the relevant 'Bill of Materials' and forward it to the 'ccounts. Similar flow will apply for the Stores' copy of 'Production Orders' for stock, when all items are completed and delivered to Stores.

星木器公司
STAR FURNITURE CO

雜件命令 MISCELLANEOUS WORK ORDER

Customer 顧客	Miscellaneous Work Order No. 雜件命令編號
Deliver to 運送至	Sales/Production Order No. 銷售/生產命令編號
Due delivery date 交貨日期	Description 詳述

Repairs of goods 修理工作	Further Processing of Goods 加工製造	Other minor jobs 其他細件
☐ From Store 來自貨倉	☐ From Store 來自貨倉	☐ Prototypes 樣本
☐ Returned by customer 由顧客退回	☐ Returned by customer 由顧客退回	☐ Maintenance 保養
		☐ Others 其他

MATERIAL RECORD 材料記錄

Description 詳述	Required 需要		Issued 發出	
	Qty 數量	Cost 成本	Qty 數量	Cost 成本
	TOTAL		TOTAL	

DAILY LABOUR RECORD 人工記錄

日期 Date	部門 Section	工人姓名 Name of worker	Time 時間		小時 Hours	工率 Rate	成本 Cost
			Started 開始	Finished 完成			
						TOTAL	

SUMMARY OF COST 成本摘要		
	Estimated 估計	Actual 實際
Materials 材料		
Labour 人工		
Overhead 雜費		
Total cost 總成本		

Charge to 記帳: ☐ Customer 顧客戶口 ☐ Expense A/c 費用戶口

Authorised by .... date ....
批准者 日期

Assigned by .... date ....
分配者 日期

Remarks
備註

Manual of Basic Production Procedures
1972 [illegible]

PRODUCTION CO

SECTION 1

INSERT PRODUCTION ORDER & SALES/PRODUCTION ORDERS & MISCELLANEOUS WORK ORDERS IN THE POCKETS BELOW IN ORDER OF PRIORITY
以工作之緩急排列，分别插入生產，銷售生產及來作命令於下列格子中。

1	2	3

To 致 Stock (Desk type DS-2)
~~Sales~~/Production Order No. 1005
銷售/生產命令編號
Customer's Ref. 顧客索引
Due ~~Delivery~~ Date : 應當交貨日期

To 致 Stock (Chair type DC-12)
~~Sales~~/Production Order No. 1006
銷售/生產命令編號
Customer's Ref. 顧客索引
Due ~~Delivery~~ Date : 應當交貨日期

To 致 Stock (Armchair type AC-18)
~~Sales~~/Production Order No. 1007
銷售/生產命令編號
Customer's Ref. 顧客索引
Due ~~Delivery~~ Date : 應當交貨日期

To 致 Singa & Company.
Sales/Production Order No. 1208
銷售/生產命令編號
Customer's Ref. 顧客索引 TSN-1005
Due Delivery Date : 應當交貨日期 18.5.1972

To 致 Asia Hup Kee
Sales/Production Order No. 1209
銷售/生產命令編號
Customer's Ref. 顧客索引 XY-12
Due Delivery Date : 應當交貨日期 21.5.1972

To 致 Nanyang Ltd.,
Sales/Production Order No. 1210
銷售/生產命令編號
Customer's Ref. 顧客索引 NL 1701
Due Delivery Date : 應當交貨日期 27.5.1972

Customer 顧客 Sun & Company.
Deliver to 發送至 179 Over Queen Street.
Due delivery date 應交貨日期 17.5.1972.
Miscellaneous Work Order No. 來作命令編號 27
Sales/Production Order No. 銷售/生產命令編號 1203.
Description 詳述 Re-Finishing of Armchair

NOTATIONS 符號

[u] · Cumulative target of each processing task for Sale/Production Orders. Letters indicate processing: F=Finishing U=Upholstery SB=Sub-contractor
銷售生產命令，各項工作完工目標，
F=修飾 U=墊套 SB=包工

(190) Progress... Furnitur... indicate... 標準... (法...

CONTROL BOARD 生

WEEK 1 第一週							WEEK 2 第二週							WEEK 3 第三週							WEE			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

EAR

EAR

500

200

150

SECTION 2

F

U

F.

U

F

F

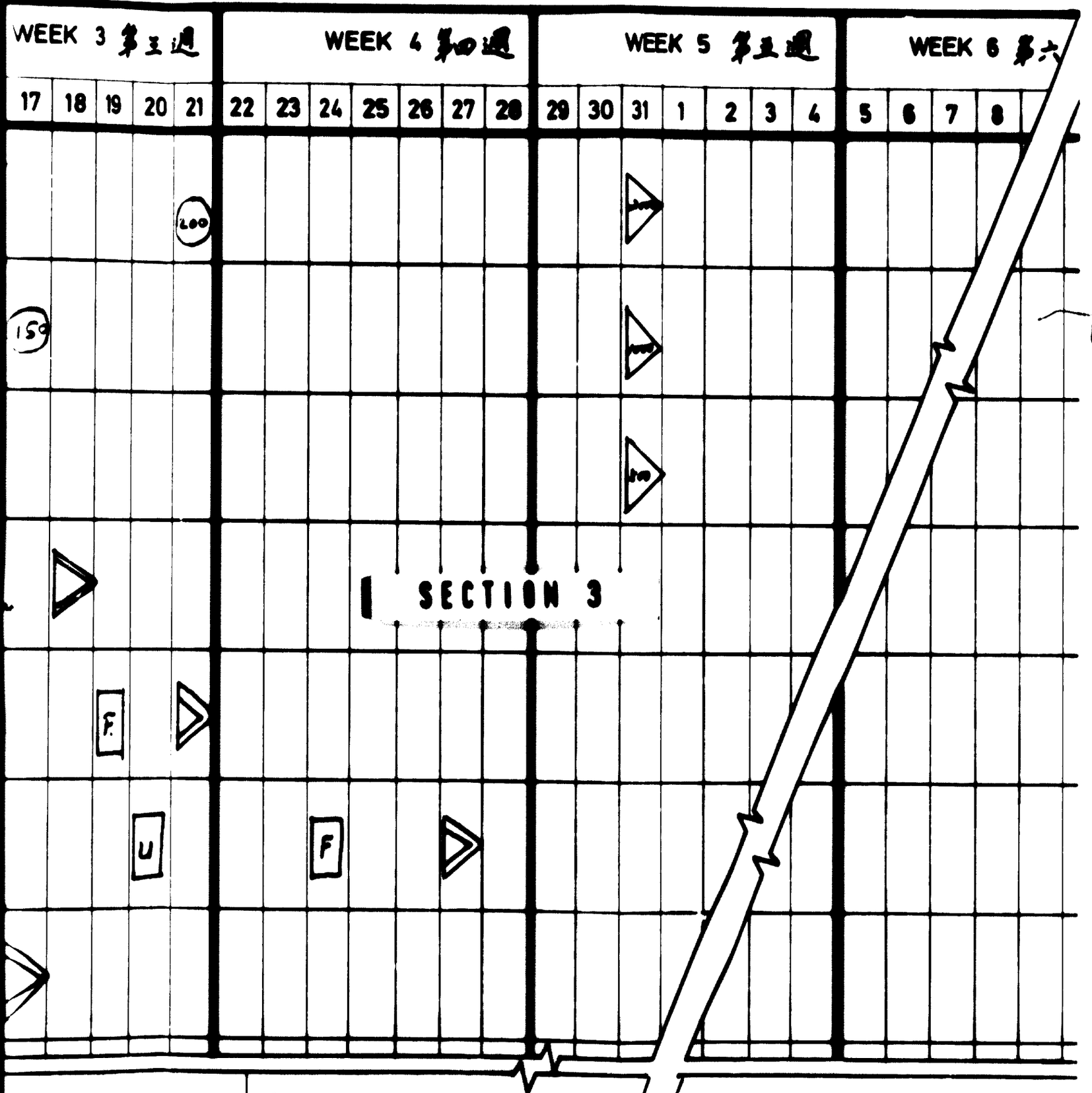
Progressive record of assembled Standard Furniture for stock (inset number indicate pieces assembled)
標準木器生產進展標誌
(注明完成件數)

Monthly completion target for machining of Standard Furniture for stock (inset number indicate units required)
標準木器每月規定總數標誌
(注明應完成件數)

Deliv
數

App

ARD 生產管制



rget for machining of
stock (inset number
)
加作總數標誌

Delivery targets
發運日期

EAR : Early assembly required
需及前裝配

023 - PRODUCTION CONTROL BOARD - Procedure

023.1 Objectives

The main objectives of the Control Board can be summarised as follows :

i) Present an overall picture of scheduled plant production and deliveries.

ii) Provide a basis for control of plant performance in terms of scheduled and actual output and deliveries.

iii) Permit visual review to be made frequently to detect deviation from schedule and take corrective actions accordingly.

023.2 The Board

023.2.1 The Board consists of a vertical "pockets" column on the far left and a series of "weeks" column which constitute a time-scale reference. The "weeks" column are ruled vertically into seven spaces corresponding to the days of the week. The columns are also ruled horizontally with each horizontal space corresponding to a pocket of the "pockets" column. If possible, the "weeks" column should be made of separate sections so that the first column can be shifted to the far right when its calendar period expires.

023.2.2 The "pockets" column is designed to receive a copy of the 'Sales/Production Orders' scheduled for production. The Forms are held in the "pockets" which overlap one another in vertical rows. The 'Sales/Production Order' Forms are arranged

in the board in order of priority and will provide a "visible index" reference of the orders on hand. To obtain the "visible index" arrangement, the upper edge of the Form is folded back, while the margin right below will protrude from the Board pocket to display the Form heading containing the basic information related to the order, that is, 'Sales/Production Order' number, name of customer, due delivery date. The Form can be easily pulled up to show the additional notations below the visible margin, or to be entered with Progress Record related to the order. Forms are inserted in the Board in priority order and remain in place until the order is completed and/or shipped. All the S/P.O. Forms of completed orders are removed from the Board leaving in the "pockets" orders in process only.

023.3 Procedure for entering Overall Scheduling Date on the Board

023.3.1 Entering Overall Schedule of Standard Furniture for Stock

-1. Once the monthly load for Standard Furniture has been determined and the relevant 'Production Orders' issued, the Production Supervisor will insert the Production copy of the 'Production Order' on the Overall Scheduling & Control Board. The Form will be arranged in the Board pockets in order of priority (ref. 6.3.1-2) and will show the quantities scheduled to be machined for the month. From this reference the Production Supervisor will enter the required quantities of each product on the time-scale line corresponding to the respective 'Production Order' Form inserted on the Board (ref. 6.3.2-1).

-2. No entry of assembly schedules, related to Standard Furniture expected to be machined for the month, will normally appear on the Overall Scheduling & Control Board because it is assumed that their assembly load will usually overlap with the machining completion date.

-3. The notation EAR (Early Assembly Requirement) will be entered on the Board when it is required to get the final assembly under way well before the completion of the machining of the product (ref. 6.3.2-2 & 6.4.2-4).

023.3.2 Entering Overall Schedule for Non-Standard Furniture and further processing of Standard Furniture from Stock

-1. 'Sales/Production Orders' will be inserted and arranged on the Control Board (ref. appendix 023) similarly with the 'Production Orders' by the Production Supervisor. 'Sales/Production Orders' will include Non-Standard Furniture and/or finishing and upholstery work of Standard Furniture from stock. In both cases the Form will show the breakdown of due completion dates of individual Sub-contractor's and Piece-Rate Assignments related to each product (ref. appendix 021.3.4-2).

-2. From this reference the Production Supervisor will enter on the Board the cumulative completion dates for the various processing tasks related to all items ordered by the given 'Sales/Production Order'. For example, if a given 'Sales/Production Order' includes item 1 (12 chairs) and item 2 (6 tables) for which the related finishing work is expected to be completed respectively on the 16th and 19th then the cumulative completion date for the finishing task of both items will be set

at the day 19th.

-3. The relative completion dates of the various processing tasks related to individual 'Sales/Production Order' are best determined by calculating processing time backward from the promised delivery date and the due completion time of the last task involved (usually the finishing task). The cumulative due completion dates of each processing task will be indicated by a square located on the relevant date of the time-scale. A code letter will be inserted in the circle to identify each processing task. Scheduled delivery dates will be indicated with a "triangle" symbol.

023.4 Procedure for entering Overall Control Data on the Board

023.4.1 Entering Overall Control Data for 'Sales/Production Orders'

-1. As reported daily by the Foreman, the progressive completion of upholstery and finishing tasks of Standard and Non-Standard Furniture will be posted by the Production Supervisor on to the Progress Record of the relevant 'Sales/Production Order' copies of the Control Board.

-2. Progress data of Non-Standard Furniture processed by the Factory Sub-contractor (maching and assembly), are derived from the Progress Record of the relevant 'Job Assignment' and posted likewise on the 'Sales/Production Order' copy of the Control Board.

-3. The progress of item delivered, derived from the relevant 'Delivery Order', will be similarly posted on the Board.

-4. In addition to the detailed progress posted for permanent reference on the 'Sales/

Production Order' Form of the Control Board, an exposed record will also be entered directly on the time-scale of the Board by crossing out the "square" and "triangle" symbols representing respectively scheduled completion of processing tasks and scheduled delivery.

023.4.2 Entering Overall Control Data for 'Production Orders' of Standard Furniture for Stock

-1. In the instance of Standard Furniture machined and assembled for stock, performance data are similarly reported on daily basis by the Foremen and posted on to the relevant 'Production Order' copy of the Control Board. However, the 'Sales/Production Order' copy of the Control Board will be posted only with the progress of quantities assembled.

-2. The exposed Progress Record on the time-scale lines will consist of crossing out the scheduled machining quantities when the machining task is completed. As for the assembly task, the exposed Progress Record will be maintained by entering the quantity assembled within a circle under the date the progress is reported.

星木器公司
STAR FURNITURE CO.

成本估計單 COST SHEET

編號 No ....

銷售生產命令編號
Sales/Production Order No. ....

顧客姓名
Customer ....

數量
Quantity .... 貨物名稱 Description ....

ELEMENTS OF COST		ESTIMATE 估計 Q'ty 數量	Unit Price 單價	Amount 金額	ACTUAL 實際 Q'ty 數量	Unit Price 單價	Amount 金額
(1) DIRECT MATERIALS 直接成本	1 Teakwood 柚木						
	2 Other timber 其他木料						
	3 Veneers						
	4 Composite boards 合成板						
	5 Plastic Laminates						
	6 Fittings 配件						
	7 Finishes						
	8 Glues						
	9 Upholstery covers						
	10 Fillings & foams						
	11 Spring & webbing						
	12 Purchased parts						
	13 Semi-completed goods						
	14 Others 其他						
	TOTAL 總共						

		ESTIMATE Hours	Amount 金額	ACTUAL Hours	Amount 金額
(2) DIRECT LABOUR 直接人工	1 Machining				
	2 Assembly				
	3 Finishing				
	4 Upholstery				
	5 Metal work				
	6 Factory Sub-contracts				
	TOTAL 總共				

	ESTIMATE	ACTUAL
TOTAL DIRECT (or Prime) COST		
(3) Manufacturing overheads		
MANUFACTURING COST		
(4) Selling and administration Overheads		
TOTAL COST 總成本		

Compiled by : .... Date:	PROFIT MARGIN : 利潤 $
Approved by : .... Date:	SELLING PRICE : 售價 $

Manual of Basic Production Procedures
1972 App. 024

024 - COST SHEET FORM Procedure

024.1 Objectives

The main objectives of the 'Cost Sheet' can be summarised as follows :

i) To provide a breakdown of elements of cost for each product manufactured.

ii) To provide estimated total cost of the product as a basis for the determination of Selling Price.

iii) To accumulate actual cost incurred for Direct Materials and Direct Labour based on the records of 'Bill of Materials', 'Sales/Production Order', weekly 'Day-Rate Processing Schedule' and 'Job Assignment'.

iv) To recover overheads based on predetermined rates.

v) To enable meaningful comparison between actual cost incurred and estimated cost. Variances which require investigation and remedial action are brought to the notice of management. This is known as management by exception.

vi) To provide a historical record of cost information useful as a basis for future estimates.

024.2 The Form & Composition

The 'Cost Sheet' shall show the description of the product manufactured, customer's name and due date for delivery. The layout of the Form includes 'Estimate and 'Actual' columns. The 'Cost Sheet' is

numerically numbered, prepared in duplicate and distributed as follows :

Original	:	Accounts for cost computation
Second copy	:	Production Supervisor for estimates and control of product

The Form is prepared by the Accounts and approved by the Manager.

024.3 Procedures

024.3.1 The Production Supervisor working closely with the Foreman and the Accounts will prepare data on estimates of material and labour costs. These estimated figures are based on the 'Bill of Materials', 'Operation Sheet', (ref. 10.5.1) past records and experience.

024.3.2 The information will be passed by the Production Supervisor to the Accounts who will accumulate and post them on to the 'Estimated' column of the 'Cost Sheet' to arrive at the 'Estimated Direct Cost'. Estimated overheads will be calculated and added to the 'Estimated Direct Cost' to arrive at the 'Estimated Total Cost'. The various cost elements of the 'Cost Sheet' are accumulated as shown on paragraph 10.7.1.

024.3.3 One copy of the 'Cost Sheet' is channelled back by the Accounts to the Production Supervisor to be used as a yardstick for cost control purposes. The other copy will be retained by the Accounts in temporary file until completion of the job.

024.3.4 -1. When the manufacturing process has been completed and the product is ready for

delivery, the Accounts will accumulate and make use of the following Forms as a reference for the calculation of actual costs to be entered into the 'Cost Sheet' (ref. 10.6.1) :

i) 'Bill of Materials'

ii) 'Day-Rate Processing Schedule'

iii) 'Job Assignment'

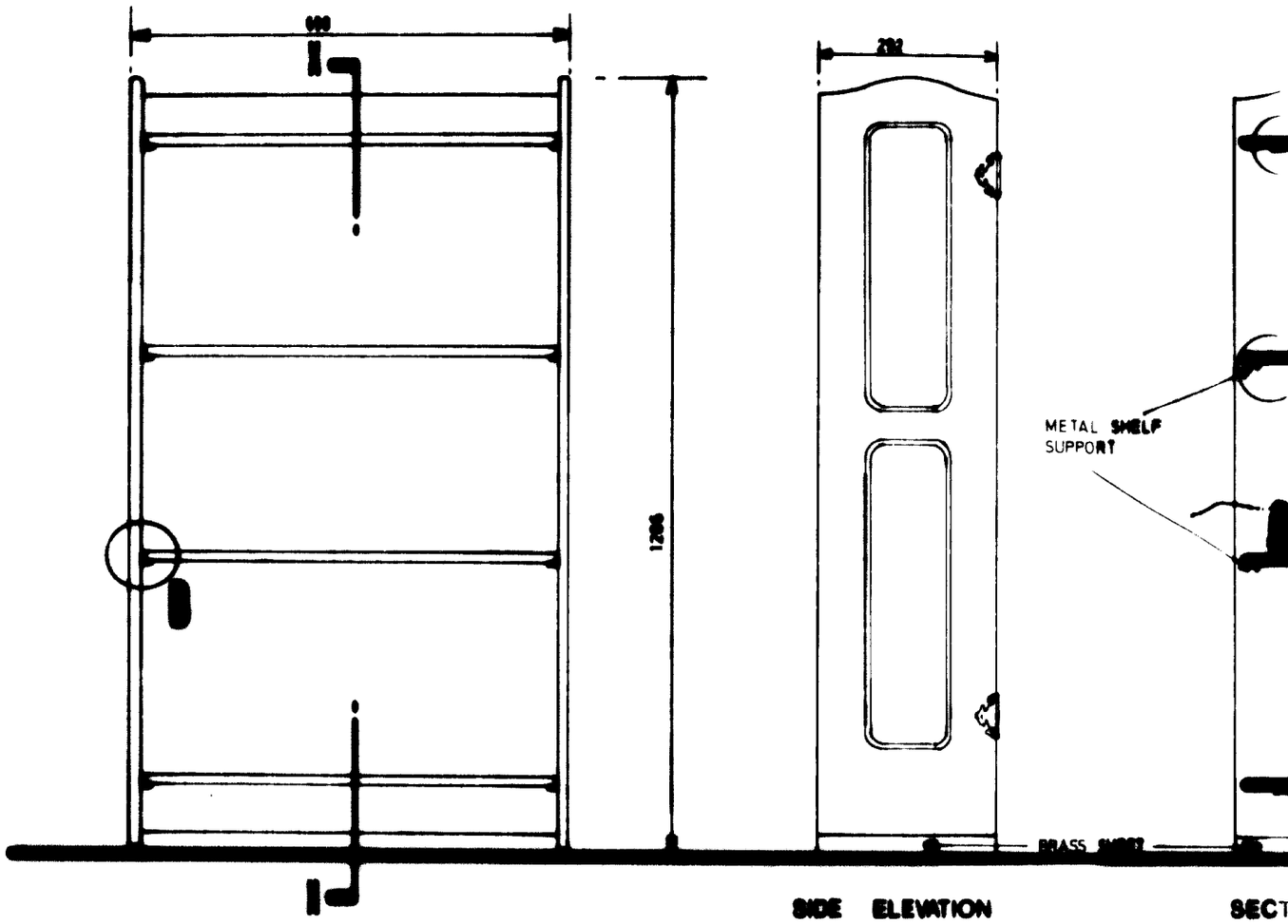
iv) 'Sales/Production Order'

-2. Cost data derived from the above documents will be accumulated together with the various overheads on the 'Actual' column of the 'Cost Sheet' to arrive at the 'Actual Total Cost' figure.

024.3.5 It should be noted that semi-completed Finished Goods - issued from the Stores for further processing according to specific customer's requirements will be charged to the item 13 of the 'Cost Sheet' at their original manufacturing cost plus the additional labour and material cost incurred in further processing.

024.3.6 The actual cost incurred are then compared with the estimates. Any exceptional variance which requires investigation and remedial actions is reported to management.

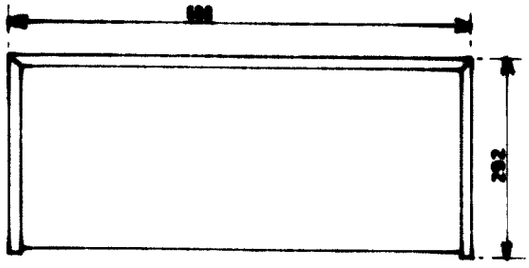
024.3.7 The completed 'Cost Sheet' will be filed by the Accounts in numerical order.



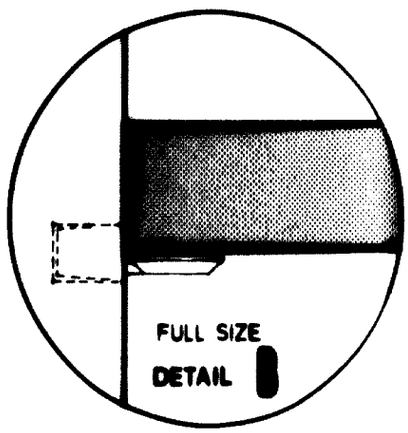
FRONT ELEVATION

SIDE ELEVATION

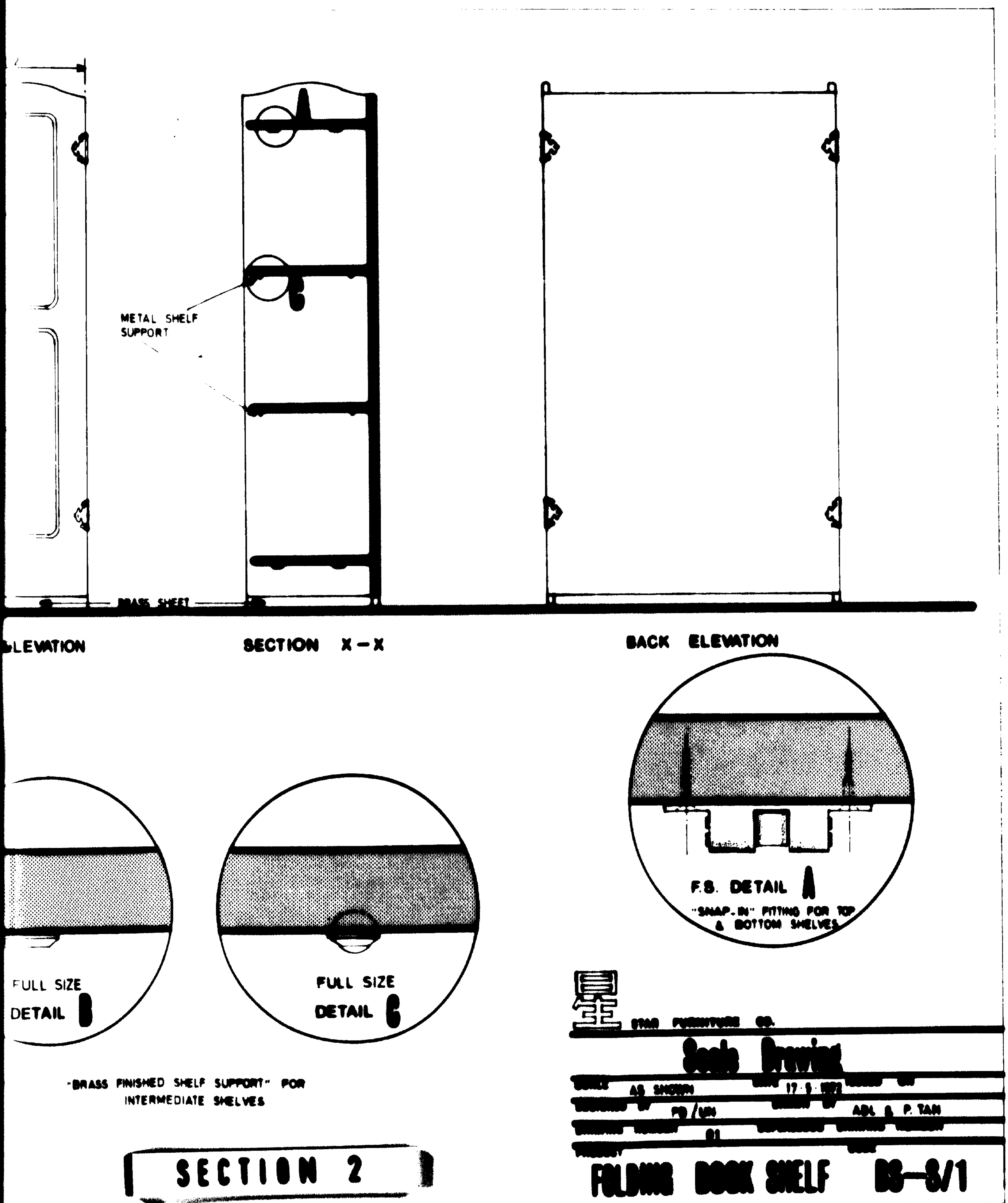
SECT

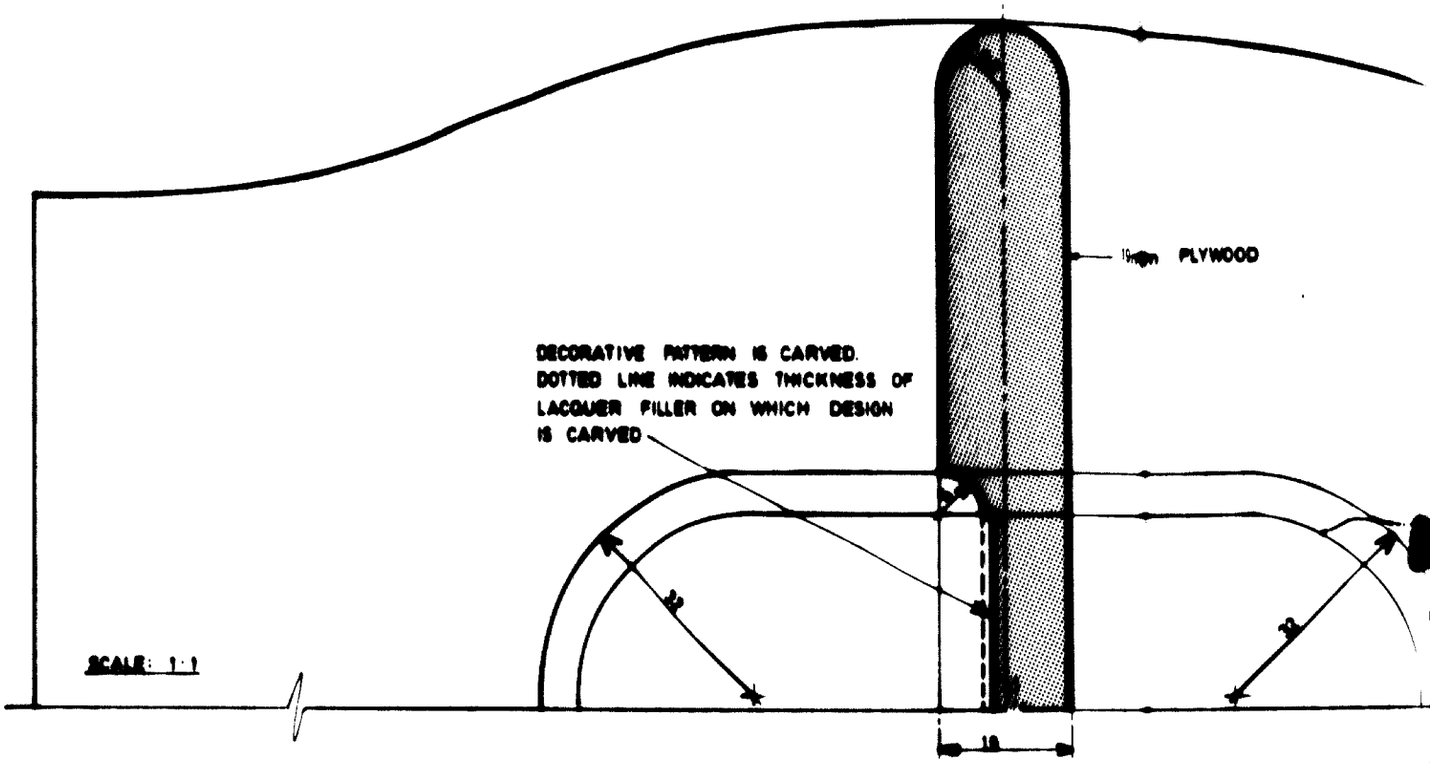


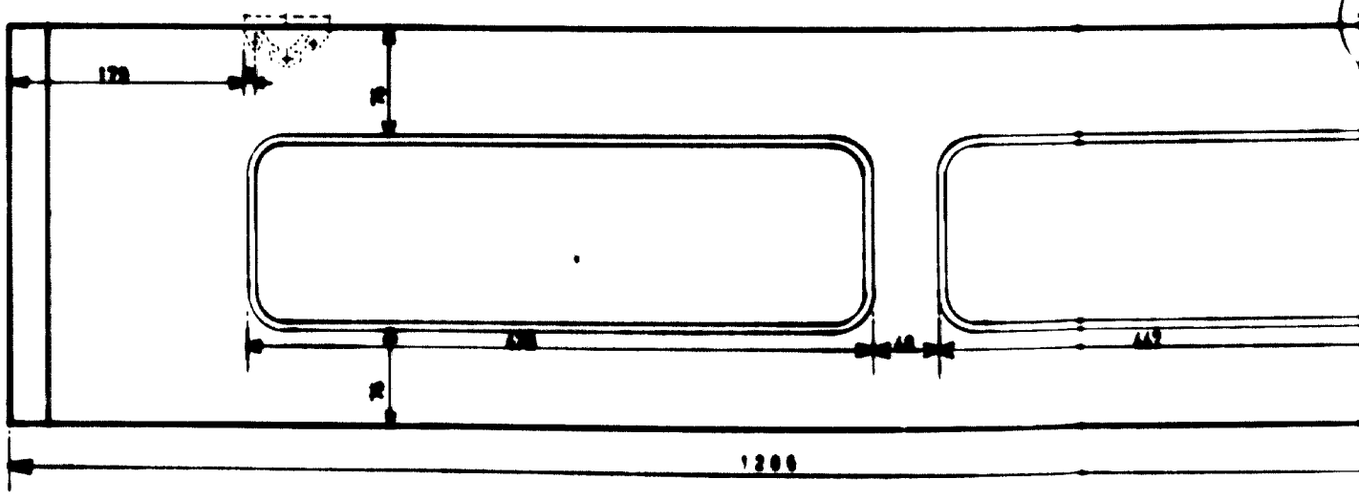
PLAN
SCALE: 1 10

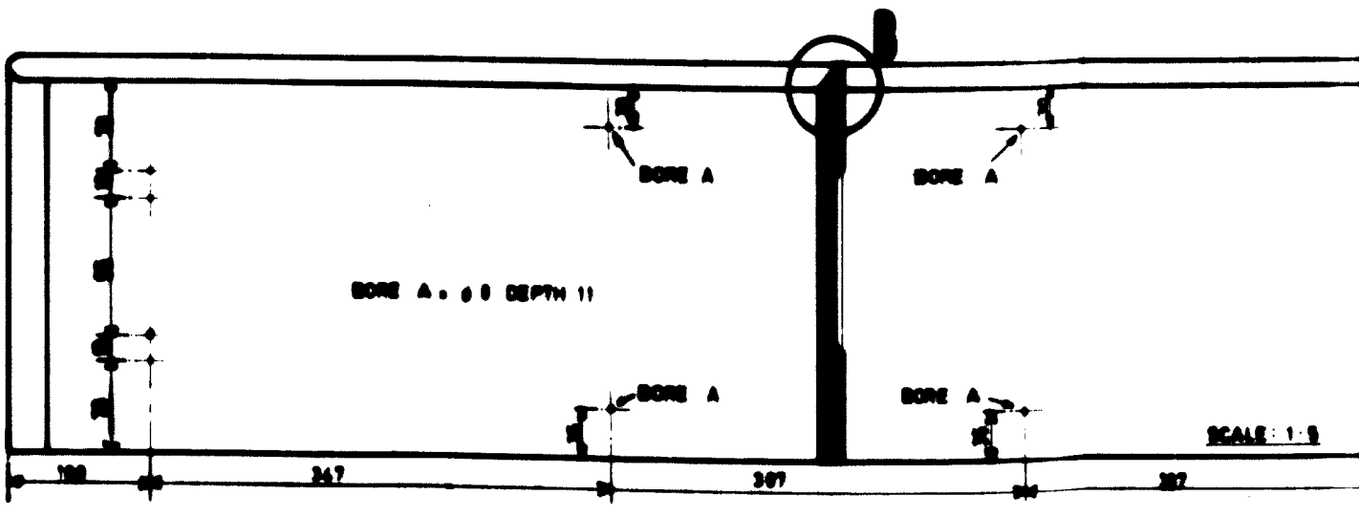


"BRASS FINISHED SHELF SUPPORT"
INTERMEDIATE SHELVES

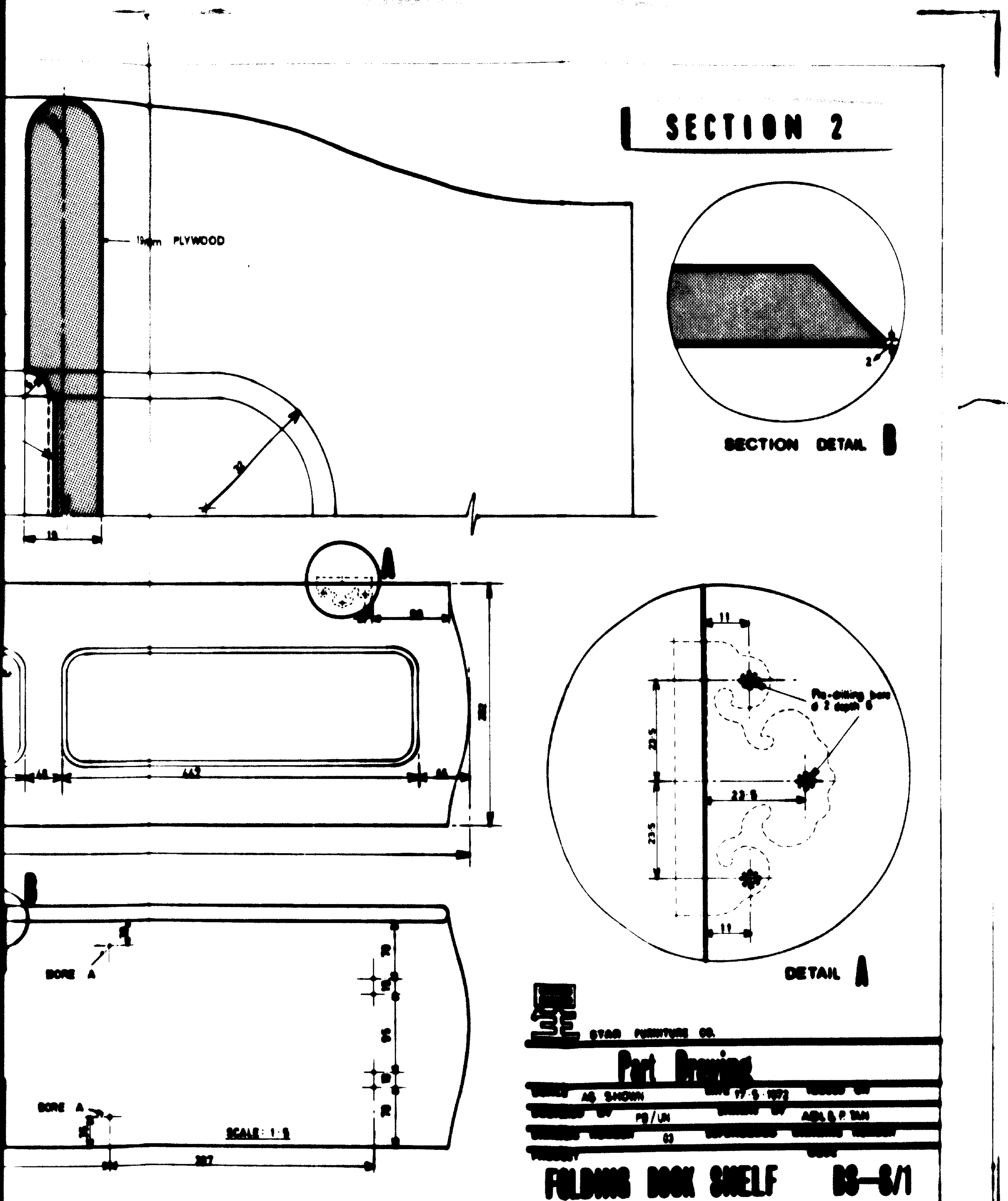

METAL SHELF SUPPORT
BRASS SHEET
ELEVATION
SECTION X – X
BACK ELEVATION
F.S. DETAIL A
"SNAP-IN" FITTING FOR TOP & BOTTOM SHELVES
FULL SIZE DETAIL B
FULL SIZE DETAIL C
"BRASS FINISHED SHELF SUPPORT" FOR INTERMEDIATE SHELVES
SECTION 2
AS SHOWN
P. TAN
BOOK SHELF

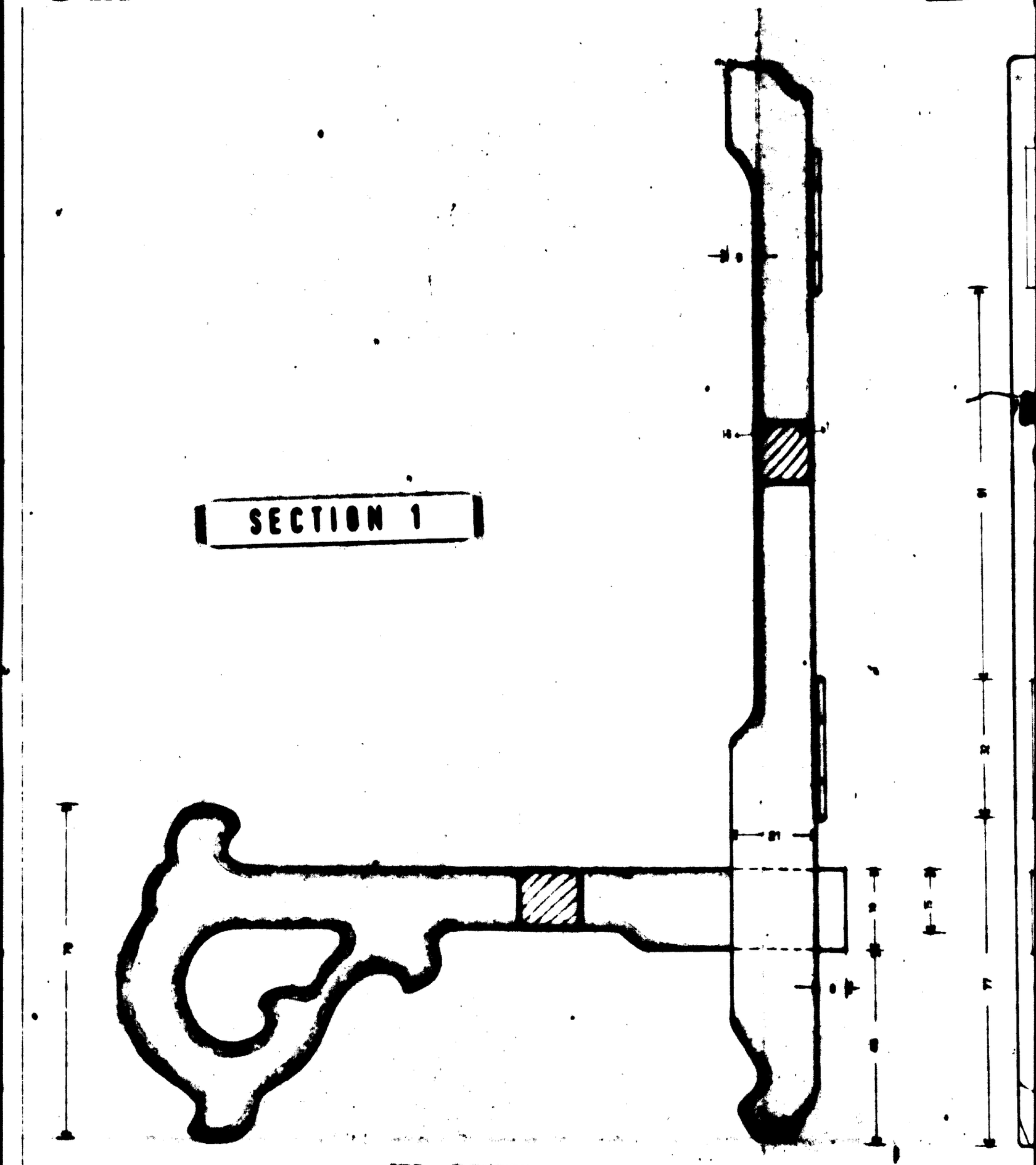

PLYWOOD
DECORATIVE PATTERN IS CARVED.
DOTTED LINE INDICATES THICKNESS OF
LACQUER FILLER ON WHICH DESIGN
IS CARVED
SCALE: 1:1


1206

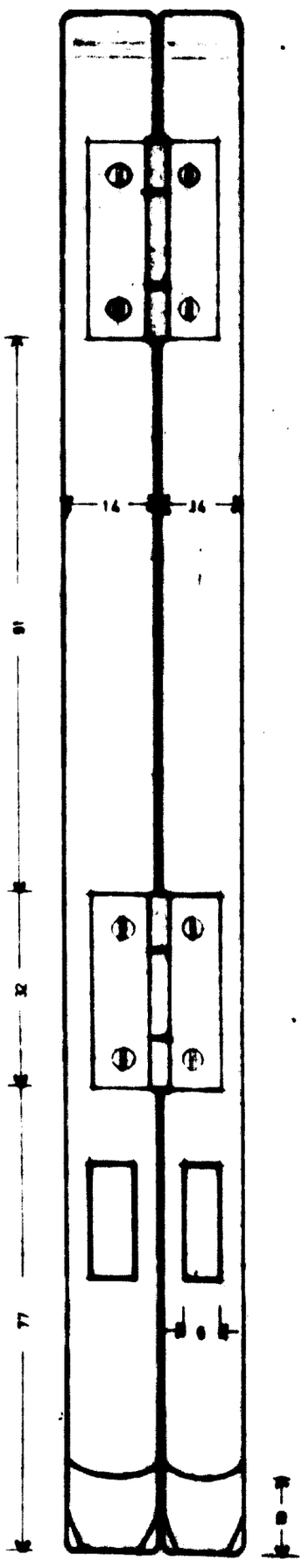

BORE A
BORE A
BORE A • 68 DEPTH 11
BORE A
BORE A
SCALE: 1:8
100
347
307

SECTION 1

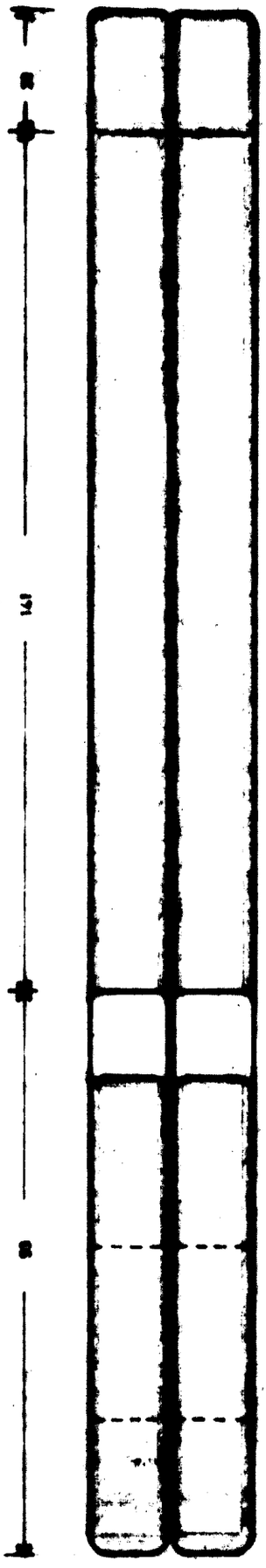

SECTION 2
PLYWOOD
SECTION DETAIL B
DETAIL A
BORE A
BORE A
SCALE 1:5
STAR FURNITURE CO.
Part Drawing
AS SHOWN
FOLDING BOOK SHELF
BS-6/1



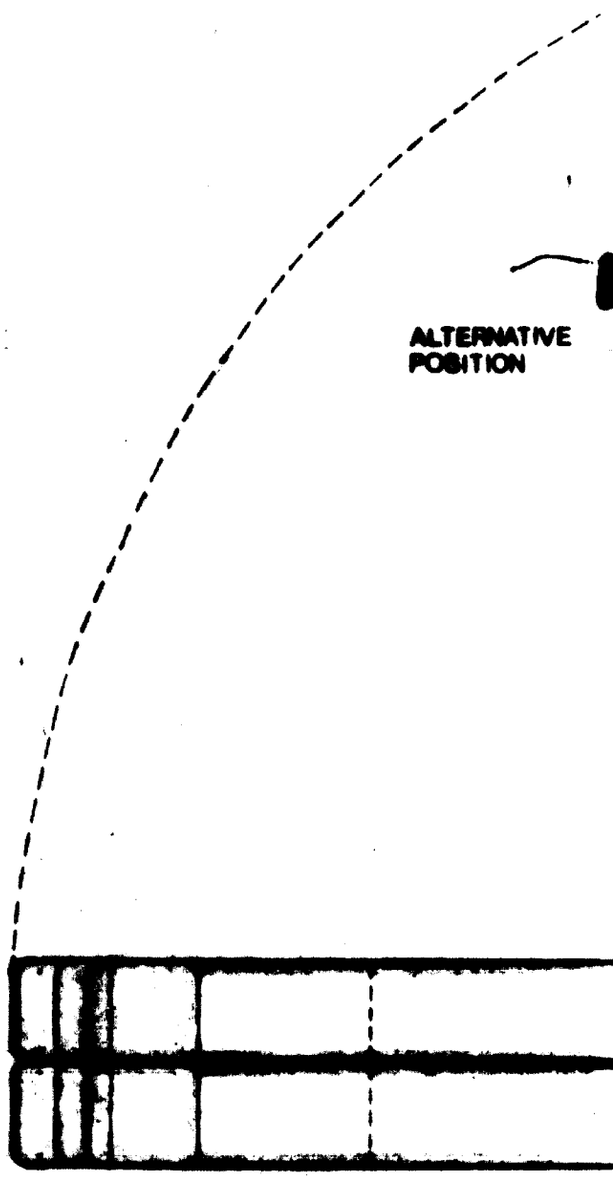
SIDE ELEVATION



END ELEVATION

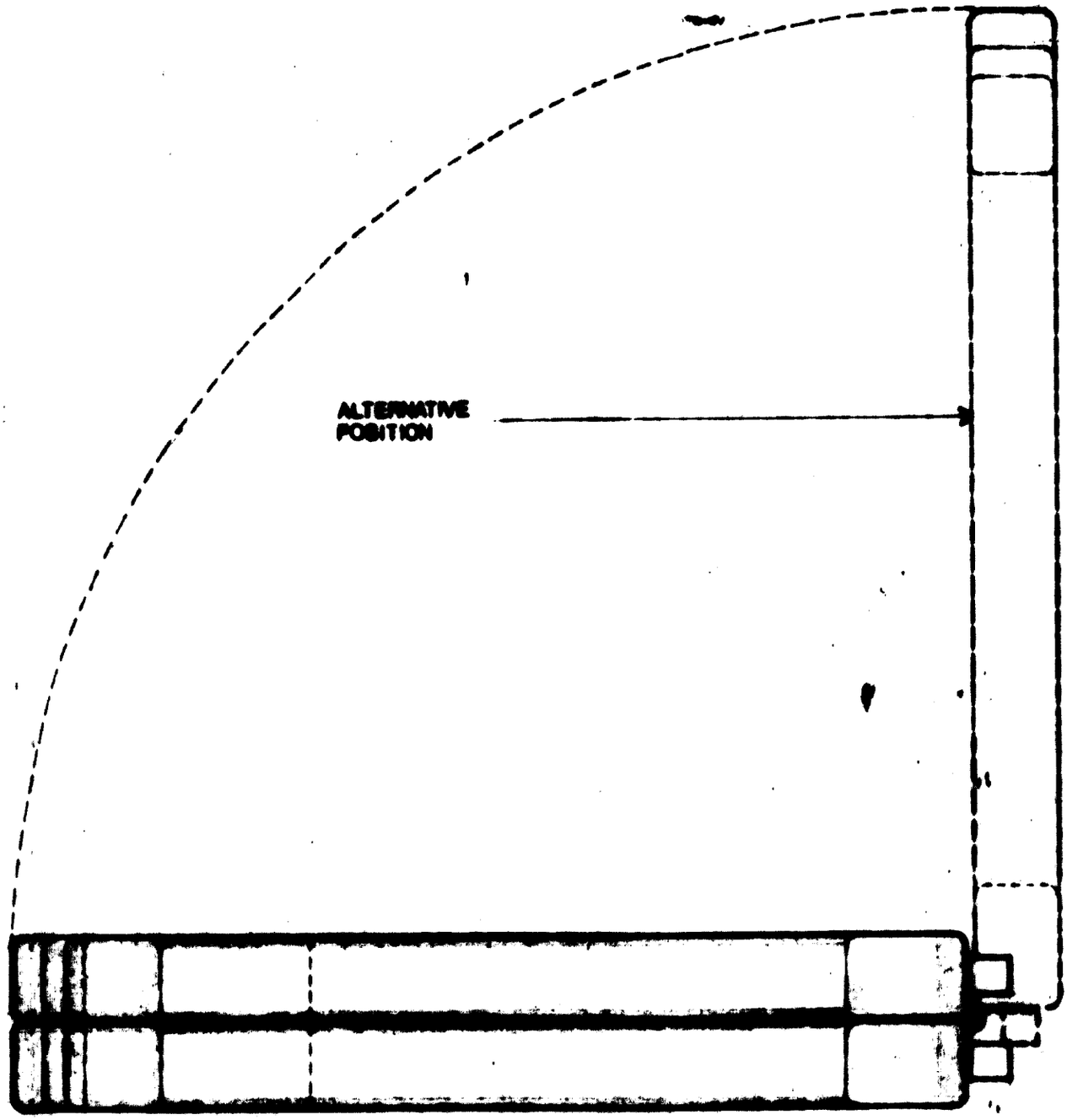


FRONT ELEVATION



PLAN

SECTION 2

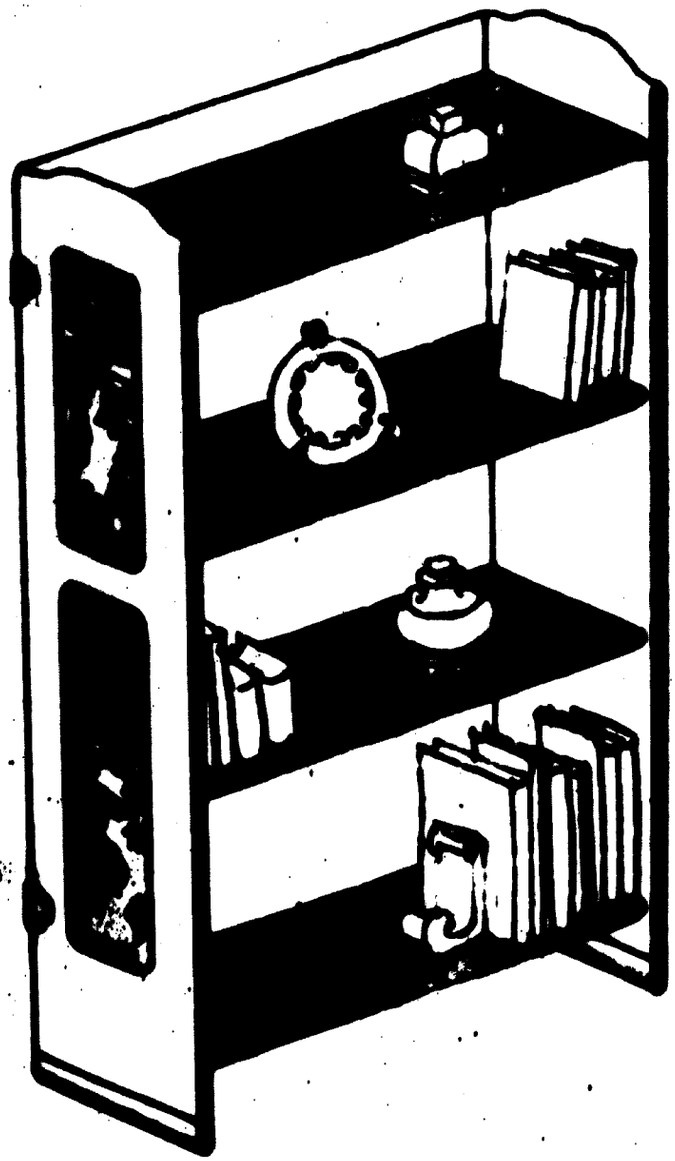


PLAN

SECTION 3

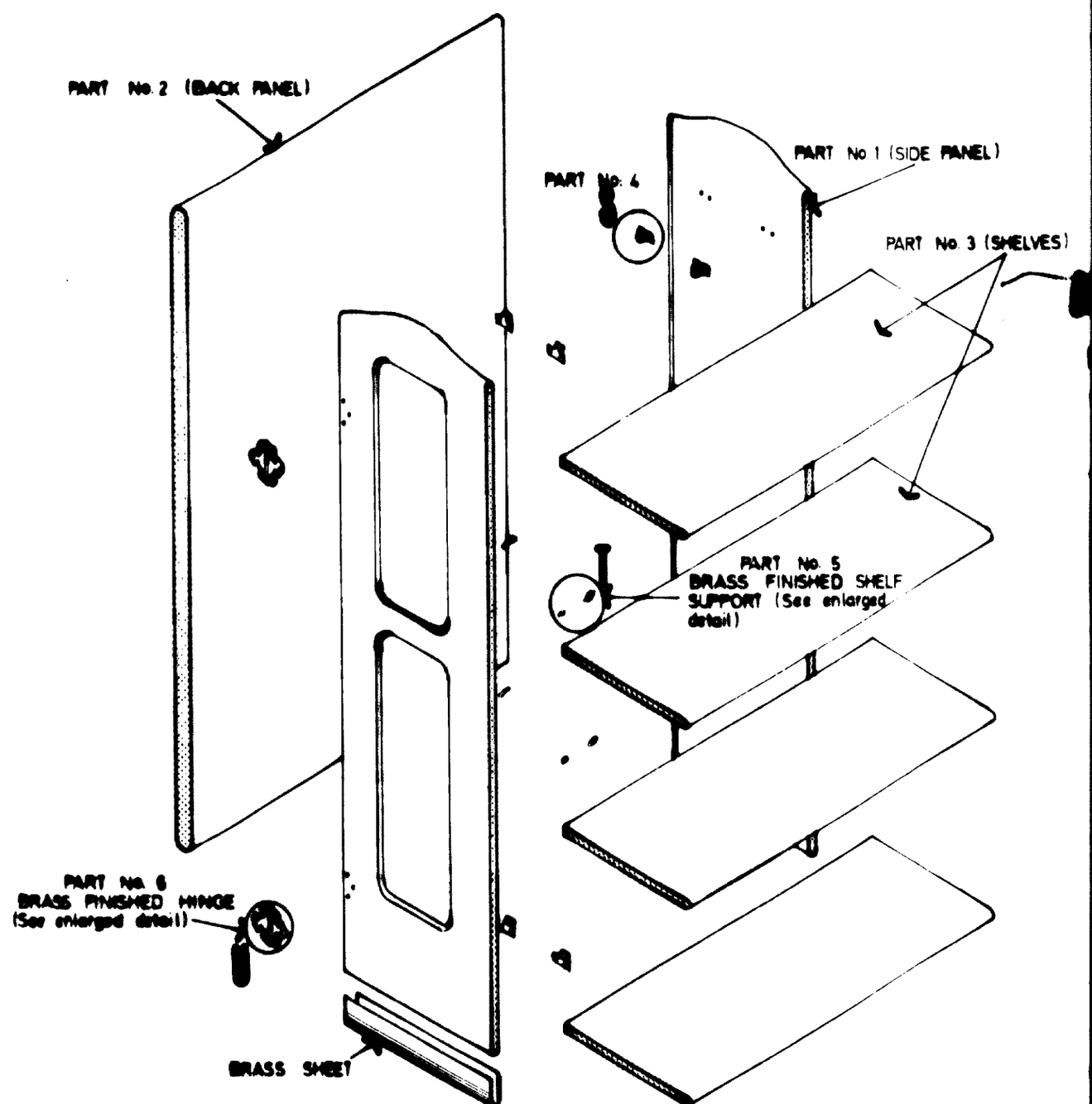
Full Size Drawing

PLATE STAND PS-S/1

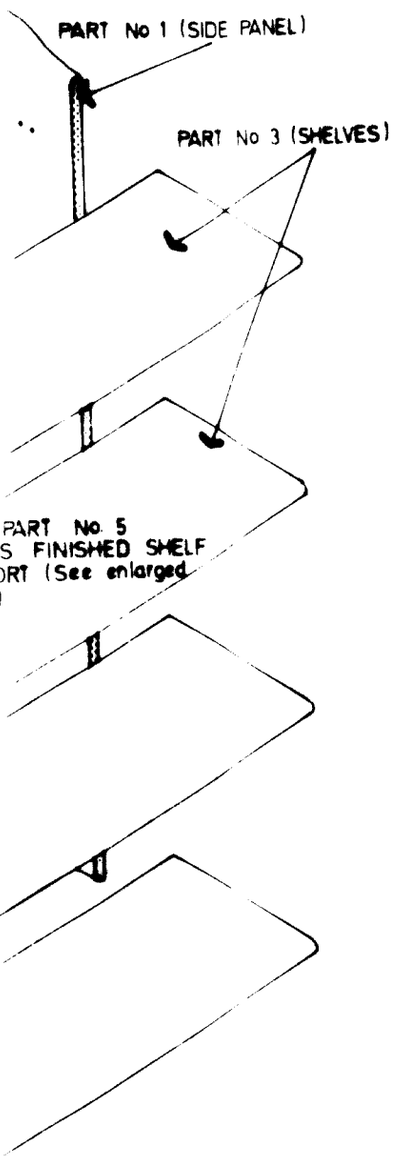


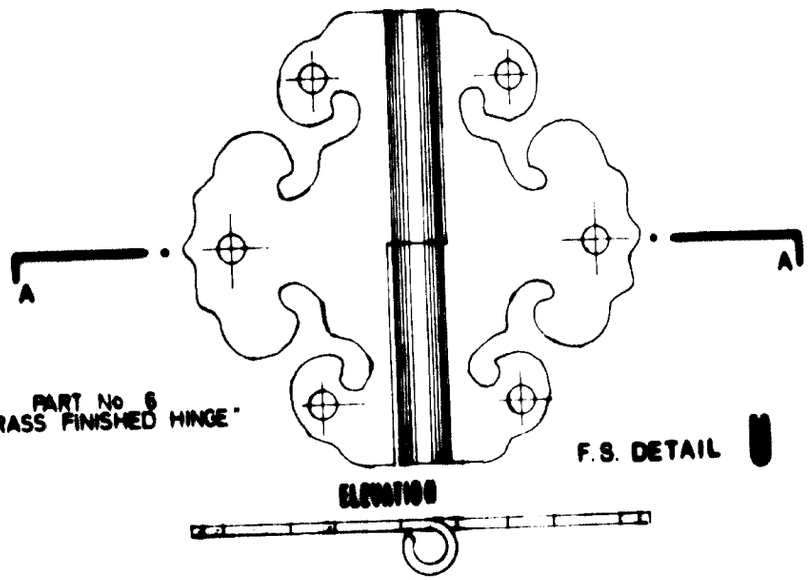
Perspective Drawing

FOLDING BOOK SHELF BS-01


PART No. 2 (BACK PANEL)
PART No. 1 (SIDE PANEL)
PART No. 4
PART No. 3 (SHELVES)
PART No. 5
BRASS FINISHED SHELF
SUPPORT (See enlarged
detail)
PART No. 6
BRASS FINISHED HINGE
(See enlarged detail)
BRASS SHEET

SECTION 1



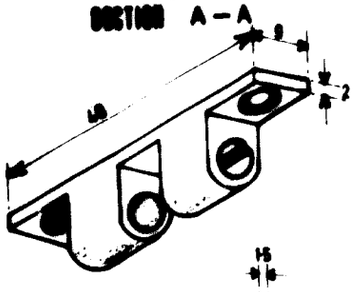


PART No 6
"BRASS FINISHED HINGE"

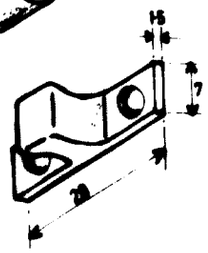
F.S. DETAIL

ELEVATION

SECTION A-A



DETAIL



PART No. 4
"SNAP-IN" FITTINGS FOR
TOP AND BOTTOM SHELVES

DETAIL

"BRASS FINISHED SHELF SUPPORT"
FOR INTERMEDIATE SHELVES
PART No. 5

SECTION 2

Isometric Drawing

AS SHOWN

17.5.1982

FOLDING BOOK SHELF DB-S/1

OPERATION SHEET

MACHINING TASKS — PARTS per unit / MACHINE	① SIDE PANEL 2 pieces	② BACK PANEL 1 piece	
CIRCULAR SAW	E.R.: A.R.: E.S/U: A.S/U: (1-1) — E.R.: A.R.: E.S/U: A.S/U: (1-2)	E.R.: A.R.: E.S/U: A.S/U: (2-1) — E.R.: A.R.: E.S/U: A.S/U: (2-2) — E.R.: A.R.: E.S/U: A.S/U: (2-3)	E.R A.R E.S/ A.S/ (3-
BAND SAW	E.R.: A.R.: E.S/U: A.S/U: (1-3)		
SPINDLE MOULDER	E.R.: A.R.: E.S/U: A.S/U: (1-4)	E.R.: A.R.: E.S/U: A.S/U: (2-4)	E.R A.R E.S/ A.S/
ROUTER	E.R. A.R. E.S/U: A.S/U: (1-5)		
BORING MACHINE	E.R. A.R. E.S/U: A.S/U: (1-6)	E.R. A.R. E.S/U A.S/U (2-5)	E.R A.R E.S/U A.S/U
ESTIMATE TOTAL TIME PER PART FOR 100 UNITS	Hrs	Hrs	Hr
ESTIMATE TOTAL TIME PER PART FOR ONE UNIT	Hrs	Hrs	Hr
ACTUAL TOTAL TIME PER PART FOR ..... UNITS	Hrs	Hrs	Hr
ASSEMBLY TASKS	ASSEMBLE FITTINGS ON SIDE PANELS FOR: E. 100 UNITS ..... E. ONE UNIT ..... A. ..... UNITS	SCREW BACK PANEL TO SIDE PANEL FOR: E. 100 UNITS ..... E. ONE UNIT ..... A. ..... UNITS	ASSE AND E. 10 E. ON A.
FINISHING TASKS	E. 100 UNITS ..... E. ONE UNIT ..... A. ..... UNITS	E. 100 UNITS ..... E. ONE UNIT ..... A. ..... UNITS	E. 10 E. ON A.

NOTATIONS:
E.R. : ESTIMATED MACHINE RUNNING TIME
A.R. : ACTUAL " " "
E.S/U. : ESTIMATED MACHINE SET UP TIME
A.S/U. : ACTUAL " " "
E. : ESTIMATE
A. : ACTUAL

GRAND

SECTION 1

Manual of Basic Production Procedures
1972 LIS-UNIDO Ass. 064-D/S.3

SHEET

SALES/PRODUCTION ORDER No: _____
PRODUCT QUANTITY THIS ORDER: _____
PRODUCT DESCRIPTION: FOLDING BOOK SHELF BS-6/1

(2) CK PANEL 1 piece	(3) SHELVES 3 piece	ESTIMATE TOTAL TIME PER MACHINE FOR 100 UNITS	ESTIMATE TOTAL TIME PER MACHINE FOR ONE UNIT	ACTUAL TOTAL TIME PER MACHINE FOR ..... UNITS
E R A R E S/U A S/U (2-2)	E R A R E S/U A S/U (2-3)	E R A R E S/U A S/U (3-1) (3-2)	Hrs	Hrs	Hrs .....
		Hrs	Hrs	Hrs .....
(2-4)	E R A R E S/U A S/U (3-3)	Hrs	Hrs	Hrs .....
		Hrs	Hrs	Hrs .....
(2-5)	E R A R E S/U A S/U	Hrs	Hrs	Hrs .....
Hrs		TOTAL ESTIMATE TIME FOR 100 UNITS OF PRODUCT Hrs		
Hrs			TOTAL ESTIMATE TIME FOR ONE UNIT OF PRODUCT Hrs	
Hrs				ACTUAL TOTAL TIME FOR ..... UNITS OF PRODUCT Hrs .....

PANEL TO SIDE PANEL	ASSEMBLE FITTINGS ON BOTTOM AND TOP SHELVES FOR:	TOTAL ESTIMATE ASSEMBLY TIME FOR 100 UNITS	TOTAL ESTIMATE ASSEMBLY TIME FOR ONE UNIT	TOTAL ACTUAL ASSEMBLY TIME FOR ..... UNITS
UNITS ..... UNIT ..... UNITS	E. 100 UNITS ..... E. ONE UNIT ..... A ..... UNITS			
UNITS ..... UNIT ..... UNITS	E. 100 UNITS ..... E. ONE UNIT ..... A ..... UNITS	TOTAL ESTIMATE FINISHING TASKS FOR 100 UNITS	TOTAL ESTIMATE FINISHING TASKS FOR ONE UNIT	TOTAL ACTUAL FINISHING TASKS FOR ..... UNITS
GRAND TOTALS ⇨		ESTIMATE FOR 100 UNITS Hrs	ESTIMATE FOR ONE UNIT Hrs	ACTUAL FOR ..... UNITS Hrs .....

SECTION 2

星木器公司
STAR FURNITURE CO.

材料估算總單(標準家具) MASTER BILL OF MATERIALS (Standard Furniture)
(永久記錄) (For permanent records)

編號 No.

Requirements for One Unit 每單位所需材料															Estimated cost of materials for One Unit 每單位材料成本估計					
item 項目	sub as. 部份裝配	part no. & name 零件名稱	mtl. 材料	size & quantity of rough pieces 粗處工尺寸及件數				size & quantity of finished pieces 成品尺寸及件數				shoulder length 肩長	exposed sides 顯露面	measure @ r. pc. 每粗成品尺度	cost @ unit meas. 每度量成本	cost @ rough pc. 每粗成品成本	waste allowance 廢料許可限度	total cost 成本	remarks 備註
				T 厚	W. 寬	L 長	pcs 件數	T 厚	W 寬	L 長	pcs. 件數								

drawings ref.	approved by 批准者 日期 date	supercedes Master Bill no. 取替以前估計總單編號	product description & code no. 產品說明及編號	total cost 成本總額	page 頁數 of
				compiled by 編寫者 日期 date	costed by 成本計算者 日期 date

星木器公司
STAR FURNITURE CO.

材料預算單（標準木器） BILL OF MATERIALS (Standard Furniture)
會計部及材料倉存本 Stores & Accounts copy

Requirements for One Unit 每單位所需材料															Requirements for .... units 需要件數 Sales/Production Order no. 銷售/生產命令編號				cost of pcs. issued 發出件數之總成本
item 項目	sub as. 部份裝配	part no. & name 木件名稱及編號	mtl. 材料	size & quantity of rough pieces 粗成品尺寸及件數				size & quantity of finished pieces 成品尺寸及件數				shoulder length 肩長	exposed sides 表面		rough pcs. 粗成品件數	finished pcs. 成品件數	% waste allow. 磨耗損補	actual rough pcs. issued from stores 粗成品發出之實際件數	
				T 厚	W 寬	L 長	pics 件數	T 厚	W 寬	L 長	pcs. 件數								

drawings ref. 繪圖索引	approved by 批准者 .... date 日期	supercedes Master Bill no. 取替以前之總單編號	product description & code no. 成品說明及編號	compiled by 編寫者 .... date 日期	approved by 批准者 .... date 日期	date mtls. required 需要材料日期

星木業公司
STAR FURNITURE CO.

材料預算單(標準傢具) BILL OF MATERIALS (Standard Furnitur[e]

領工存根 Foremen copie[s]

item 項目	sub as. 部份裝配	part no. & name 零件名稱及編號	mtl 材料	size & quantity of rough pieces 粗成品厚寬長及件數: T 厚	W 寬	L 長	pcs. 件數	size & quantity of finished pieces 成品厚寬長及件數: T 厚	W 寬	L 長	pcs 件數	shoulder length 肩長	exposed sides 表面	rough pcs. 粗成品件數	finished pcs. 成品件數	% waste allow. 廢料已加	actual rough pcs. received from stores 從貨倉實際收到之粗成品件數	mach[i]nes s[e]quenc[e] 機行程序

Requirements for One Unit 每單位所需材料

Requirements for ..... units 需要的數

Sales/Production Order no. 銷售/生產命令編號

drawings ref. 繪圖索引	approved by 批准者 日期 date	supercedes Master Bill no. 取替以前總單編號	product description & code no. 成品說明及編號	compiled by 填寫者 日期 date	approved by 批准者 日期 date	date mtl requ[ired] 需要材料日期

星木器公司
STAR FURNITURE CO.

材料預算單 BILL OF MATERIALS
非標準式產品 (Non-Standard Furniture)

貨倉/會計部用本 STORES & ACCOUNTS COPY

Product Description : 產品詳述 ....

Sales/Production Order 銷售/生產命令

Qty. 數量 ....

號數 No. ....

Item 項目	Part name 零件名稱	Mtl. 材料	Size & qty. of rough pcs. required 粗成品尺寸件數及成本					Actual rough pcs. issued from Stores 粗成品零件由貨倉發出件數	Actual cost 實際成本
			T 厚	W 寬	L 長	Total pcs. 件數	Cost 成本		
			Estimated Cost 預計成本					Actual Cost 實際成本	

Remarks 備註	Compiled by 編寫者	Approved by 批准者	Received by 收貨者
Date materials required 需要材料日期	Date 日期	Date 日期	Date 日期 ....

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星木器公司 STAR FURNITURE CO.

[illegible] BILL OF MATERIALS (Non-Standard Furniture)

[illegible] SUB-CONTRACTOR COPY

Product Description : 產品詳述 ....

Qty. 數量 ....

Sales/Production Order 銷售/生產命令 編號 No. ....

Item 項目	Part name 零件名稱	Mtl. 材料	Size & qty. of rough pcs. required [illegible]				Qty. finished pcs. reqd. 成品件數	Actual rough pcs. received from Stores [illegible]
			T 厚	W 寬	L 長	Total pcs. [illegible]		

Remarks : 備註	Compiled by 編寫者	Approved by 批准者	Received by 收貨者
Date materials required [illegible]	Date 日期	Date 日期	Date 日期 ....

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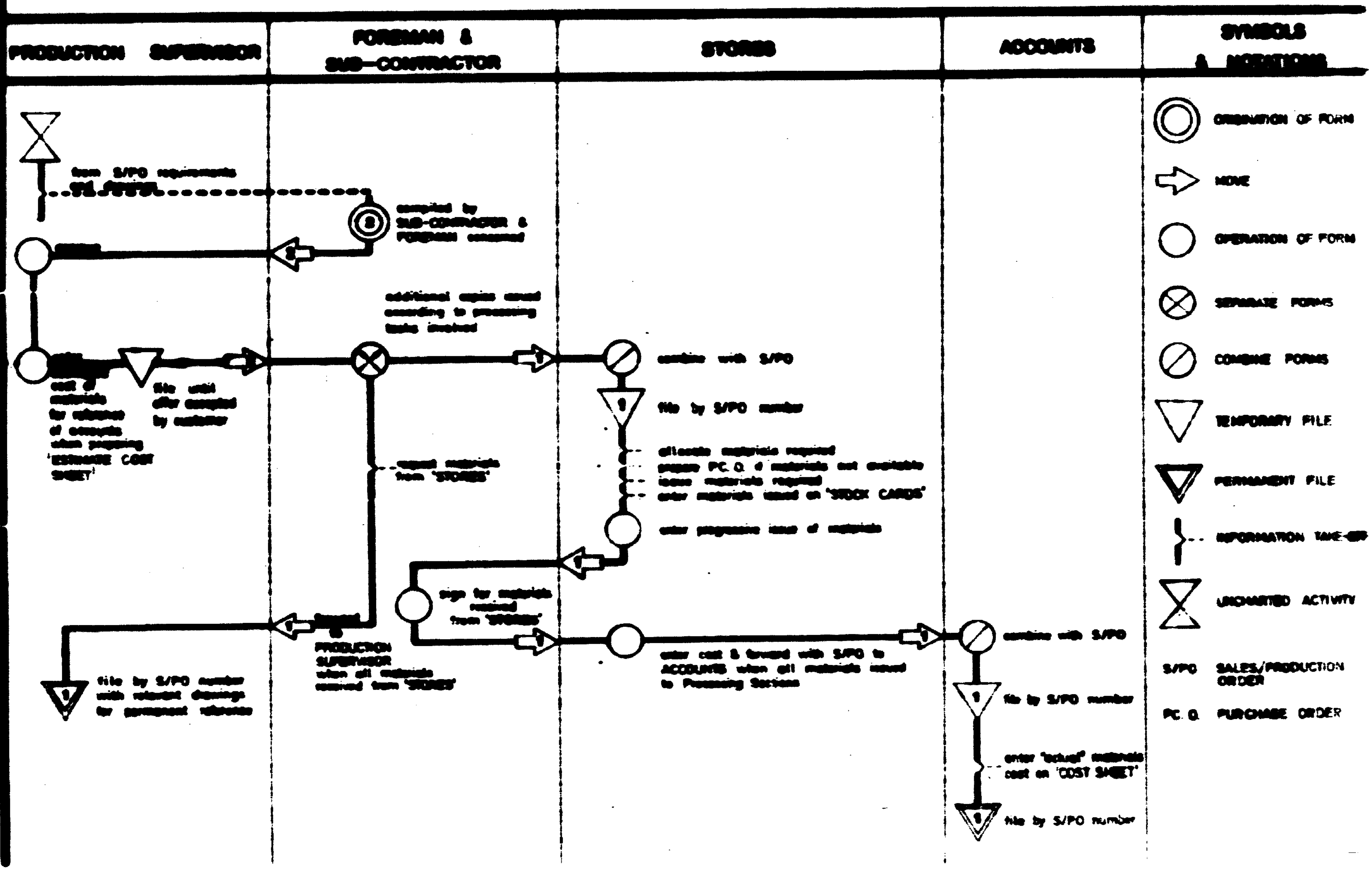
FLOW CHART OF BILL OF MATERIALS
(Standard Furniture)
SYMBOLS
ACCOUNTS
STORES
FOREMAN
PRODUCTION SUPERVISOR

FLOW CHART OF BILL OF MATERIALS
(non - standard furniture)



星木器公司
STAR FURNITURE CO.

購貨訂單 PURCHASE ORDER

編號 No. ....

致 To. ....

....

Please supply the following goods and submit your invoice quoting the above No.
請供應下列貨物
發票請註明本單編號

[illegible] SUPPLIER COPY

Quan-tity 數量	Description 詳述	Unit Price 單價 $	¢	Amount 金額 $	¢

Remarks 備註

Total 總計

Please deliver to : ....
請送交至

Date wanted : ....
需要日期

星木器公司
For STAR FURNITURE CO.

....
(signature) 簽名

1972 LTS-UNIDO 064-D/SIS

星木器公司 STAR FURNITURE CO.

購貨訂單 PURCHASE ORDER

編號 No. ....

致 To: ....

....

Please supply the following goods and submit your invoice quoting the above No.
請供應下列貨物
發票請引用本單編號

會計部存本 ACCOUNTS COPY

Quantity 數量	Description 詳述	Unit Price 單價 $	¢	Amount 金額 $	¢
Remarks 備註		Total 總共			

Please deliver to: ....
請交送至

Date wanted: ....
需要日期

星木器公司
For STAR FURNITURE CO.

....
(signature) 簽名

Required for 用途
- ☐ Replenishment of stock 補回存貨
- ☐ Sales/Production Order No. 產銷命令編號
- ☐ Others 其他

Requested by ....
申請者

Goods received on ....
收貨日期

Goods received by ....
收貨人

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星木器公司
STAR FURNITURE CO.

購貨訂單 PURCHASE ORDER

編號 No. ....

致 To: ....

....

Please supply the following goods and submit your invoice quoting the above No.
請供應下列貨物
發票請列明本單編號

貨倉存本 STORES COPY

Quan-tity 數量	Description 詳述	Unit Price 單價		Amount 金額	
		$	¢	$	¢
Remarks 備註		Total 總計			

Please deliver to: ....
請發送至

Date wanted: ....
需要日期

星木器公司
For STAR FURNITURE CO.

....
(signature) 簽名

Required for 用途
- ☐ Replenishment of stock 普通補足
- ☐ Sales/Production Order No. 產銷令合編號
- ☐ Others 其他

Requested by ....
申請者

Goods Received on ....
收貨日期

Goods received by ....
收貨人

1972

FLOW CHART OF DELIVERY ORDER
SYMBOLS & DESCRIPTIONS
ACCOUNTS/SALES
CUSTOMER
STORES/DELIVERY
PRODUCTION SUPERVISOR

042 - PURCHASE ORDER FORM Procedure

042.1 Objectives

i) Constitutes authorisation of purchases of Direct Materials from supplier. The Form is also used for the purchasing of indirect materials.

ii) For reference to ensure that the Direct Materials received from the supplier are according to quantities, specifications and prices stipulated.

iii) To be retained as permanent reference in respect to future purchasing.

iv) To constitute record of receipt of purchased goods for Stores' reference.

042.2 The Form & Responsibility

The 'Purchase Order' is a three-copy prenumbered Form to be distributed to the following :

Original : Supplier

Second copy : Stores

Third copy : Accounts/Purchasing

The Form is compiled by the Stores, authorised by the Purchasing or the Manager as required and issued by the Purchasing.

042.3 Procedure

042.3.1 When the minimum stock level for Direct Materials is reached, or when more stock materials are required for specific order, the 'Purchase Order' will be compiled by the Storekeeper.

a) Indicate the descriptions of the goods, quantity to be purchased, unit price, amount and total cost.

b) Enter the destination of delivery.

042.3.2 The Forms will be forwarded to the Accounts/Purchasing for delivery, authorising and filling in supplier's name and address.

042.3.3 Alternatively, when substantial amount is involved, the 'Purchase Order' is forwarded to the Manager for approval.

042.3.4 One copy of the 'Purchase Order' will be channelled to the supplier by the Purchasing.

042.3.5 One copy will be sent to the Stores where the Form will be filed temporarily by 'Purchase Order' number until the arrival of the goods. The Storekeeper will check the goods received with the specifications in the 'Purchase Order' and the supplier's 'Delivery Order', acknowledge and remark any differences on the latter before transfer to Accounts/ Purchasing. The quantity and date received will be entered on the 'Purchase Order' and he will record the required information on the "In" column of the relevant 'Stock Card'. The Form is filed for permanent reference by 'Purchase Order' number when all goods received.

042.3.6 The Accounts/Purchasing will file one copy temporarily according to supplier's name. On receipt of the supplier's 'Delivery Order' and Invoice, he will check against the 'Purchase Order', prepare the 'Remittance Advice' and file all the Forms in an "Unpaid" file by supplier's name. When Invoice is due for payment, a cheque is drawn in favour of the supplier, then the 'Purchase Order' will be filed in a "Paid" file by supplier's name.

星木家公司
STAR FURNITURE CO.

存貨卡 STOCK CARD

直接材料 Direct Materials

編號 No.....

尺寸 Size.....

Minimum Stock Level..... 名稱 Description.....

最低存量

日期 Date	收入 Received			發出 Issued			結存 Balance		分配 Allocated			供存 Available
	供應商送貨單編號 Vendor's D/O No.	單價 Unit Price	數量 Qty.	生產或存貨令編號 P.O. or S/PO No.	單價 Unit Price	數量 Qty.	單價 Unit Price	數量 Qty.	生產或存貨令編號 P.O. or S/PO No.	數量 Qty.	分配總數 Total Allocation	數量 Qty.
1/1	D/O 1011	$2	50				$2	50				50
4/1							$2	50	S/PO 001	+30	30	20
5/1							$2	50	PO 011	+5	35	15
7/1				S/PO 001	$2	30	$2	20		-30	5	15
9/1							$2	20	S/PO 002	+5	10	10
10/1				PO 011	$2	5	$2	15		-5	5	10
12/1				S/PO 002	$2	5	$2	10		-5	0	10
2/2	D/O 1012	$2.40	50				$2.42	60				60

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星 星木器公司
STAR FURNITURE CO.

存貨卡 STOCK CARD

成品 Finished Goods

編號 No.

成品編號 Code No.

Minimum Stock Level 最低存量 名稱 Description

日期 Date	收入 Received		發出 Issued		結存 Balance	分配 Allocated			實存 Available
	生產命令編號 Prod. Order No.	數量 Qty.	銷貨命令編號 S/Prod. Order No.	數量 Qty.	單價 Qty.	銷貨命令編號 S/Prod. Order No.	數量 Qty.	分配總數 Total Allocation	數量 Qty.
2/1	P.O. 011	50			50				50
4/1					50	S/PO 001	+30	30	20
5/1					50	S/PO 002	+5	35	15
7/1			S/PO 001	30	20		-30	5	15
9/1					20	S/PO 003	+5	10	10
10/1			S/PO 002	5	15		-5	5	10
12/1			S/PO 003	5	10		-5	0	10
2/2	P.O. 018	50			60				60

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043 - STOCK CARDS FORM (for Direct Materials & Finished Goods)

043.1 Objectives

The main objectives of the 'Stock Card' can be summarised as follows :

i) To record receipt of Direct Materials and Finished Goods (Standard Furniture) into Stores. The receipt of the Direct Material is posted from Vendor's Delivery Order after the goods arrived. Finished Goods are posted from the Progress Record of the 'Production Order' when processed furniture is transferred from Processing Sections to Stores.

ii) To record the issue from Stores. The issues are posted from 'Bill of Materials' with respect to Direct Materials while the issue of Standard Furniture is posted from the Progress Record of the 'Sales/Production Order'.

iii) To show the balance on hand i.e. the difference between quantity received and quantity issued.

iv) To allocate the balance on hand for incoming 'Sales/Production Order' and show the available quantity.

v) To facilitate planning of production schedules according to Sales forecasts. When the minimum level of stock is reached, Management can be advised so that a 'Purchase' or a 'Production Order' for new stock can be issued.

vi) To provide a basis for determining the value of Direct Materials and Finished

Goods which are part of the company's assets.

043.2 The Form & Responsibilities

The Form can be presented either as individual 'Stock Card' or as a 'Stock Record Book'. It is kept by the Storekeeper for recording receipt and issuing.

043.3 Procedure

043.3.1 A sample procedure for filling the 'Stock Card' or 'Stock Record Book' for Direct Materials (see Stock Card Form A page 043/1) is given below. Note that each entry is recorded on a separate line so that records can be easily inspected.

043.3.2 January 3rd - Receipt
Assume received 50 units of Direct Materials. Balance on hand will be 50.

On receiving the supplier's 'Delivery Order' and 50 units of Direct Materials, the Storekeeper will enter the date, number of Vendor's D.O., quantity received and unit price in the appropriate column of the 'Stock Card' or 'Stock Record Book'. Since this is the first entry, the balance on hand will be 50 and the quantity available will also be 50.

043.3.3 January 4th - Allocation
Allocated 30 units. Balance on hand (50) unchanged, but quantity available reduced(=20)

The Storekeeper allocates 30 units on receipt of 'Bill of Materials' will enter quantity allocated (not yet issued) and the S/P.O. number 001 in the allocation column. The allocation will not modify the balance on hand which remains at 50. However, the quantity available for new 'Sales/Production Orders'

(derived by subtracting the quantity allocated and quantity available) is reduced to 20 units.

043.3.4 <u>January 5th - Allocation</u>
<u>Allocated 5 units. Add 5 units to total allocation (=35), subtract from quantity available (=15).</u>

Similarly, the Storekeeper will further allocate 5 items against the 'Bill of Materials' of P.O. No.011. The total quantity allocated increased to 35, but quantity available is reduced to 15. Again the allocation would not modify the balance on hand which remains at 50.

043.3.5 <u>January 7th - Issue</u>
<u>Issued 30 units. Subtract from balance (=20) and from total quantity allocated (=5)</u>.

On request from Processing Sections or Sub-contractors for materials based on the 'Bill of Materials', the Storekeeper will issue material, subtract quantity issued (=30) from balance on hand and from total quantity allocated. The balance on hand will now be 20 and total allocated will be 5. The quantity available remains at 15.

043.3.6 <u>January 9th - Allocation</u>
<u>Allocated 5 units. Add 5 to total allocation (=10), subtract from quantity available (=10)</u>

The Storekeeper on receipt of the 'Bill of Materials' bearing S/P.O. No.002, will allocate 5 units required thereby increasing total allocation to 10, but reducing amount available from 15 to 10. The balance on hand remains unchanged at 20.

043.3.7 January 10th - Issue

Issued 5 units. Subtract 5 units from balance on hand (=15) and from total allocation (=5)

On request for materials related to 'Bill of Materials' P.O. No.011, the Storekeeper will issue 5 units and enter on the 'Stock Card' or 'Stock Record Book'. The balance on hand and total allocation will both be reduced by 5 to 15 and 5 respectively. The quantity available remains unchanged at 10.

043.3.8 January 12th - Issue

Issued 5 units. Subtract from balance (=10) and from quantity allocated (=0)

With the issue of 5 units as required by 'Bill of Materials' S/P.O. No.002, the Storekeeper enters on the issue column, subtract the issue from balance on hand which becomes 10 and also subtract total allocation which is reduced to 0. The quantity available remains at 10 units.

043.3.9 February 2nd - Receipt

Received 50 units into Stores. Balance on hand has been increased to 60 units

When the stock reaches the minimum level, for example, at 10 units, the Storekeeper will compile the 'Purchase Order' and forward to the Manager-Owner for authorisation and signature. One copy will be filed temporarily until the arrival of the goods (e.g. 50 units on 2nd Feb.). Information on unit price, quantity received and date will then be entered together with Vendor's D.O.number in the "Received" column of the 'Stock Card' or 'Stock Record Book'.

043.3.10 In the case of Finished Goods (Standard Furniture)(see Stock Card Form B page 043/2) the procedure of inventory recording is similar to that of Direct Materials, except the 'Unit Price' columns are excluded. The same entries used in the'Direct Materials Stock Card'is also adopted in the'Finished Goods Stock Card' to illustrate the movements of stocks.

The emphasis in the 'Finished Goods Stock Card' is to record the quantity of Standard Furniture while the unit cost record of each furniture, which is generally treated as confidential, will be derived from the relevant 'Cost Sheet' and maintained by the Accounts.

The entries of 'Finished Goods Stock Card' will be based on (1) Receiving column, from the 'Production Orders and (2) Issuing and Allocation columns, from the'Sales/Production Orders'.

043.4 Pricing of Inventory

043.4.1 'Moving Average Method'

For the purpose of this Manual the 'Moving Average' System of pricing inventory (Direct Materials) is adopted. By 'Moving Average Method', the average price at any time is derived by dividing the balance-value figure by the balance-unit figure. Further to the quantities adopted in the above sample procedure for 'Direct Material Stock Card', unit price is hereby introduced in the following illustrations.

043.4.2 Receipt

January 3rd - Assume that the unit price for the 50 units of Direct Materials

received is $2. This rate is entered into the 'Unit Price' column under both Received and Balance headings.

043.4.3 **Issue**

January 7th, 10th and 12th - This unit price of Direct Materials for each issue is $2 based on the cost of material received on the 3rd. The cost of Direct Material of each issue can be obtained by simply multiplying the quantity issued by the unit price (=$2).

043.4.4 **Price Adjustment**

February 2nd - Assume that the unit price of Direct Materials received at this date has gone up to $2.50 due to the increase in purchase price. Therefore, the balance of stock on hand consists of (1) 10 units of old stock at $2 per unit and (2) 50 units of new stock received at $2.50 per unit. The average unit price is calculated as follows :

10 units	x	$2.00 =	$ 20.00
50 units	x	$2.50 =	125.00
60 units			$145.00

The average unit price is obtained by dividing $145 by 60 (= $2.42 per unit). This new rate is entered into the balance column for the pricing of subsequent issues until another batch of Direct Materials has been received into Stores.

星木業公司
STAR FURNITURE CO.

送貨單 DELIVERY ORDER

編號 No.

銷售/會計部存本 SALES/ACCOUNTS COPY

To: 致 ....

Offer/Sales Order No. 估價/銷售單編號 ....

應出貨送日期 Due delivery date : ....

Customer Ref : 顧客查閱 ....

Item 項目	Qty. 數量	Description 詳述	Qty. this Delivery 送貨數量	Qty. to follow 尚欠數量	Remarks 備註

Deliver to : 送貨至	Delivered by : 送貨者	Inspected by : 檢驗者	Approved by : 批准者
Date Delivered : 送貨日期			

We do not accept responsibility for any damage or shortage unless indicated by receiver on this delivery receipt

[illegible]

Received Goods as shown above

[illegible]

收貨人 by ....

Date: 日期 ....

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星木傢俬公司
STAR FURNITURE CO.

送貨單 DELIVERY ORDER

編號 No.

顧客存本 CUSTOMER COPY

To: ....
致 ....

Offer/Sales Order No. ....
報價銷售單編號

應当發送日期
Due delivery date : ....

Customer Ref : 顧客參閱 ....

Item 項目	Qty. 數量	Description 評述	Qty. this Delivery 送件數量	Qty. to follow 尚欠數量	Remarks 備註

Deliver to : 送達至	Delivered by : 送貨者	Inspected by : 檢驗者	Approved by : 批准者
.... Date Delivered : 送達日期	....	....	....

We do not accept responsibility for any damage or shortage unless indicated by receiver on this delivery receipt
顧客未當時[illegible]
本[illegible]

Received Goods as shown above
上列各項貨物如數查收

收貨人 by ....

Date: 日期 ....

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星木器公司
STAR FURNITURE CO.

送貨單 DELIVERY ORDER

編號 No.

生產部存本 PRODUCTION COPY

To: ....
致 ....

Offer/Sales Order No. ....
[illegible]

[illegible]
Due delivery date : ....

Customer R: [illegible] ....

Item [illegible]	Qty. [illegible]	Description 描述	Qty. this Delivery [illegible]	Qty. to follow [illegible]	Remarks 備註

Deliver to : [illegible]	Delivered by : 送貨者	Inspected by : 檢驗者	Approved by : 批准者
.... Date Delivered : [illegible]		....	....

We do not accept responsibility for any damage or shortage unless indicated by receiver on this delivery receipt

[illegible]

Received Goods as shown above
[illegible]

[illegible] by ....

Date: [illegible] ....

Manual of Basic Production Procedures
1972 LIS-ENTEC Ann. 064-D/SIS

星木器公司
STAR FURNITURE CO.

送貨單 DELIVERY ORDER

No.

STORES COPY

To:

Customer Ref:

Offer/Sales Order No.

Due delivery date:

Item	Qty.	Description	Qty. this Delivery	Qty. to follow	Remarks

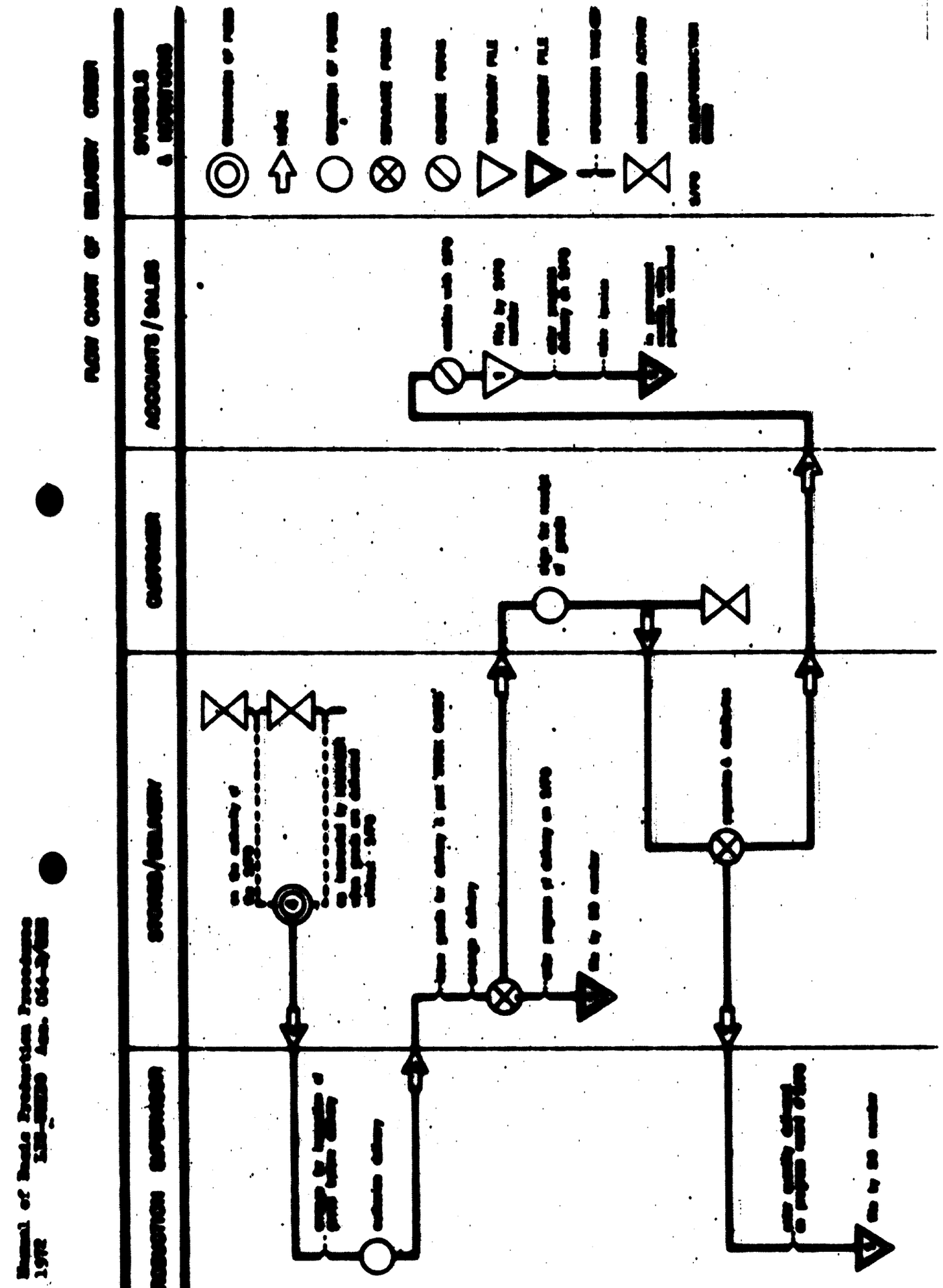
Deliver to:	Delivered by:	Inspected by:	Approved by:
Date Delivered:			

We do not accept responsibility for any damage or shortage unless indicated by receiver on this delivery receipt

Received Goods as shown above

by ....

Date:



044 - DELIVERY ORDER FORM - Procedure

044.1 Objectives

i) To ensure that the goods delivered are according to specifications of customer.

ii) Used for recording the delivery of goods from the factory.

iii) Used as a proof of goods delivered and received by the customer, and a basis for the preparation of Invoice.

044.2 The Form & Compilation

The 'Delivery Order' is a pre-numbered five-copy Form, to be distributed as follows :

Original	:	Original
Second copy	:	Production Supervisor
Third copy	:	Accounts/Sales
Fourth copy	:	Stores/Delivery

The Form will be compiled by the Stores/Delivery on the authority of the S/P.O. and authorised by the Production Supervisor.

044.3 Procedure

044.3.1 When the job for a 'Sales/Production Order' is completed, or when the 'Sales Order' is for Finished Standard items available from stock, arrangements will be made for delivery to the customer.

044.3.2 The Storekeeper/Delivery Clerk will compile the 'Delivery Order' in quintuplicate and :

a) Enter the customer's name, reference,

destination of delivery, and the 'Sales/ Production Order' number.

b) Fill in the due delivery date, the item number, quantity ordered, and the description of item(s) ordered.

c) Enter the quantity of this delivery and the quantity to follow.

He will then forward the 'Delivery Order' to the Production Supervisor for approval of the delivery.

044.3.3 Alternatively, if the goods are delivered without 'Sales Order', the Storekeeper/Delivery Clerk will forward all the four copies of the 'Delivery Order' initially to the Manager for approval, before channelling the Forms to the Production Supervisor.

044.3.4 On receiving the signed 'Delivery Order' from the Production Supervisor, the Stores/Delivery will withdraw the Finished Goods from Stores and arrange for delivery. He will enter the date of this delivery and the name of the person delivering the goods.

044.3.5 The Form will be signed for inspection, before delivery, as delegated by the Production Supervisor.

044.3.6 The goods together with three copies of the 'Delivery Order' will be despatched to the customer. On receiving the goods, the customer will sign the 'Delivery Order' and retain one copy. The other two copies are returned through the Delivery Clerk to the Production Supervisor for separation and distribution.

044.3.7 The Production Supervisor will retain one copy, enter the quantity delivered on the

Progress Record of his respective 'Sales/ Production Order' Form and file the 'Delivery Order' by numerical order.

044.3.8 The second copy is channelled to the Accounts/Sales where the 'Delivery Order' will be checked against the 'Sales/Production Order' before entering the 'Delivery Order' number and the quantity delivered on the 'Sales/Production Order'. An Invoice for the goods delivered will be prepared, and then the 'Delivery Order' will be filed permanently by numerical sequence.

DAY-RATE

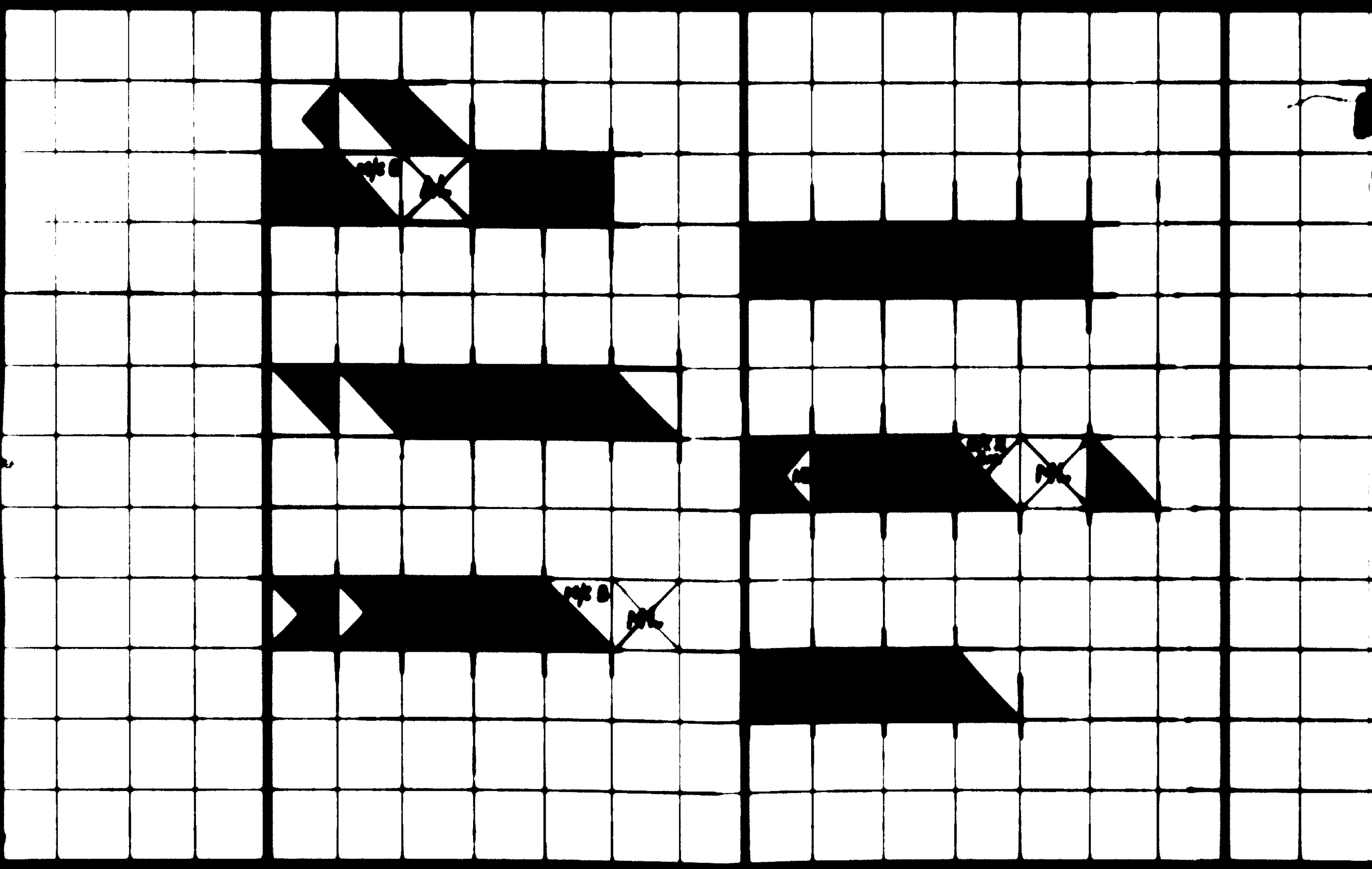
SECTION 1

SALES/PRODUCTION ORDER NO. 銷售生產命令編號 / DAYS & DATE 日期 / MAN RATE PER HOUR 工人時率 / WORKERS 工人姓名		045							046			
		星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR
Mr. A 甲	$1/-											
Mr. B 乙	$1/-											
Mr. C 丙	$1/-											
Mr. D 丁	$1/-											
Mr. E 戊	$1.50											
Mr. F 己	$1.50											
Mr. G 庚	$1.50											
Mr. H 辛	$2/-											
Mr. I 壬	$2/-											
Mr. J 癸	$2/-											

TOTAL WEEKLY DIRECT LABOUR COST FOR EACH ORDER 生產命令各單每週直接人工之成本	36 hrs. (小時) @ $1/- p.hr. (時率) = $36/- 48 hrs. (小時) @ $1.50 p.hr. (時率) = $72/- 48 hrs. (小時) @ $2/- p.hr. (時率) = $96/- 132 hrs. (小時) $ 204/-	10 hrs. (小時) @ $1/- 8 hrs. (小時) @ $1.50 4 hrs. (小時) @ $2/- 2 hrs. O/T ([illegible]) @ [illegible] 24 hrs. (小時)
REMARKS 備註	Carried forward	Job C[illegible]

PROCESSING SCHEDU

046				047							048								
星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE



046	047	048	
1/2 p. hr. (每小時) = $10/- 1.50 p. hr. (每小時) = $12/- 2/- p. hr. (每小時) = $8/- 1½ × 2/- p. hr. (每小時) = 6/- $36/-	38 hrs. (小時) @ $1/- p. hr. (每小時) = $38/- 36 hrs. (小時) @ $1.50 p. hr. (每小時) = $54/- 32 hrs. (小時) @ $2/- p. hr. (每小時) = $64/- 4 hrs o/t (超時) @ 1½ × $1/- p. hr. (每小時) = $ 6/- 110 hrs (小時) $162/-	40 hrs (小時) @ $1½ p. hr. (每小時) = $60/- 30 hrs. (小時) @ $1.50 p. hr. (每小時) = $45/- 28 hrs. (小時) @ $2/- p. hr. (每小時) = $56/- 2 hrs. o/t (超時) @ 1½ × $1.50 p. hr. (每小時) = 4.50 100 hrs. (小時) $165.50	26 hrs. (小... 8 hrs. (小... 12 hrs. (小... 46 hrs. (小...
Closed	Carried forward	Job closed	C...

SECTION 2

EDULE 日薪工人工作程序表

	049							050							杂作 MISCELLANEOUS				
星期日 UN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI

	049	050	MISCELLANEOUS
0/- 5/- 6/- .50 5.50	26 hrs. (小時) @ $1/- p.hr. (每小時) = $26/- 8 hrs. (小時) @ $1.50 p.hr. (每小時) = $12/- 12 hrs. (小時) @ $2/- p.hr. (每小時) = $24/- 46 hrs. (小時) $62/-	20 hrs. (小時) @ $1/- p.hr. (每小時) = $20/- 8 hrs. (小時) @ $2/- p.hr. (每小時) = $16/- 28 hrs. (小時) $36/-	6 hrs. (小時) @ $1/- p.hr. 4 hrs. (小時) @ $1.50 p.h. 10 hrs. (小時)
	Carried Forward	Carried Forward	Job com-

SECTION 3 | Appendix 051 | DAY-RATE

…人工作程序表

050					雜作 MISCELLANEOUS							每週工人工作時間總數 TOTAL TIME FOR EACH WORKER		
星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	星期一 MON	星期二 TUE	星期三 WED	星期四 THUR	星期五 FRI	星期六 SAT	星期日 SUN	出勤日數 WEEKLY ATTENDANCE (DAYS)	超時時數 OVERTIME HOURS PER WEEK	非生產時數 UNPRODUCTIVE HOURS PER WEEK
												6	–	–
												6	–	AB 2
												5 (ML-1)	4	AB 2 M/C B 4
												6	–	–
												6	–	–
												6	–	–
												5 (ML-1)	2	AB 2
												6	–	–
												5 (ML-1)	2	M/C B 4
												6	–	–

… (小時) @ $[illegible]/- p.hr. (每小時) = $20/-
… (小時) @ $[illegible]/- p.hr. (每小時) = $16/-
… (小時) $36/-

6 hrs. (小時) @ $1/- p.hr. (每小時) = $6/-
4 hrs. (小時) @ $1.50 p.hr. (每小時) = $6/-
10 hrs. (小時) $12/-

Carried forward

Job closed

NOTATIONS 附註

AL : ANNUAL LEAVES 年假
ML : MEDICAL LEAVES 病假
M/C B: MACHINE BREAKDOWN TIME 機器損壞時間
AB : ABSENT 曠工
O/T : OVERTIME 超時

SECTION 4

051 - DAY-RATE PROCESSING SCHEDULE FORM Procedure

051.1 Objectives

i) To schedule, assign and report on work of Day-Rate Direct Labour on a weekly basis.

ii) To assign and report on overtime work of Day-Rate Direct Labour.

iii) To accumulate on a weekly basis total Day-Rate Direct Labour costs, including overtime costs, by each 'Sales/Production Order' or miscellaneous 'Work Order'.

iv) To record weekly attendance and unproductive time of each worker.

v) To keep as a record of past performance of worker as a basis for estimating labour costs.

051.2 The Form & Responsibility

The weekly 'Day-Rate Processing Schedule' is a one-copy Form compiled by the Foreman of Processing Sections employing Day-Rate Workers.

051.3 Procedure

051.3.1 The Foreman will be responsible for charting in advance the work schedule of individual worker by jobs in the successive week with the following notations :

 - To schedule 2 direct working hours

 - To schedule 4 direct working hours

 - To schedule 6 direct working hours

 - To schedule 8 direct working hours

The Foreman will also be entering the day to day records of the time (productive and unproductive) spent by each worker on each job. The time recorded include normal time, overtime and unproductive time.

051.3.2 At weekends he will forward the Schedule to the Accounts where normal time, overtime, and leave period are entered in the payroll sheet.

051.3.3 The Accounts will multiply the hours worked (normal and overtime), leave period, and sick leave period by the relevant rate to arrive at gross earnings per worker; and work out necessary deductions to arrive at the net pay. The labour cost of individual worker will be entered on the worker's earnings card. When the job is completed, Accounts will accumulate the direct labour costs to the specific job and enter in the relevant 'Job Cost Sheet'.

051.3.4 The Schedule will then be channelled back to Production where it is filed in past performance file and used as reference in estimating future jobs.

051.3.5 A sample procedure for filling the Weekly Labour Schedule and Report on Job 047 for the whole week is given below :-

i) The hours allocated to workers on Monday and Wednesday on Job 047 had been duly performed.

ii) On Tuesday, machine breakdown had resulted in 4 hours of unproductive time which was originally scheduled for normal working time.

iii) On Thursday, 2 hours of work in excess of the scheduled time was spent by workers on the job beyond normal working time. This would constitute as overtime. The overtime was to recover the 4 hours unproductive time caused by machine breakdown on Tuesday.

iv) A breakdown in the machinery operated by Worker I resulted in a loss of 4 hours of scheduled normal working time on Friday, while Worker C reported again an overtime of 2 hours.

v) On Saturday, the scheduled work hours should be 12 hours, but Worker I did not report for duty on medical reasons. This leaves the actual work hours to 4.

vi) At the end of the week, a summarisation of Direct Day-Rate Labour hours on Job 047 is made, and the direct labour cost is obtained by multiplying the normal hours worked by relevant rate per hour. Overtime pay is calculated by multiplying the hours of overtime by 1½ times of the relevant rate per hour. The total direct labour hours and direct labour costs for the week would be accumulated and carried forward to the following week if the job has not been completed.

051.3.6 Alternatively, the following provides a sample procedure for filling the Labour Schedule and Report of a particular worker, for example Mr. C for the whole week ending 18 December 1971.

i) Mr. C spent 8 hours on Job 047 on Monday as allocated.

ii) On Tuesday, due to failure in the operation of machine, 4 hours of unproductive time

was incurred which was then recorded under the column of "Total Unproductive Time (hours) per week for each worker".

iii) Mr. C applied for one day leave on Wednesday which was noted down under the column of "Weekly Attendance".

iv) An overtime of 2 hours on the job was spent by Mr. C on Thursdays and Fridays in addition to the scheduled time of 8 hours per day.

v) Mr. C started on a minor job on Saturday. He spent 6 hours on the job and was absent from his duties for 2 hours. This was therefore recorded under the column of "Unproductive Time".

vi) At the end of the week the Labour Report on Mr. C shows he was in attendance for 5 days with one day on annual leave, a total of 4 hours as overtime, and a total of 6 hours of unproductive time of which 4 hours was due to machine breakdown and an absenteeism of 2 hours.

051.3.7 If miscellaneous work (such as prototypes, repairs etc.) is performed by direct labour, the time spent will be entered in the last column of the Schedule reserved for miscellaneous work.

星木傢公司
STAR FURNITURE CO

工作分配單 JOB ASSIGNMENT

編號 No. .....

生產部存本 PRODUCTION COPY

Overall due completn. date 總完成日期	Assigned to 分配給 ☐ Piece-Rate Worker 計工工人 ☐ Sub-contractor 包工	S/PO no. 產銷令 / 合約號	Name of Worker / Sub-contractor 工人或包工姓名

TASKS 工作	☐ Machining 机作	☐ Assembly 裝配	☐ Finishing 修飾	☐ Upholstery 坐褥	☐ Others 其他

Item no. 項目	Qty. assign. 分配數量	Description & Progress Record of processed items 製造品詳述及工作進展記錄	Cost 成本 @ 每件	Cost Tota 總共	Due completion date 應完成日期	Progress payment 支付進展
				總共 Total		總共 Total

Remarks 備註	分配者 Assigned by ..... Date 日期	Worker/Sub-contractor 工人/包工者 ..... (signature) 簽名
	批准者 Approved by ..... Date 日期	Date 日期 .....

Manual of Basic Production Procedures
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星木器公司
STAR FURNITURE CO

工作分配單 JOB ASSIGNMENT
編號 No. ....

會計部存本 ACCOUNTS COPY

Overall due completn. date 總完成日期	Assigned to 分配給 ☐ Piece-Rate Worker 件工工人 ☐ Sub-contractor 包工	S/PO no. 生產令 令編號	Name of Worker/Sub-contractor 工人或包工姓名

TASKS 工作	☐ Machining 機件	☐ Assembly 裝配	☐ Finishing 修飾	☐ Upholstery 墊裝	☐ Others 其他

Item no. 項目	Qty. assign. 分配數量	Description & Progress Record of processed items 製造品部或工作進展記錄	Cost 成本 @ 單價	Total 總共	Due completion date 應當完成日期	Progress payment 支付進展
			Total 總計		Total 總計	

Remarks 備註

分配者 Assigned by ....

Date 日期 ....

批准者 Approved by ....

Date 日期 ....

Worker/Sub-contractor 工人/包工簽

.... (signature) 簽名

Date 日期 ....

星木器公司
STAR FURNITURE CO

工作分配單 JOB ASSIGNMENT

編號 No. ....

WORKER/SUB-CONTRACTOR COPY
工人/包工者存本

Overall due complotn. date 總完成日期	Assigned to 分配給 ☐ Piece-Rate Worker 件工工人 ☐ Sub-contractor 包工	S/PO no. 生產令 令編號	Name of Worker/ Sub-contractor 工人或包工姓名

TASKS 工種	☐ Machining 机作	☐ Assembly 裝配	☐ Finishing 外飾	☐ Upholstery 坐套	☐ Others 其他

Item no. 項目	Qty. assign. 分配數量	Description & Progress Record of processed items 製造品部或人工中進展紀錄	Cost 成本 @ 每件	Cost 成本 Total 總共	Due completion date 應當完成日期	Progress payment 支付進展
			總共 Total		總共 Total	

Remarks 備註	分配者 Assigned by .... Date 日期 .... 批准者 Approved by .... Date 日期	Worker/Sub-contractor 工人/包工者 .... (signature) 簽名 Date 日期 ....

Manual of Basic Production Procedures
1978 [illegible]

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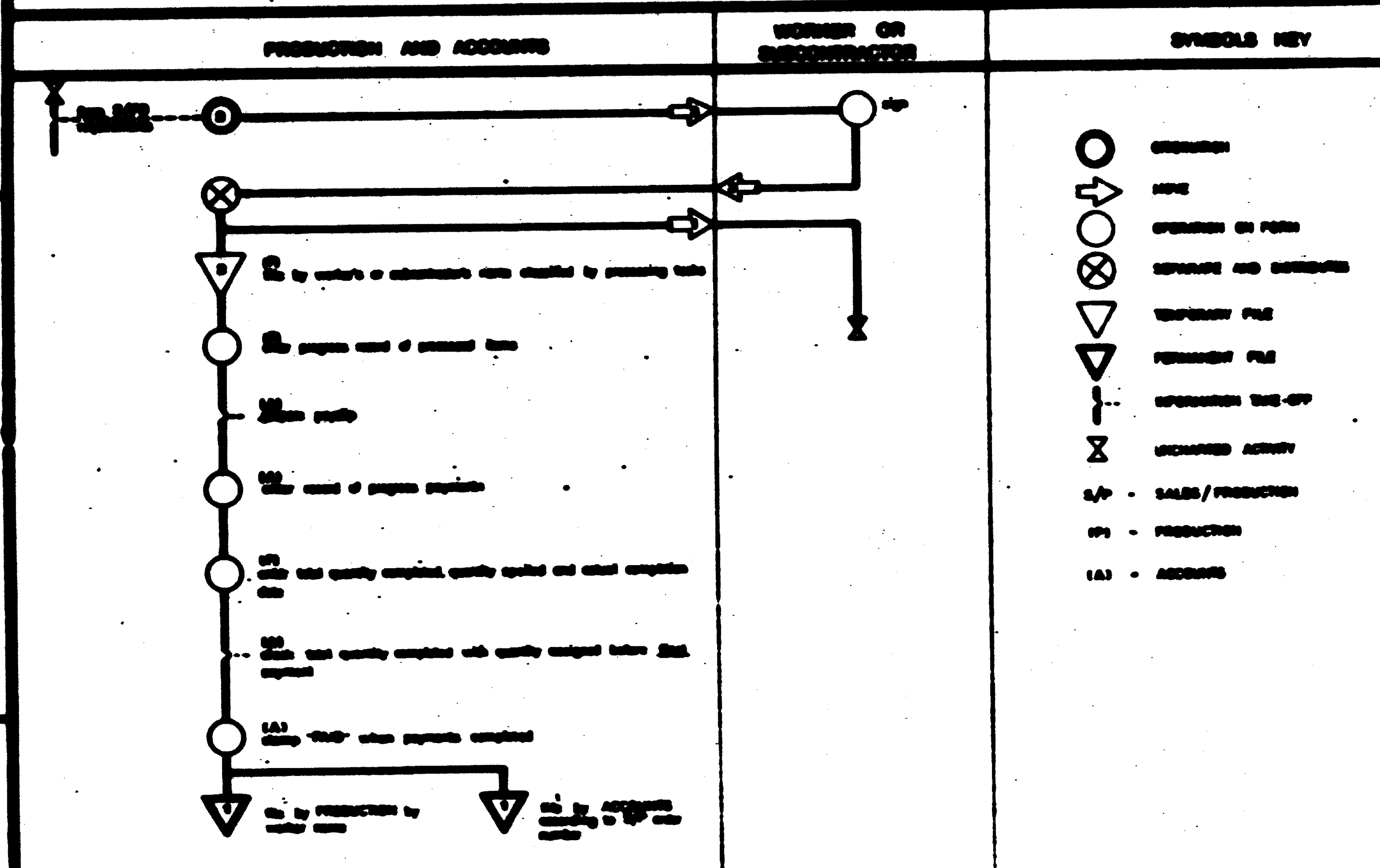
FLOW CHART OF JOB ASSIGNMENT
(For piece-rate workers & subcontractors)



052 - JOB ASSIGNMENT FORM Procedure

052.1 Objectives

The Form is designed for the control of Piece-Rate Workers and Sub-contractors to fulfil the following objectives :

i) To assign jobs on a functional basis.

ii) Serves as a record for checking the progress and completion of the assignment according to the stipulated schedule.

iii) To be used by the Accounts to control progressive and final payments related to the assignment.

052.2 The Form & Responsibility

The 'Job Assignment' Form is issued in triplicate by the Production Supervisor and distributed as follows :

Original	: Production Supervisor & Foremen
Second copy	: Accounts
Third copy	: Piece-Rate Worker or Sub-contractor

The Form is compiled by the Foremen or the Production Supervisor as required, and approved by the Production Supervisor.

052.3 Procedure

052.3.1 On receiving the 'Sales/Production Order', the Production Section (the Production Supervisor or the Foremen) will assign work to the Piece-Rate Worker or the Sub-contractor by using the 'Job Assignment' Form.

052.3.2 The Production Supervisor will compile and approve the 'Job Assignment' for the Sub-contractor. The Form will be compiled instead by the Foreman and approved by the Production Supervisor when work is assigned to the Piece-Rate Worker. The Form will be compiled as follows :

a) Enter the 'Job Assignment' number, the 'Sales/Production Order' number, the date assigned, the overall due completion date and the name of Worker/Sub-contractor.

b) Tick off the type of process/processes involved in the assignment (machining, assembling etc.)

c) Fill in the item number, the quantity assigned, description, drawing number, the cost per unit and total cost, and the due completion date of each item if applicable.

052.3.3 All the three copies of the 'Job Assignment' Forms will be forwarded to the Worker or the Sub-contractor for signature.

052.3.4 It will then be separated and distributed by the Production Supervisor or the Foremen.

052.3.5 One copy of the Form will be forwarded to the Worker or the Sub-contractor for retention.

052.3.6 The Production Section will retain two copies (its own copy and the Accounts copy) and file them temporarily by the Worker's or Sub-contractor's name according to scheduled completion date. The Production will enter the quantity of items processed on the Progress Record of the 'Job Assignment'.

052.3.7 The Accounts will have to refer to the common file retained by the Production Supervisor in calculating, disbursing, and recording all progressive payments made to the Worker or the Sub-contractor prior to the completion of the assignment.

052.3.8 On completion of the assignment, the Production Supervisor will enter the actual date of completion, remark the total quantity completed and the quantity spoiled, if any. The Production copy will be filed permanently by the Worker's or the Sub-contractor's name, while the duplicate copy will be channelled to the Accounts.

052.3.9 The Accounts will be responsible for cross-checking the total quantity completed against quantity assigned before preparing the payslip for final payment. Any discrepancy arising will be recorded and adjustments made accordingly in the final payment. A payslip is prepared and combined to the 'Job Assignment' Form. When final payment is made, the Form is stamped "PAID", filed by 'Sales/ Production Order' and used as reference when the 'Job Cost Sheet' is prepared.

053 - SUB-CONTRACTOR PROCESSING SCHEDULE CHART Procedure

053.1
Objectives

The Chart is used in connection with Factory Sub-contractors' work (ref. Section 9 paragraph 9.2.4). Its main objectives are listed below :

i) To schedule Sub-contractors' work.

ii) To facilitate the selection of Sub-contractors for particular Orders.

iii) To show at a glance the current load and available man-days of each Sub-contractor.

053.2
The Chart & Accounta-bility

The 'Sub-contractor Processing Schedule' is one-copy Chart made up of six columns. The first column shows Sub-contractors' names and code numbers. In the second column is recorded the total weekly available man-days of each Sub-contractor. The next four columns give a breakdown of weeks and days.

The Chart is compiled by the Production Supervisor in consultation with the Sub-contractors (ref. Section 6 paragraph 6.4.3).

053.3
Procedure

053.3.1 A facsimile 'Sub-contractor Processing Schedule' is illustrated below :

'SUB-CONTRACTOR PROCESSING SCHEDULE'

SUB-CONTRACTOR NAME & ORDER NO.	WEEKLY MAN DAYS AVAIL.	WEEK 1						WEEK 2						WEEK 3						WEEK 4					
		1	2	3	4	5	6	8	9	10	11	12	13	15	16	17	18	19	20	22	23	24	25	26	27
ORDER NO.1	30		Ch	Ch	Mk 1				Ch	Ch	Mk	6						Ch	Ch	Mk	2				
WO NO.2	60	Ch	Ch	Mk							Ch	Ch	Mk 3												

053.3.2 When starting the Chart the weekly available man-days for each Sub-contractor will be filled in alongside the Sub-contractor's name. To compute the man-days the number of workers employed by a given Sub-contractor is multiplied by the number of working days in a week. e.g. Sub-contractor No. 1 has 4 workers under him. Assuming that he himself is member of the workforce, the total number of workers is 5. Assumed that the working week is of 6 full days, the weekly man-day capacity of Sub-contractor No. 1 is 5 x 6 = 30 man-days.

053.3.3 It is assumed that when the Chart is started the following 'Sales/Production

Orders' are on hand :

Order No.	Delivery Date	Completion Date	Estimated man-days Required
1	8/1	6/1	30
2	29/1	27/1	45
3	22/1	20/1	180

053.3.4 The estimated man-days required to process the Order, as related to Sub-contractor's work, is derived from the appropriate data posted on the relevant 'Sales/ Production Order' (ref. appendix 021 paragraph 021.3.4-2).

053.3.5 The schedule of Sub-contractor's work with respect to a particular Order will generally depend on three factors :

i) The delivery date.

ii) The expected completion date of the successive processing tasks, that is, finishing and upholstery.

iii) The relationship between the man-days requirement for the particular Order, and the man-days requirement related to other outstanding Orders.

053.3.6 The choice of the Sub-contractor on the part of the Production Supervisor will be based on the available man-days capacity of the Sub-contractors and on their existing completion targets.

053.3.7 It should be borne in mind that the detailed schedule and the distribution of work load within each Sub-contractor Team is not the concern of the Production Supervisor but it is worked out by the Sub-contractor himself.

Therefore, the line ruled on the Chart for each Order, does not indicate (contrary to the Quote Chart system) the starting date and the duration of the job. Here the line simply stands to show the completion target date stipulated by the Production Supervisor and the man-days loaded on the Order starting backward from the target date. The loading is based on the weekly man-days capacity of the particular Sub-contractor.

053.3.8 Again, the gap between the "load lines" of Orders No.5 and No.2 does not mean that there is no work scheduled for the days 15th, 16th and 17th by the Sub-contractor No. 1. It just indicates that the Sub-contractor has an available capacity of 15 man-days for the period ending 27th January.

053.3.9 -1. Let us assume that later the following Orders are received :

Order No.	Delivery Date	Completion Date	Man-days Required
4	5/1	4/1	30
5	15/1	13/1	30

-2. Order No. 4 is urgent and cannot be postponed. The Production Supervisor has two options open to him in assigning the work to the Sub-contractors:

i) Assign the job to the Sub-contractor No.1 and delay Order No. 1 for one week.

ii) Assign the job to the Sub-contractor No.2 and delay Order No. 3 for three days.

-3. Of the two options the Production Supervisor decides for the second, in view of

the fact that the customer of Order No. 3 has accepted a delay in delivery of three days. The Order No. 5 is loaded instead on Sub-contractor No. 1.

FINAL REPORT

04457 (344) 04457 (344)

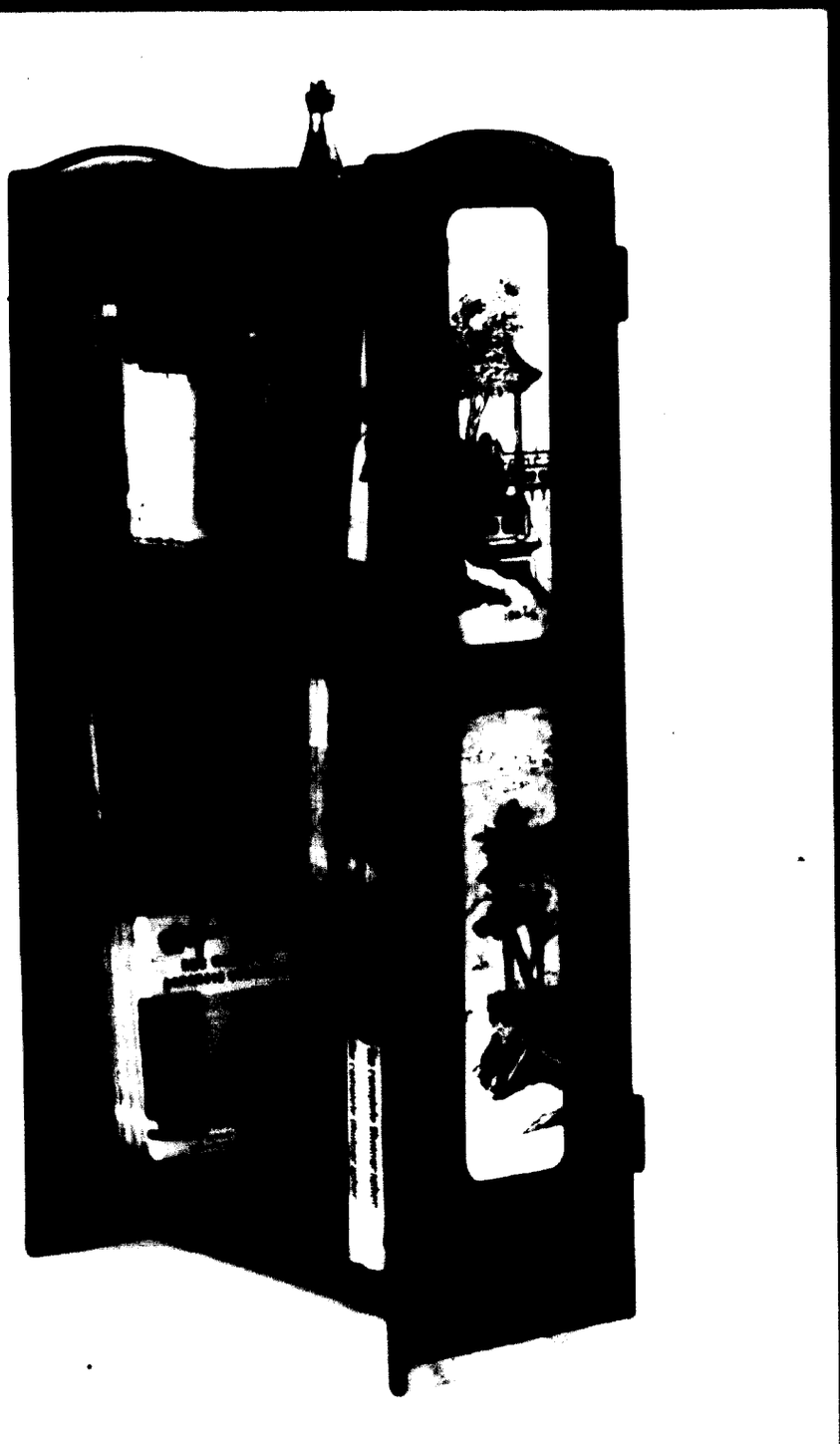
by
Pietro Borretti
United Nations Woodworking Adviser
attached to Light Industries Services
of the Government of Singapore.

Appointed under the
UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION
Assignment 064-D/SIS

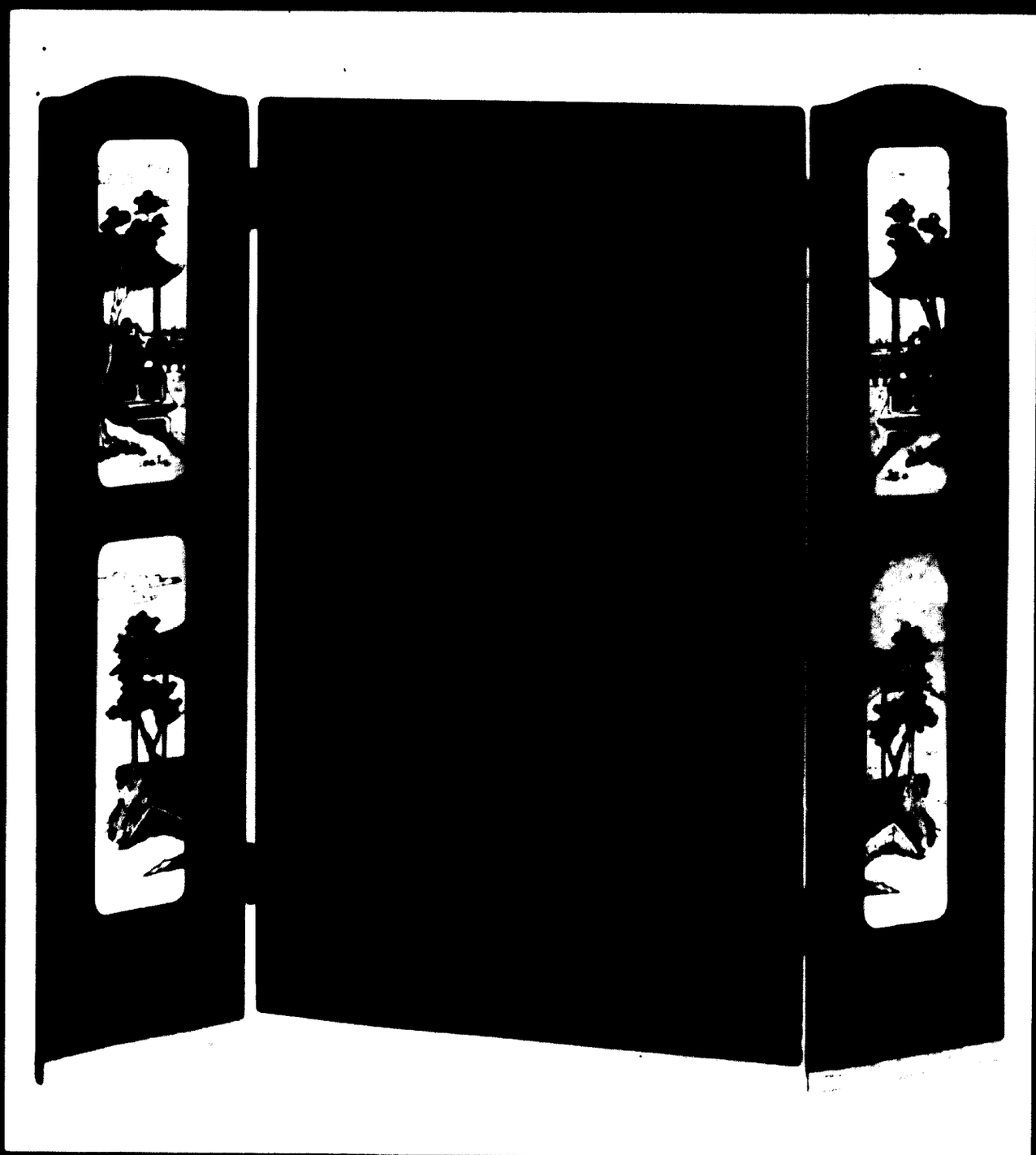
20 May 1972

ANNEXES B-C-D-E

PRODUCT DESIGNS & PHOTOS : P. BORRETTI



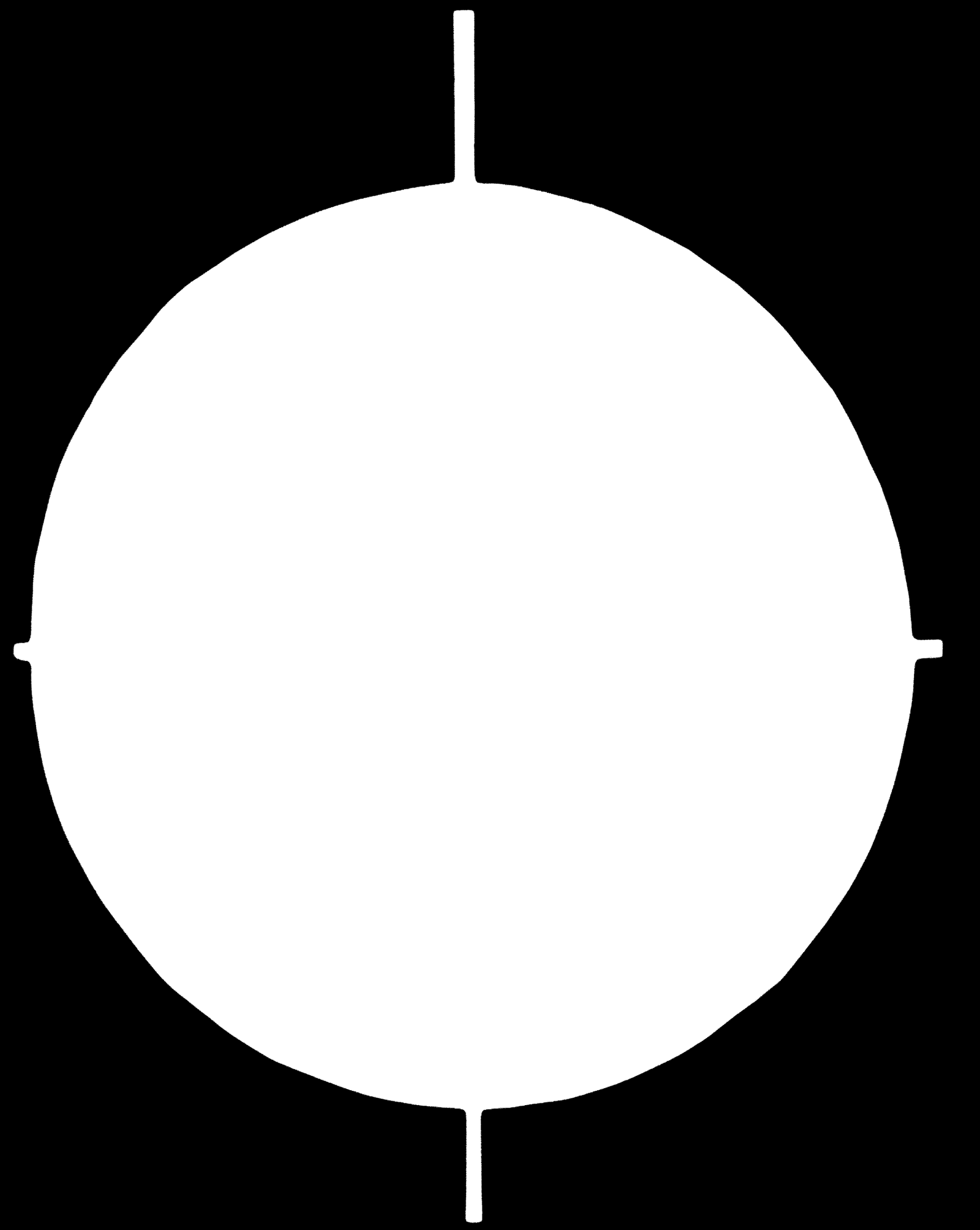
FOLDING BOOKSHELF
Front View



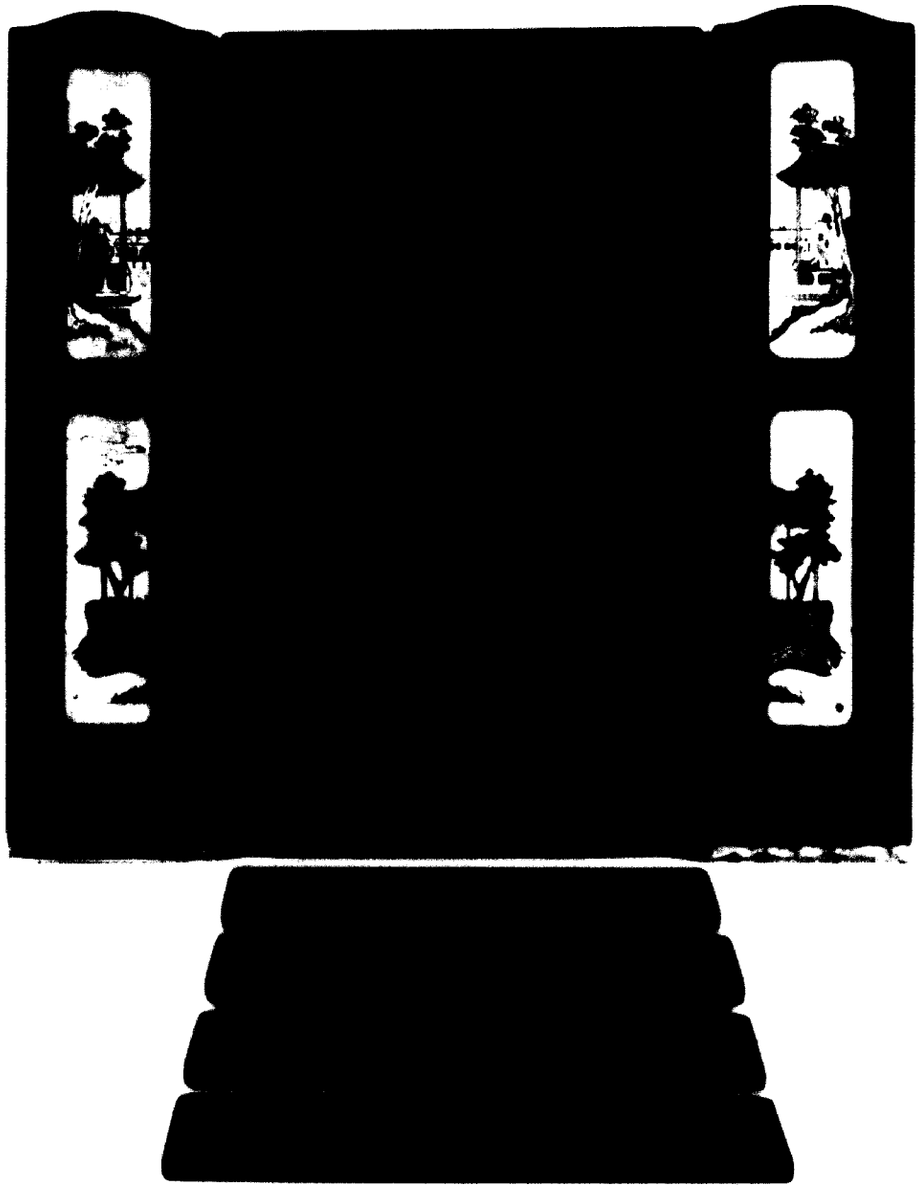
FOLDING BOOKSHELF
View showing the item with removed shelves being utilized as folding screen.

C-846

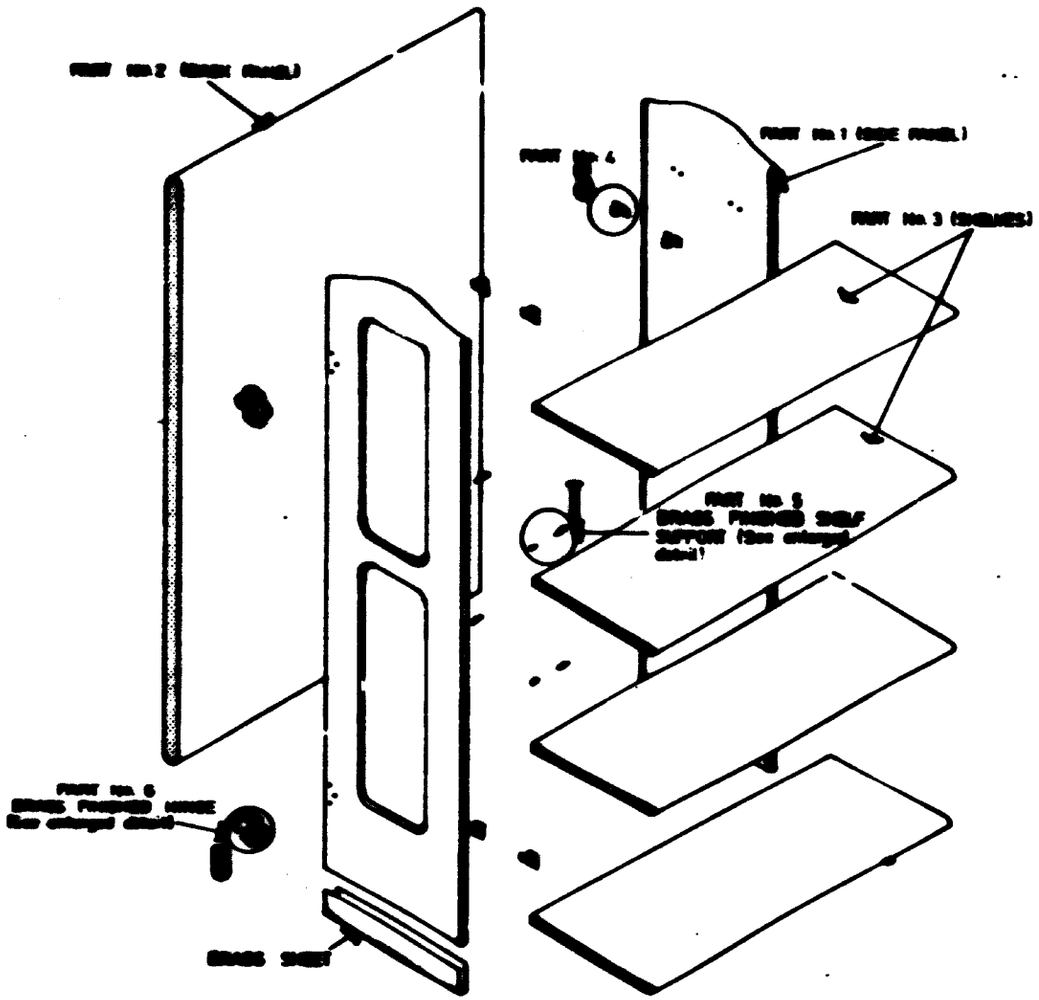
85.10.21
AD.87.04
ILL 5.5+10

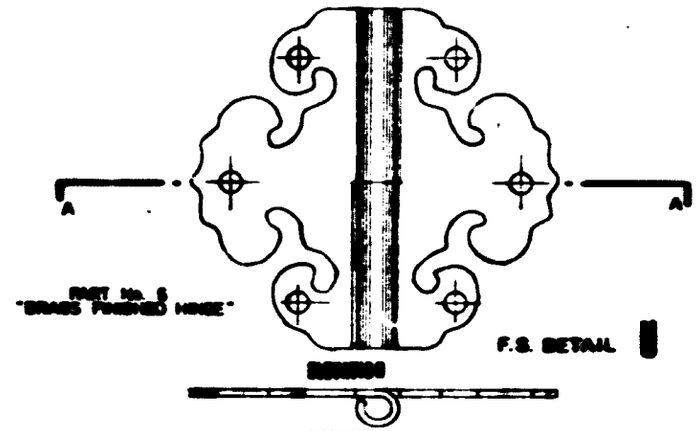


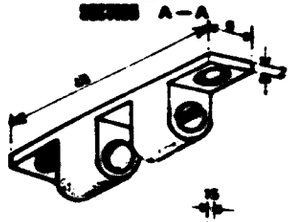
FOLDING BOOKSHELF



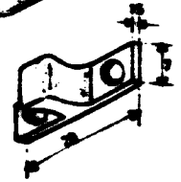
FOLDING BOOKSHELF
Demounted view of bookshelf showing folding components and shelves.







PART No. 6
"SNAP-IN" FITTINGS FOR
TOP AND BOTTOM SHELVES

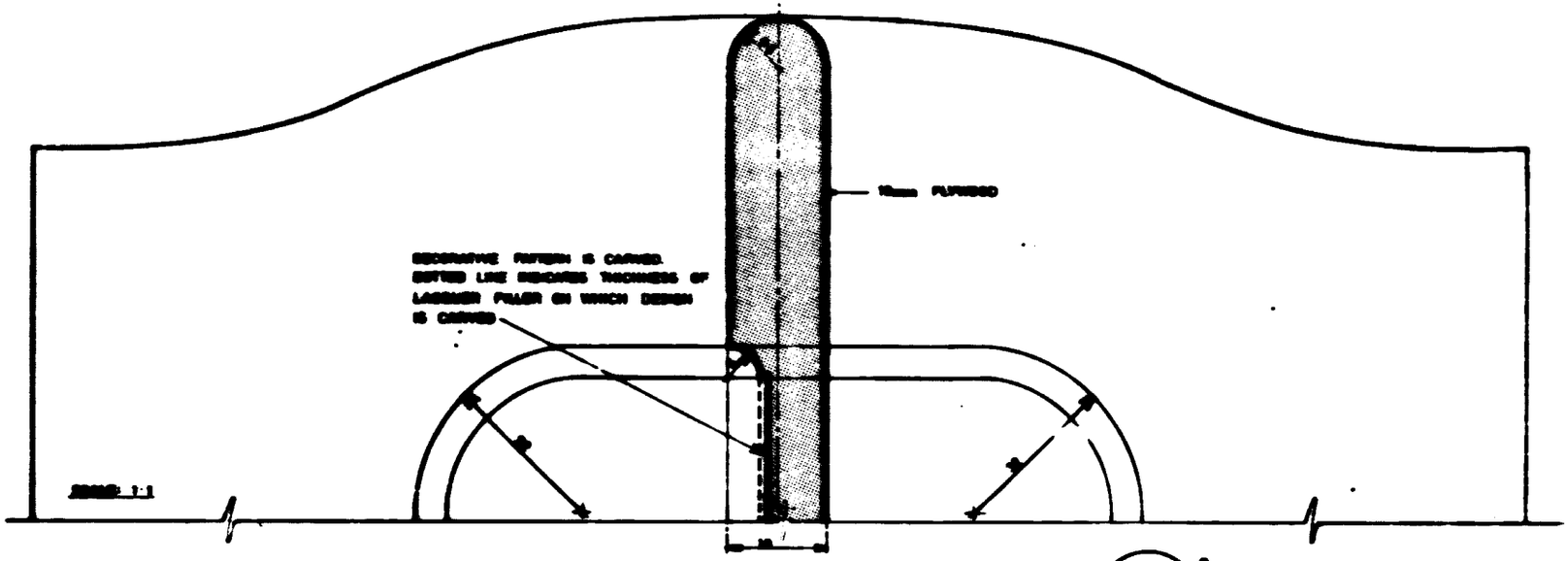


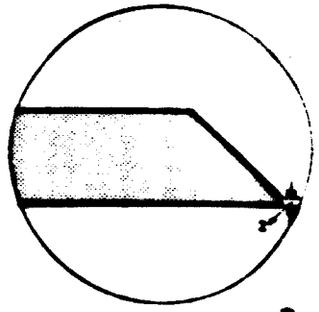
"BRASS FINISHED SHELF SUPPORT"
FOR INTERMEDIATE SHELVES
PART No. 5

STAR FURNITURE CO.

Isometric Drawing

SCALE AS SHOWN	DATE 17 5 1972	CHECKED BY	
DRAWING BY PTB/LIN	DESIGN BY ABL & P TAN		
DRAWING NUMBER		TECHNICIAN DRAWING NUMBER	
PRODUCT FOLDING BOOK SHELF		CODE BS-S/1	





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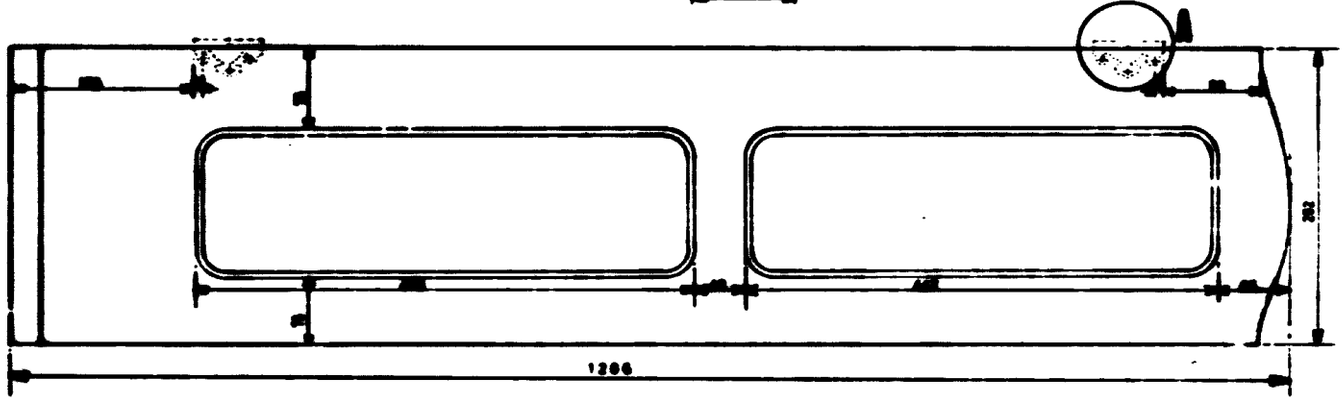
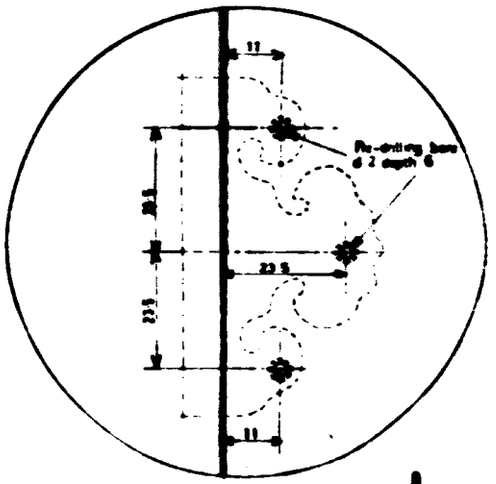
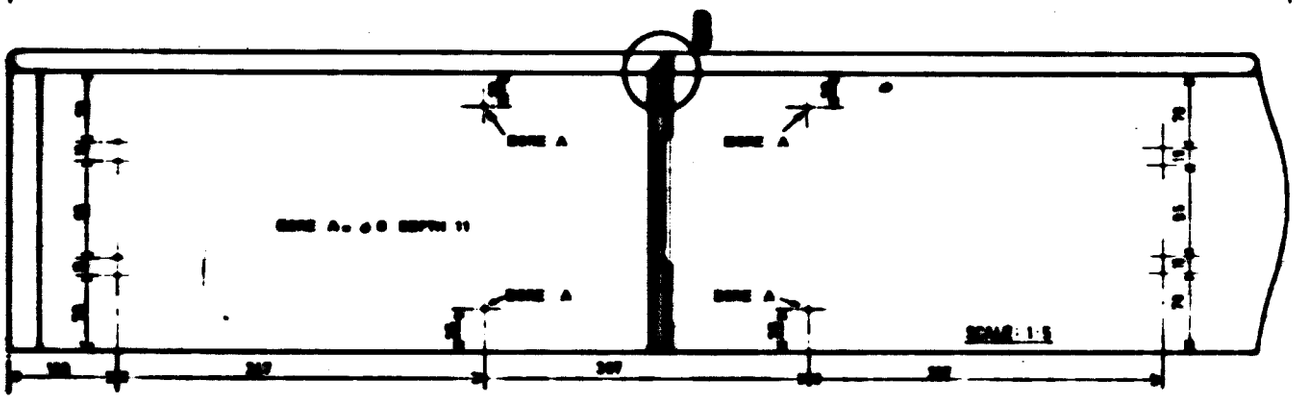




DETAIL A



EDAA FURNITURE CO.

Part Drawing

SCALE AS SHOWN DATE 17.5.[illegible] ISSUED ON

DESIGNED BY PB/JL DRAWN BY AGL & PTAN

DRAWING NUMBER 03 SUPERSEDES DRAWING NUMBER

PRODUCT DBSE

FOLDING BOOK SHELF BS-6/1

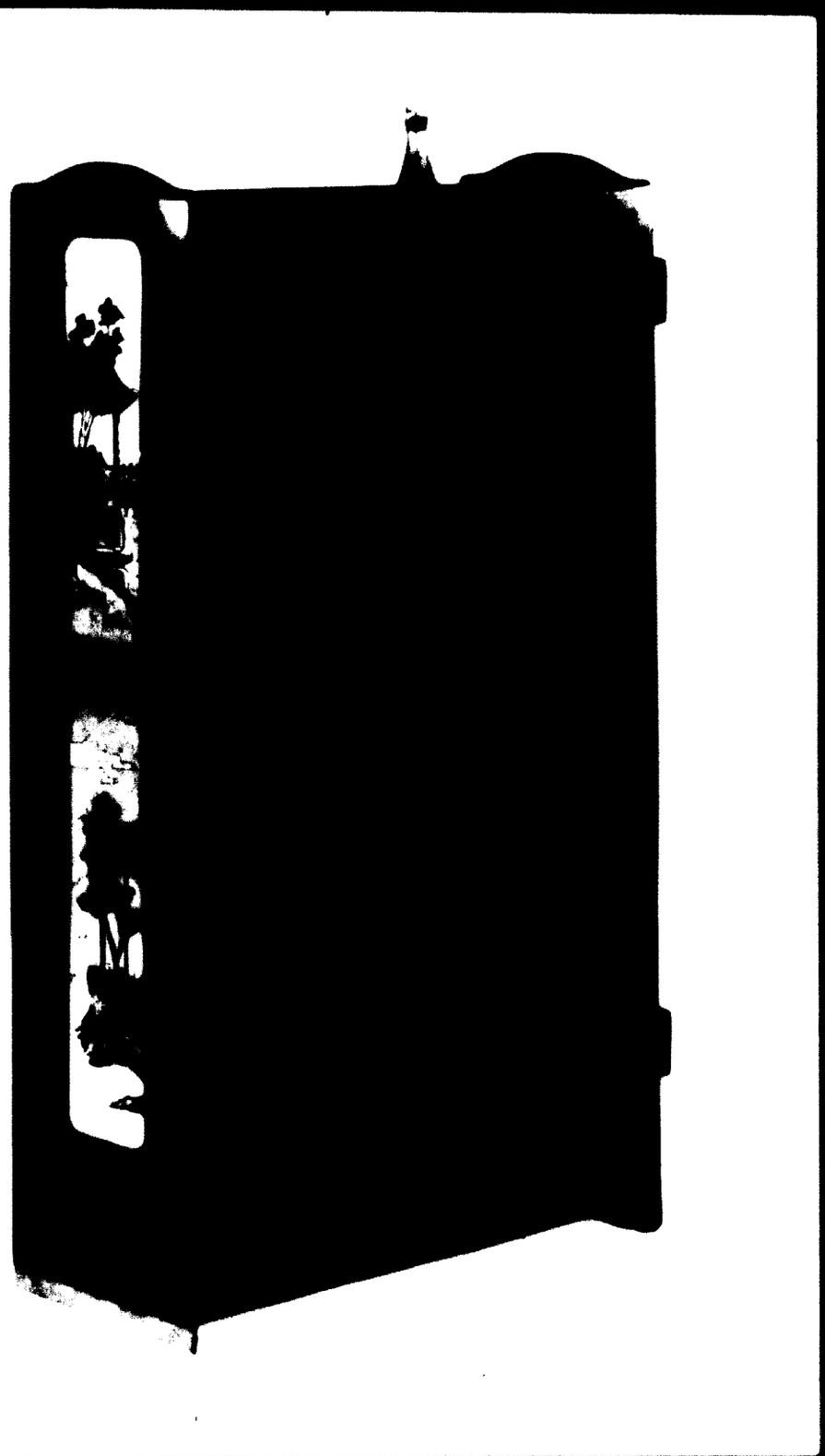
OPERATION SHEET

SALES/PRODUCTION ORDER No .....
PRODUCT QUANTITY THIS ORDER .....
PRODUCT DESCRIPTION FOLDING BOOK SHELF BS-SH

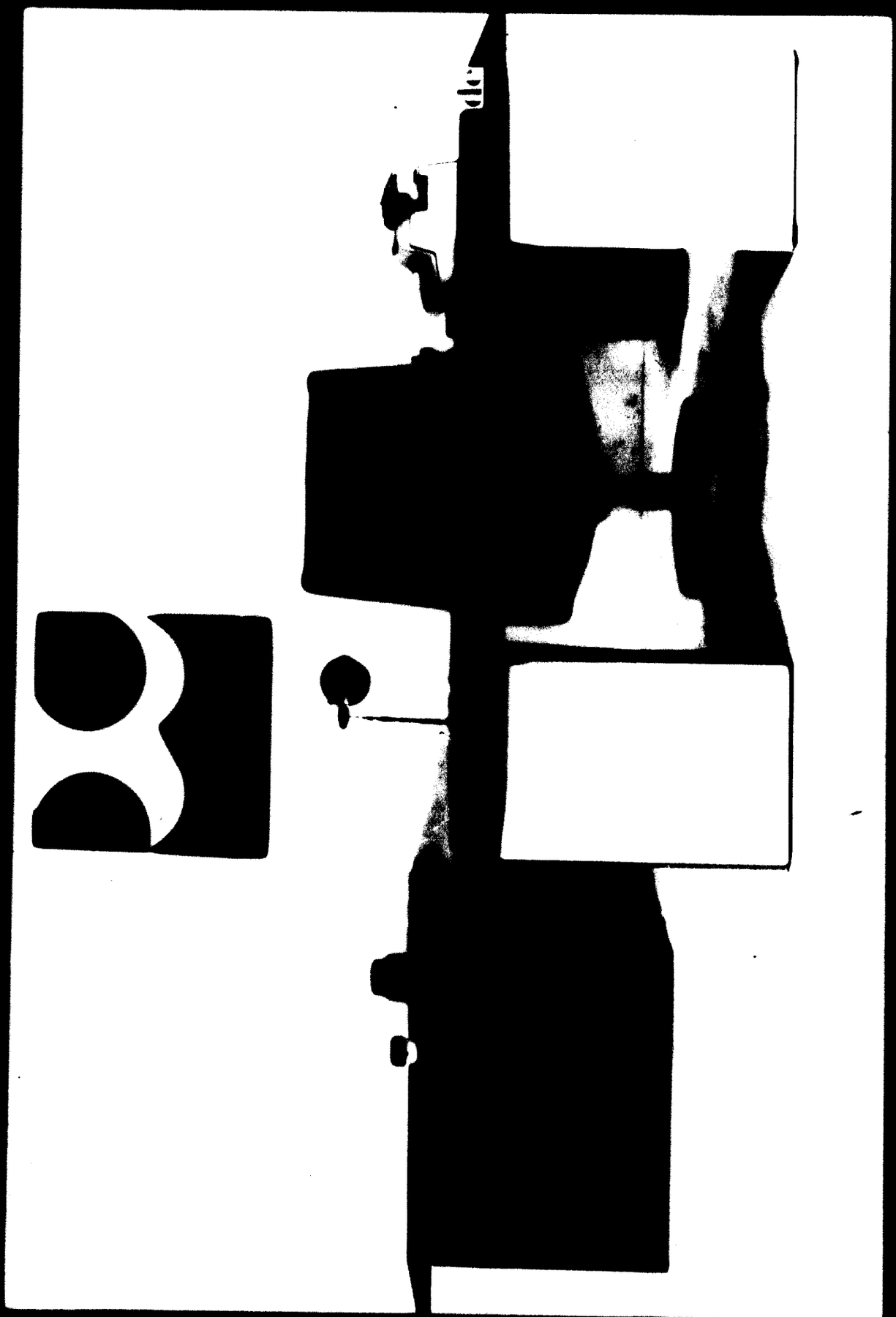
MACHINING TASKS

MACHINE \ PARTS per Unit	① SIDE PANEL 2 pieces	② BACK PANEL 1 piece	③ SHELVES 3 pieces	ESTIMATE TOTAL TIME PER MACHINE FOR 100 UNITS	ESTIMATE TOTAL TIME PER MACHINE FOR ONE UNIT	ACTUAL TOTAL TIME PER MACHINE FOR ..... UNITS
CIRCULAR SAW	E.R: A.R: E.S/U: A.S/U: 1-1, 1-2	E.R: A.R: E.S/U: A.S/U: 2-1, 2-2, 2-3	E.R: A.R: E.S/U: A.S/U: 3-1, 3-2	Hrs	Hrs	Hrs .....
BAND SAW	E.R: A.R: E.S/U: A.S/U: 1-3			Hrs	Hrs	Hrs .....
SPINDLE MOULDER	E.R: A.R: E.S/U: A.S/U: 1-4	E.R: A.R: E.S/U: A.S/U: 2-4	E.R: A.R: E.S/U: A.S/U: 3-3	Hrs	Hrs	Hrs .....
ROUTER	E.R A.R E.S/U: A.S/U: 1-5			Hrs	Hrs	Hrs .....
BORING MACHINE	E.R A.R E.S/U: A.S/U: 1-6	E.R A.R. E.S/U: A.S/U: 2-5	E.R A.R E.S/U: A.S/U	Hrs	Hrs	Hrs .....
ESTIMATE TOTAL TIME PER PART FOR 100 UNITS	Hrs	Hrs	Hrs	TOTAL ESTIMATE TIME FOR 100 UNITS OF PRODUCT Hrs		
ESTIMATE TOTAL TIME PER PART FOR ONE UNIT	Hrs	Hrs	Hrs		TOTAL ESTIMATE TIME FOR ONE UNIT OF PRODUCT Hrs	
ACTUAL TOTAL TIME PER PART FOR ..... UNITS	Hrs	Hrs	Hrs			ACTUAL TOTAL TIME FOR ..... UNITS OF PRODUCT Hrs
ASSEMBLY TASKS	ASSEMBLE FITTINGS ON SIDE PANELS FOR: E 100 UNITS ..... E ONE UNIT ..... A ..... UNITS	SCREWING BACK PANEL TO SIDE PANEL FOR: E. 100 UNITS ..... E. ONE UNIT ..... A. ..... UNITS	ASSEMBLE FITTINGS ON BOTTOM AND TOP SHELVES FOR: E 100 UNITS ..... E ONE UNIT ..... A ..... UNITS	TOTAL ESTIMATE ASSEMBLY TIME FOR 100 UNITS	TOTAL ESTIMATE ASSEMBLY TIME FOR ONE UNIT	TOTAL ACTUAL ASSEMBLY TIME FOR ..... UNITS .....
FINISHING TASKS	E 100 UNITS ..... E ONE UNIT ..... A ..... UNITS	E. 100 UNITS ..... E ONE UNIT ..... A. ..... UNITS	E. 100 UNITS ..... E. ONE UNIT ..... A ..... UNITS	TOTAL ESTIMATE FINISHING TASKS FOR 100 UNITS	TOTAL ESTIMATE FINISHING TASKS FOR ONE UNIT	TOTAL ACTUAL FINISHING TASKS FOR ..... UNITS .....
BRAND TOTALS ⇨				ESTIMATE FOR 100 UNITS Hrs	ESTIMATE FOR ONE UNIT Hrs	ACTUAL FOR ..... UNITS Hrs

NOTATIONS:
E.R. ESTIMATED MACHINE RUNNING TIME
A.R. ACTUAL " " "
E. S/U. ESTIMATED MACHINE SET UP TIME
A. S/U. ACTUAL " " "
E. ESTIMATE

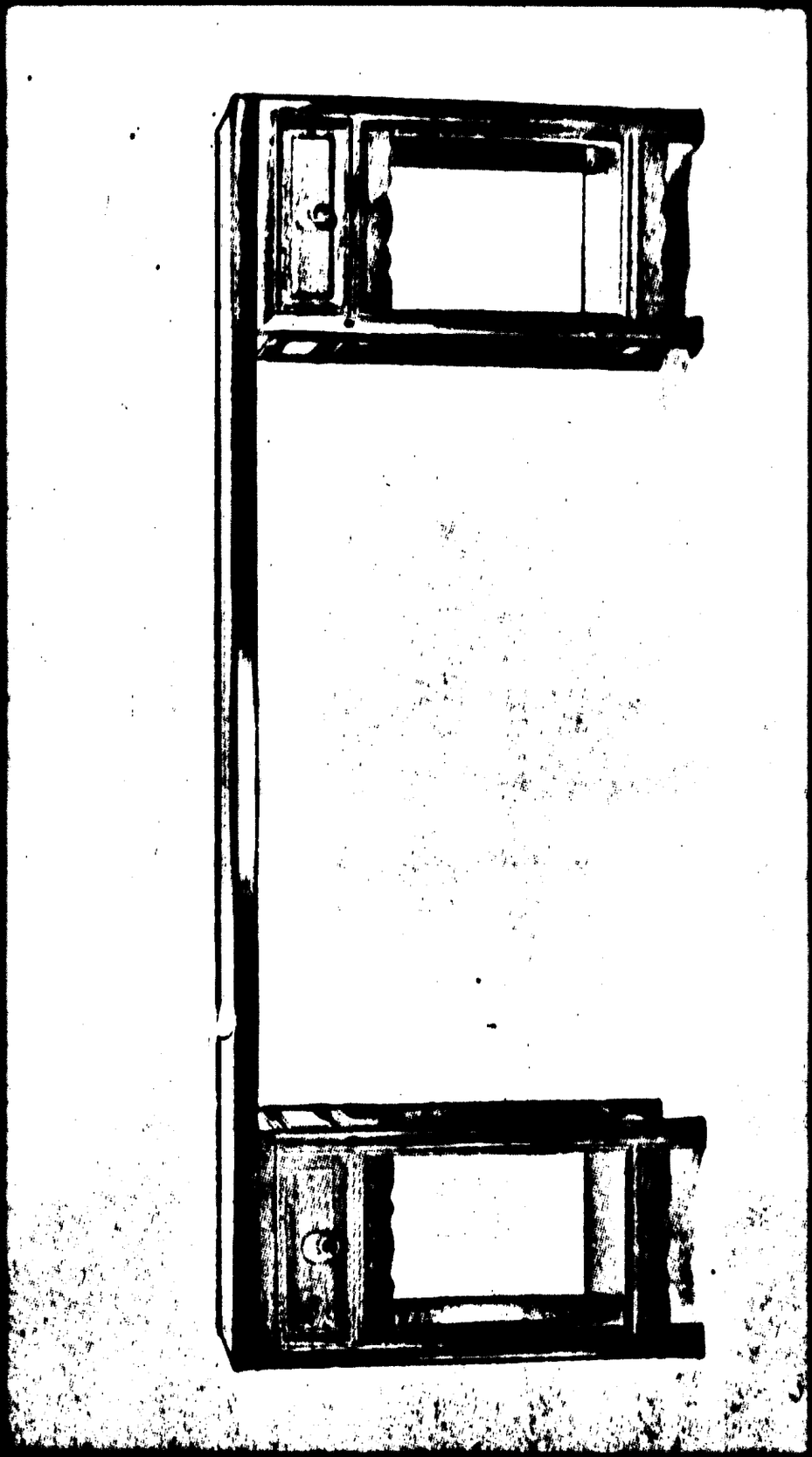


FOLDING BOOKSHELF
Back View

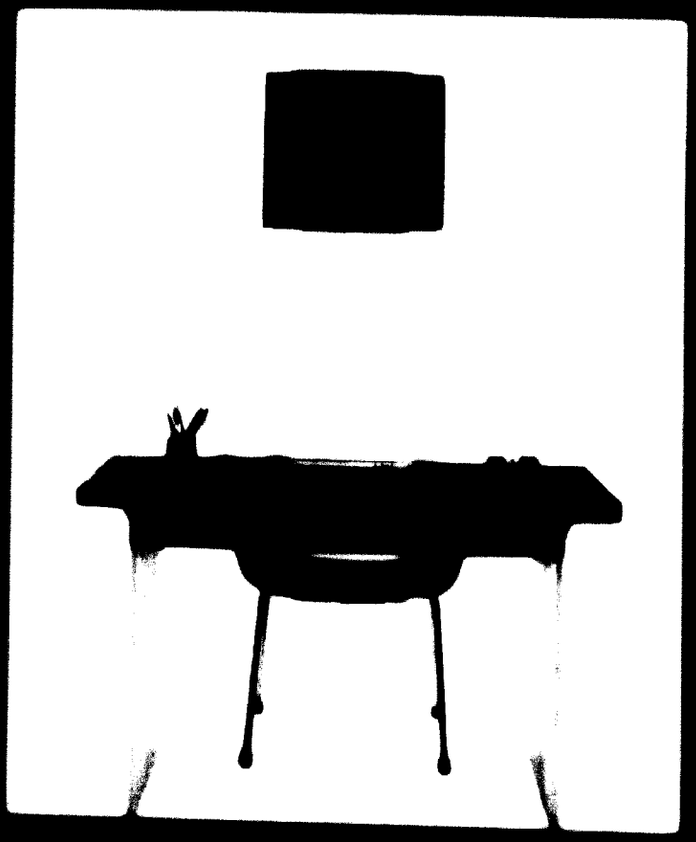


DESK SYSTEM
Back view of Executive Unit with Side Extention.
Front view of Standard Pedestals coupled to form Side Cabinet.

DESK SYSTEM
Front view of Executive Unit.

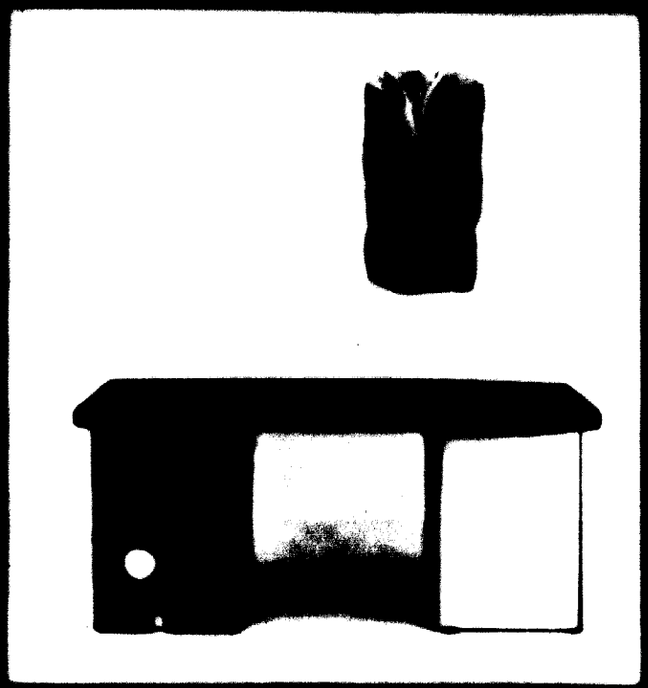


DESK SYSTEM
Original demountable desk of traditional Chinese design which provided the inspiration.

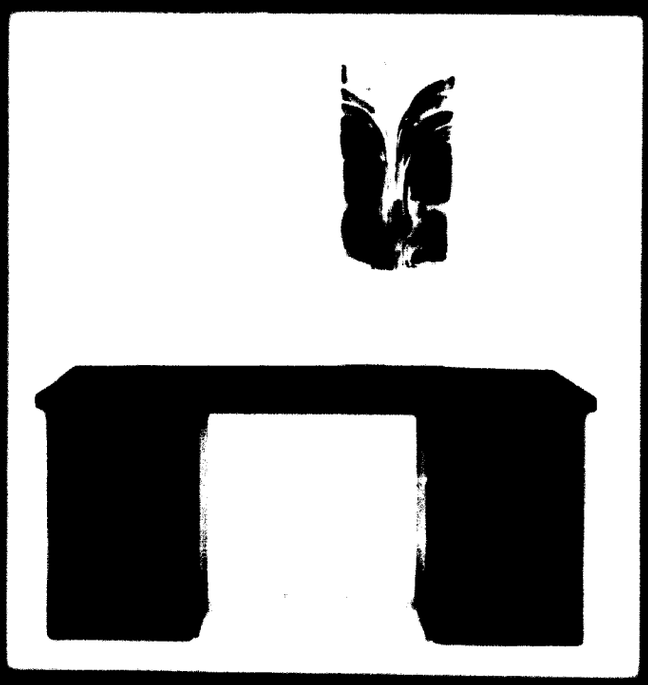


DESK SYSTEM
Back view of desk arrangement consisting of two side panels and table top.

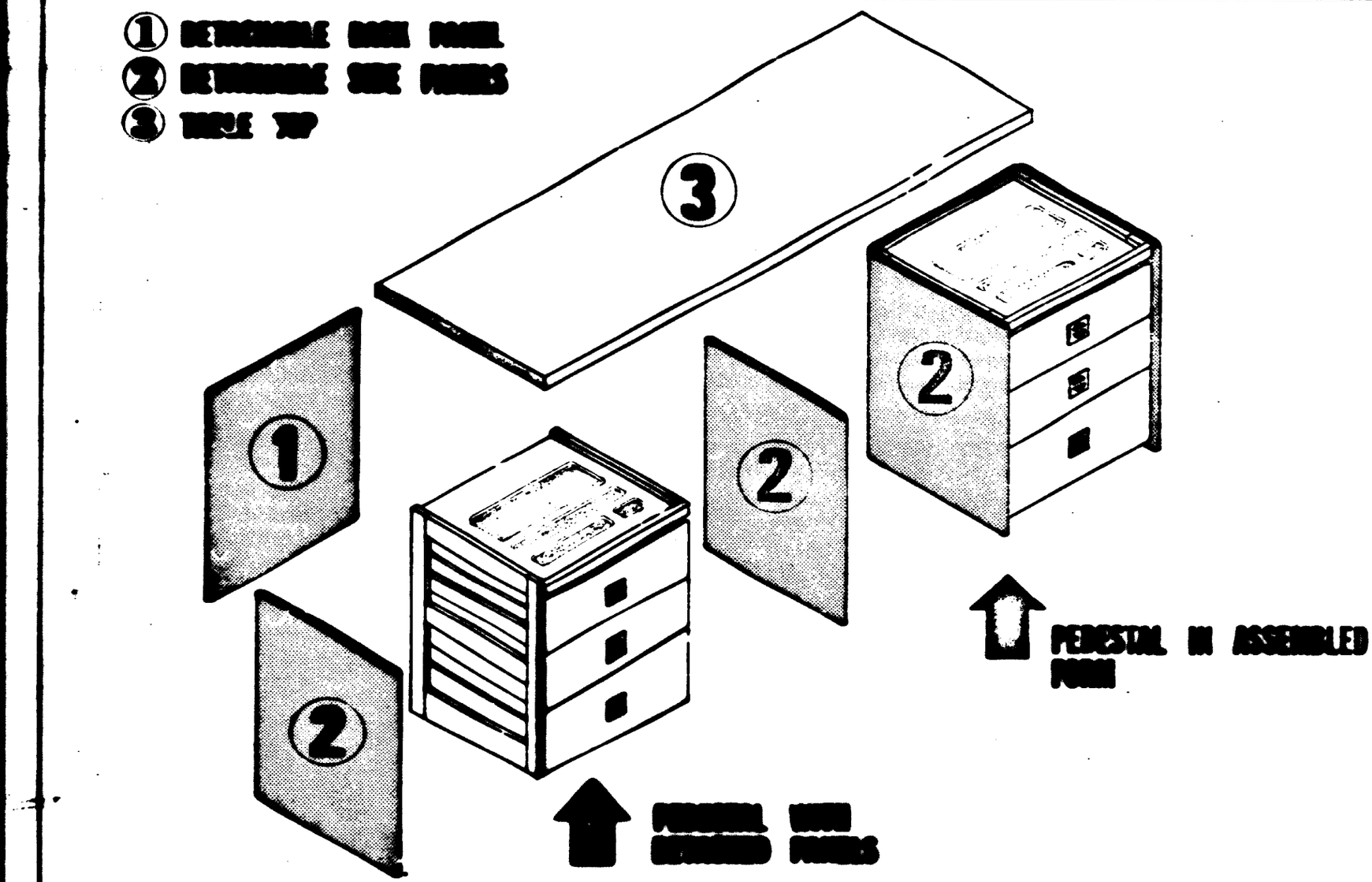
DESK SYSTEM
Back view of desk arrangement consisting of one pedestal, one side panel and table top.



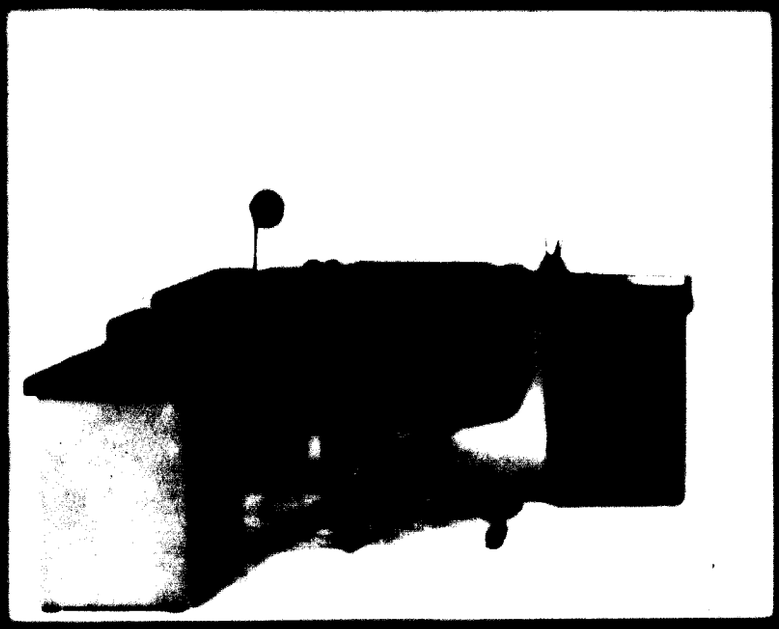
DESK SYSTEM
Front view showing detachable back lined with paper poster. It illustrate the "renewable look" feature of the system.



DESK SYSTEM
Front view of Junior Executive Unit.



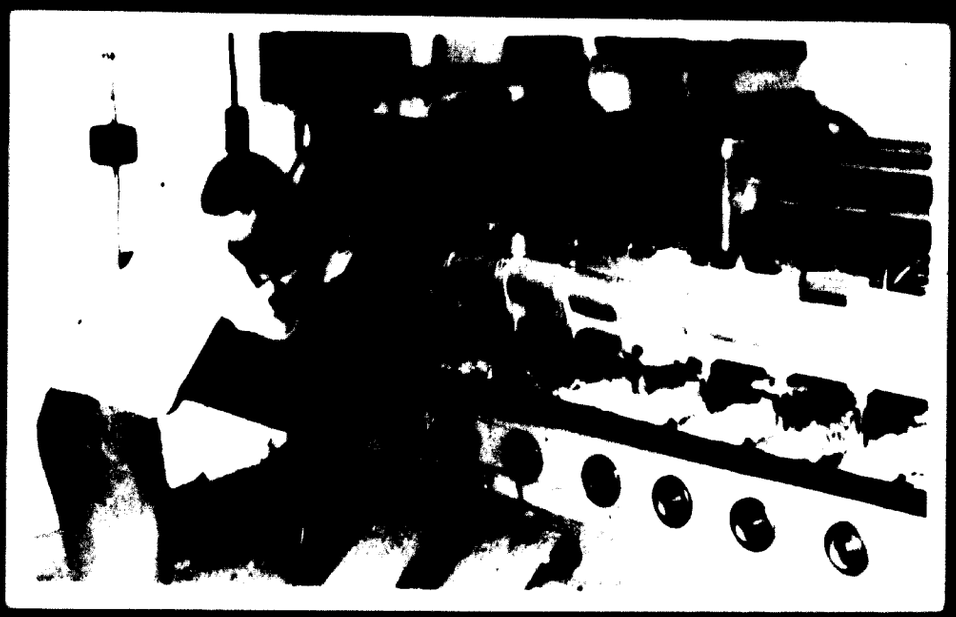
BASIC COMPONENTS OF DESK SYSTEM

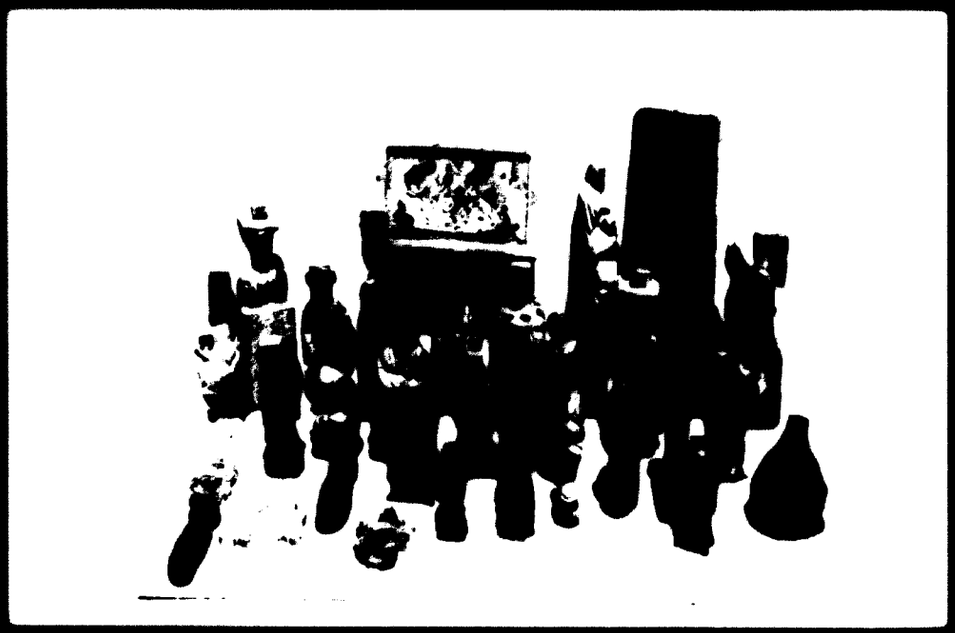


DESK SYSTEM
Front view of Executive Unit with Side Extention.

AUTOMATIC 'ROUND' TENONER MACHINE

introduced by the 1951



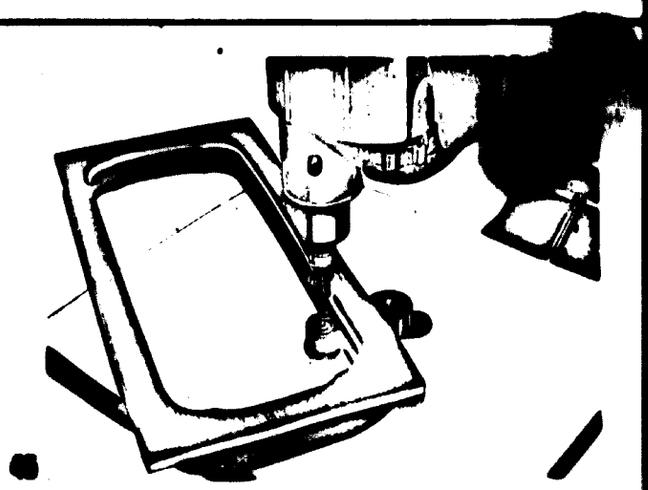


SEMI-AUTOMATIC CARVING MACHINE selected and commissioned by the team.

Training in TOOL MAINTENANCE conducted by the team.

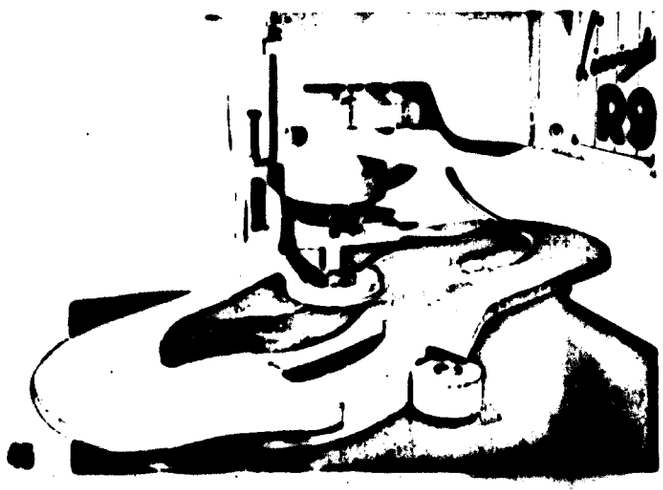
Automatic copying device

This is a feeding device with varying speeds that gives movement to a ring-type closed template that repeats the profile of the workpiece to be produced. The automatic copying device is suggested as an indispensable accessory in mass production work that makes the router a machine for exigent and precise heavy duty work.
The two feed rollers have distinct functions: the central one ensures the feeding of the template keeping it always at a constant distance from the cutter; the external one feeds the template keeping it close to the central roller.
The possibility to vary the speed enables to adapt the feeding of the workpiece to the working exigencies and to the rotation speed of the spindle. There are today special devices that enable the automatic copying of profiles. They are however fitted in very expensive machines that avail themselves of electronic controls with punch cards and photoelectric cells.
Thanks to the SCM patent (for profiles of a particular type) today a simple and very efficient accessory named «automatic copying device» can be mounted on normal routers



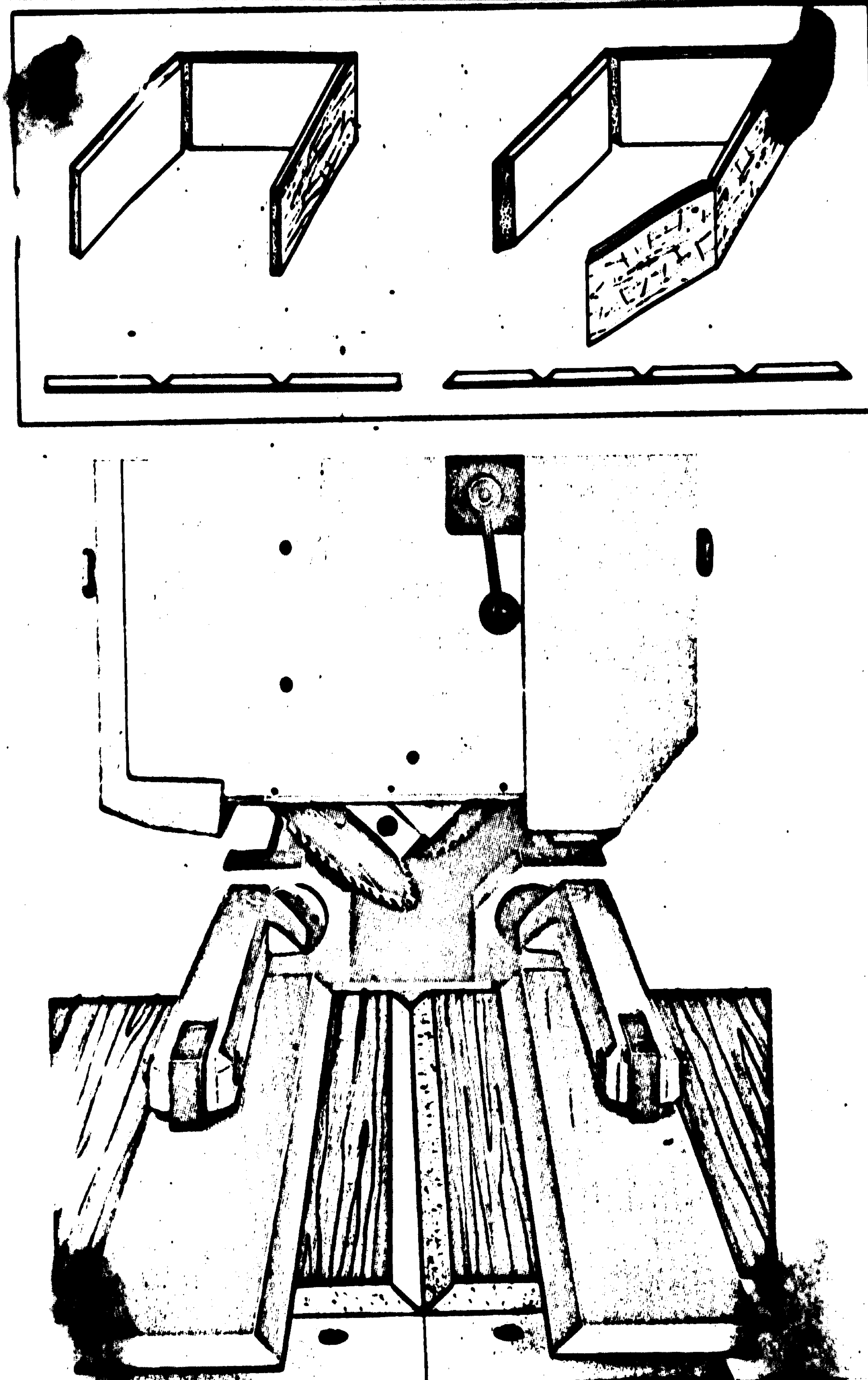
Cutout of a chipboard panel with the automatic copying device in eleven seconds

Routing of the upper edge of a workpiece by means of the automatic copying device and floating head



LOW[illegible]T-AUTOMATION

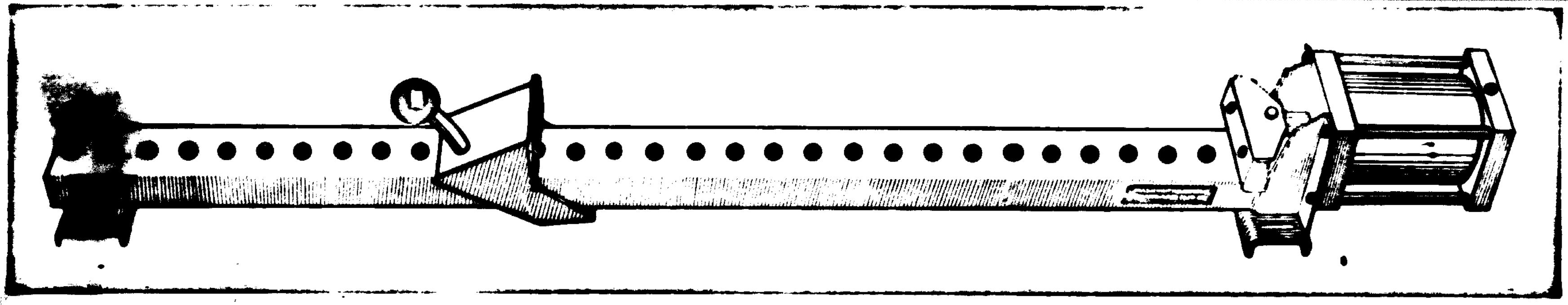
Routing Machine with automatic copying device, introduced by the term



V-GROOVING MACHINE introduced by the team

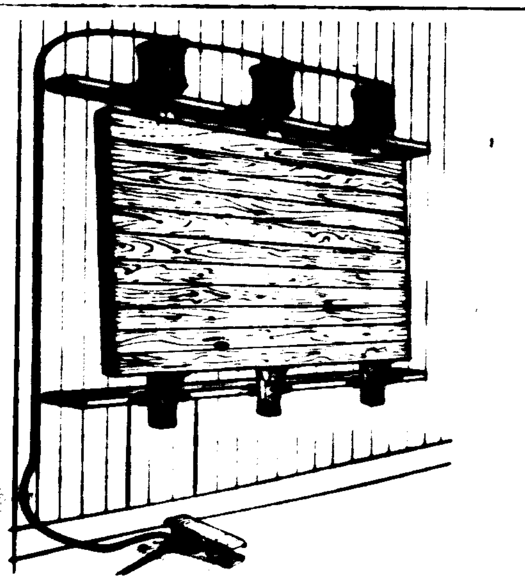
LOW-COST-AUTOMATION

Inexpensive, versatile air clamping equipment introduced by the team

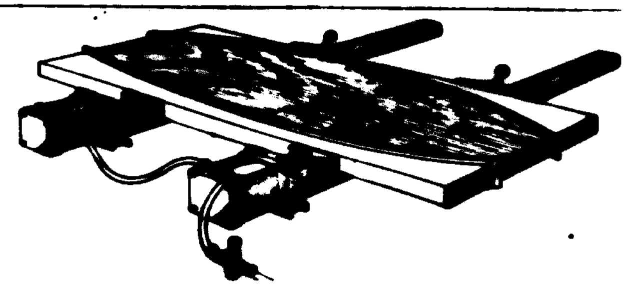


The Quick-Grip Clamps are primarily intended for glueing and assembling operations. They are ideal for use in the manufacture of glueing frames, fabrication presses, etc. Several Quick-Grip Clamps can be connected in series to the same valve. With supplementary valves it is possible to regulate the speed and pressure of the cylinder. Foursided pressing can be arranged by using special accessories. The Quick-Grip Clamps are available in different lengths and with cylinders and accessories for a wide variety of requirements.

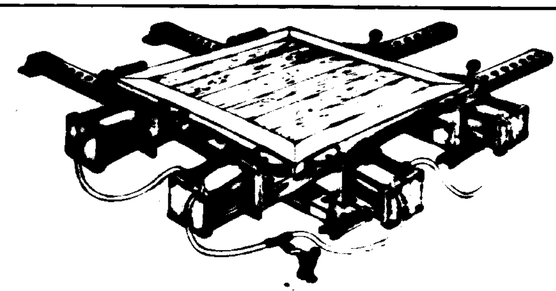
A



B



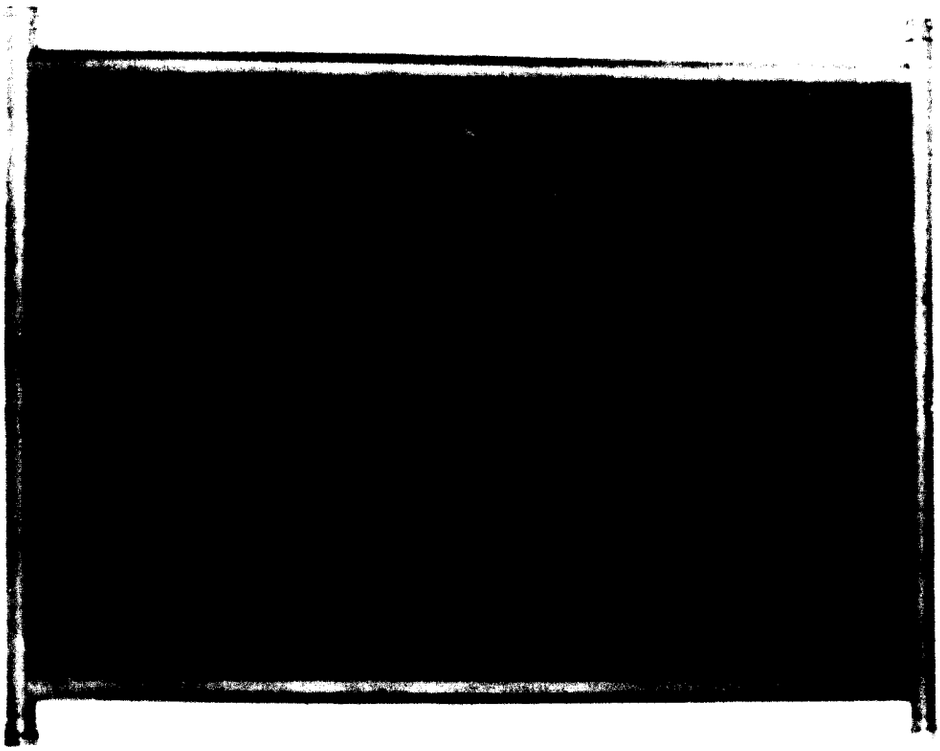
C



A Example showing Quick-Grip Clamp fitted on wall.

B Fixtures used for pressing profiled and curved edges.

C Example showing four-sided pressing. The two right-hand clamps are provided with raising pieces to give the same level on all counterholds and cylinders.



DRINK TRAY

Plywood base lined with batik cotton.
Overlay of polyester embossed with Chinese
"Double Happiness" symbol. Frame of bamboo.

The design was developed to experiment
on the possibility of using a traditional
material such as batik in conjunction
with modern finishing techniques, to obtain
a tough waterproof and decorative surface.

INFORMATION SHEETS FOR THE WOODWORKING INDUSTRY

Prepared by the Woodworking Team

LIGHT INDUSTRIES SERVICES, EDB

179 River Valley Road,
Singapore, 6.

ANNEX F

TRAINING NOTES
IN MAINTENANCE
&
MACHINE OPERATION

INDEX

Operation of Planing Machine

1. Knife and Table Adjustment

In order to do satisfactory work, the rear table must be exactly level with the knife in the cutter head as shown in figure 1.

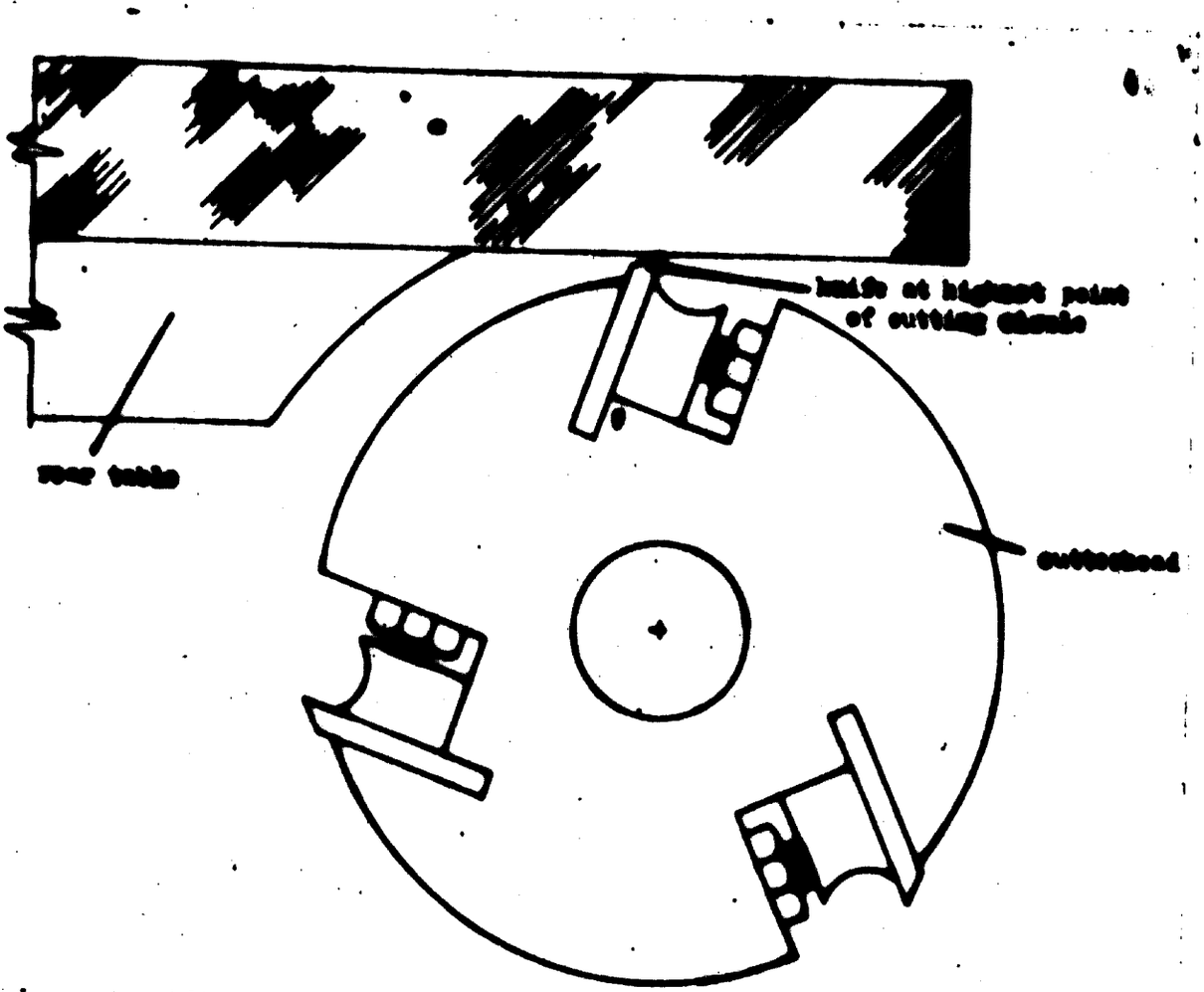


Fig. 1 Alignment of knife and rear table

To make this adjustment, raise or lower the rear table until it is level with the cutting edge of one of the knives using an accurate straight edge at least 10" long. A similar check is then made on all knives at both ends of the cutting edge and at the center too. If a knife is found out of alligment, it must be adjusted. One of the best methods of setting knife is with a magnet as shown in figure 2.

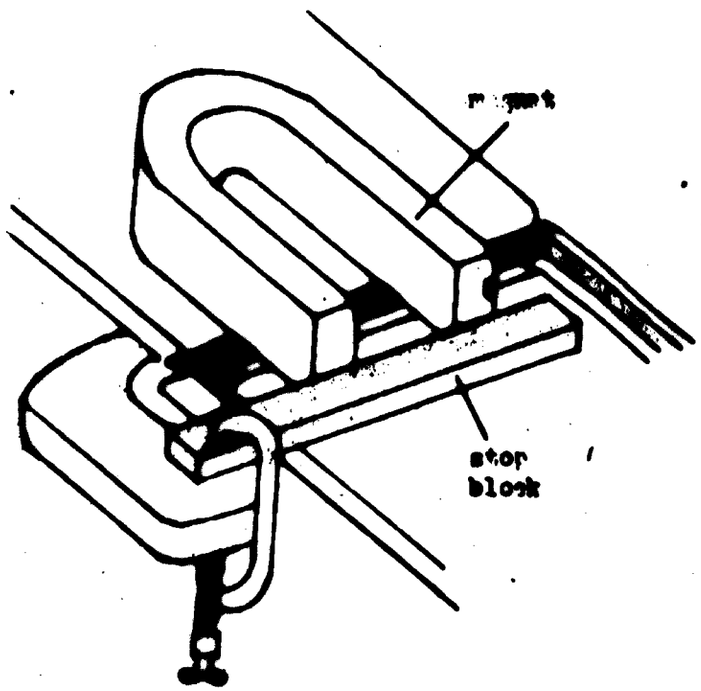


Fig. 2 Adjustment of knives' projection

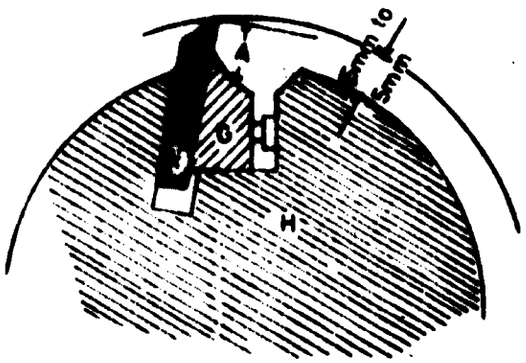


Fig. 3 Projection of knife

An index mark should be scraped on the magnet and a stop block should be clamped to the front table at such a position as to bring the mark in line with the cutting edge of the knife when it is at its highest point. The knife is placed in its slot and is pulled up to its required level by the magnet. When mounted in the cutter head, the cutting edge of high speed steel knives should project from 1.5 mm to 5 mm from the surface of the cutter head as shown in figure 3.

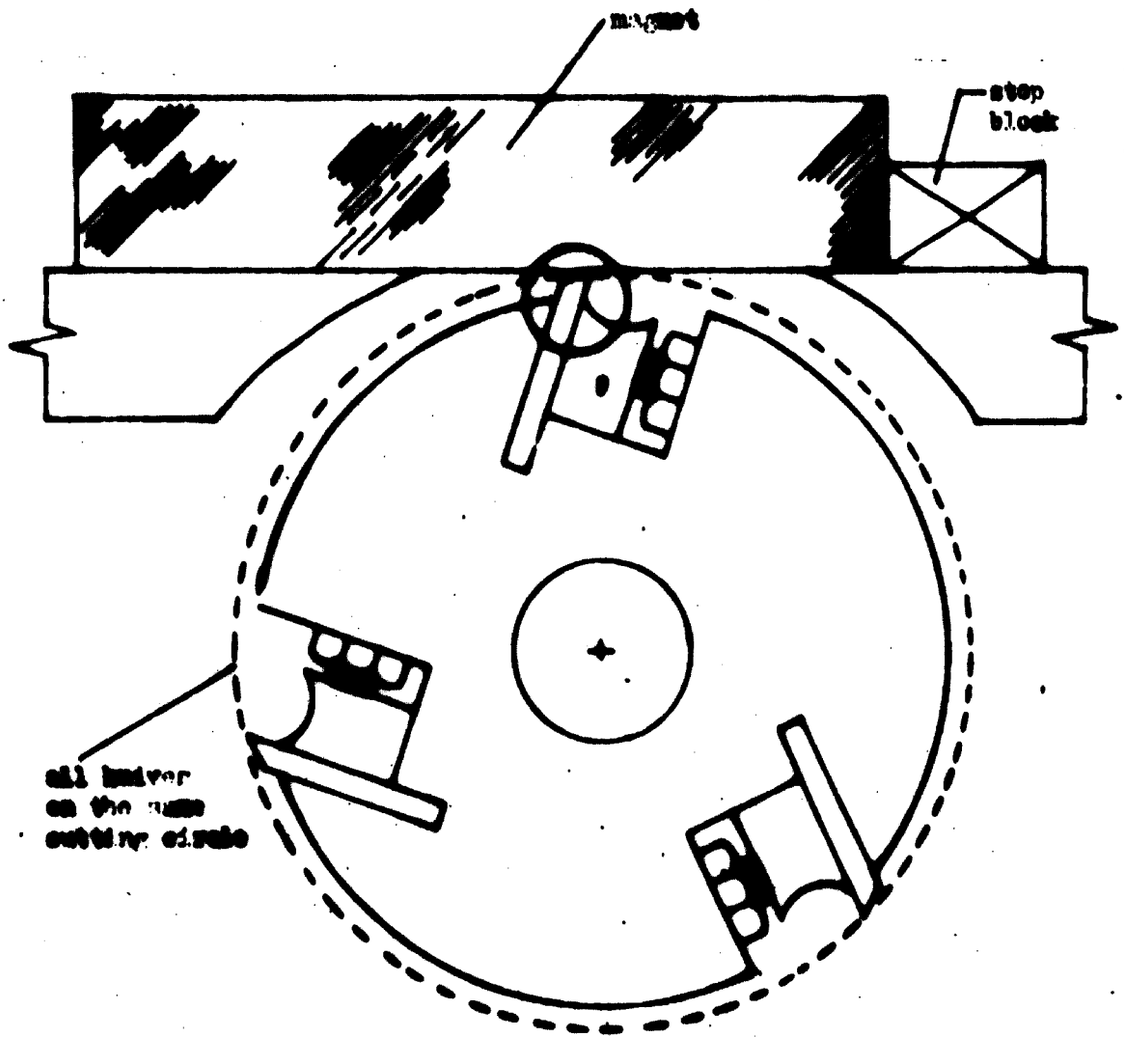


Fig. 4

Maximum projection is used for rough planing and minimum projection is used for fine finish planing. The projection of carbide-tipped knife should not exceed 0.8 mm projection.

2. Knife Balancing

Before mounting the knives in the cutter block they must all be weighed to make sure that they all have the same weight. This must be done properly with an accurate balancing device or a standard weighing scale. If the weight of the knife is not the same, some unimportant portion of the heavier knife should be grinded away to reduce the weight. Balancing the knife is necessary because even 1 oz difference in weight will result in vibrations causing poor finish planing and damage to bearings.

3. Knife Grinding

The important thing is to grind knives slowly. Do not force the grind even if using a water adjustment because the alternate excessive heating of the knife and quick cooling by the water may cause the knife to crack or soften the edge. When the edge of the knife turns blue, or blue spots appear on the surface of the knife, the temper of the knife is lost. If the coolant adheres to the knife's surface, it may be assumed that no undue heat is being generated. If, however, the coolant runs off the knife's surface like drops of water off a hot stove, the wheel is probably glazed and not cutting freely. The wheel must be dressed. Wet grinding, has a big advantage over dry grinding. The proper rim speed for wet grinding is 4,000 ft. per minute.

4. Straight Grinding versus Hollow Grinding

By hollow grinding, the knife when becomes dull can be honed for one or more times before it is necessary to remove the knife for resharpening. However, it must be borne strongly in mind that, too much hollow grinding will weaken the cutting edge and the edge may break off during operation. For thin high speed steel knives, frequent light straight grinding is the best.

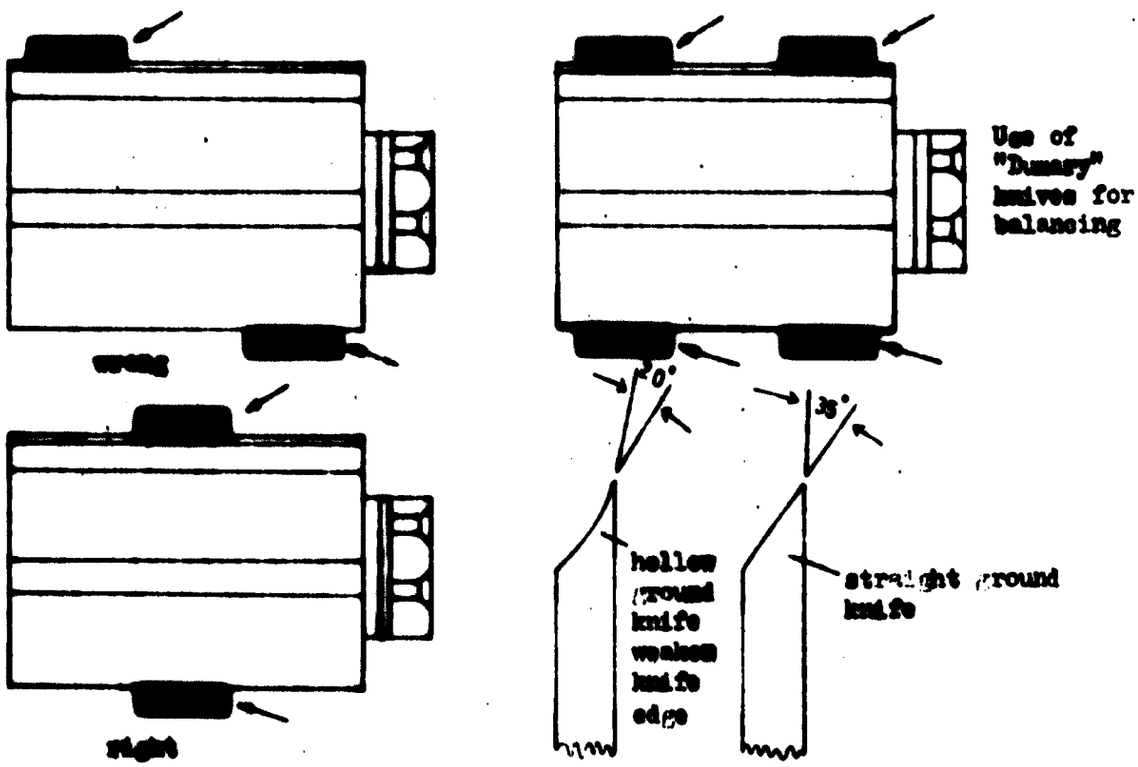


Fig. 5

diameter of wheel	diameter of hollow grind	angle of spindle
4"	28"	8° 8'
	40"	5° 43'
	50"	4° 35'
	60"	3° 49'
	72"	3° 11'
6"	28"	12° 6'
	40"	8° 32'
	50"	6° 51'
	60"	5° 43'
	72"	4° 46'
8"	28"	15° 57'
	40"	11° 19'
	50"	9° 6'
	60"	7° 36'
	72"	6° 21'
10"	28"	19° 39'
	40"	14° 2'
	50"	11° 19'
	60"	9° 28'
	72"	7° 54'
12"	28"	23° 2'
	40"	16° 42'
	50"	13° 30'
	60"	11° 19'
	72"	9° 28'

Table of Diameter of Hollow Grinding

5. Setting Knives for Grinding

Be sure that the knife bar and face of the knife are free from gum, dirt, or other foreign matter. Any rough spots on the knife should be filed or sand down. When the knife is half ground, loosen all but one bolt that holds the knife, then tighten the bolts immediately and finish grinding. This should be done in order to compensate for the expansion of the knife caused by heating.

6. Knives Honing

It is not necessary to regrind the knives by machine as soon as they get blunt. In fact, careful honing at regular intervals will maintain a sharp edge for some time. To hone the knife, partly cover a fine stone with paper so that it will not mark the table and place it on the front table as shown in Fig. 7.

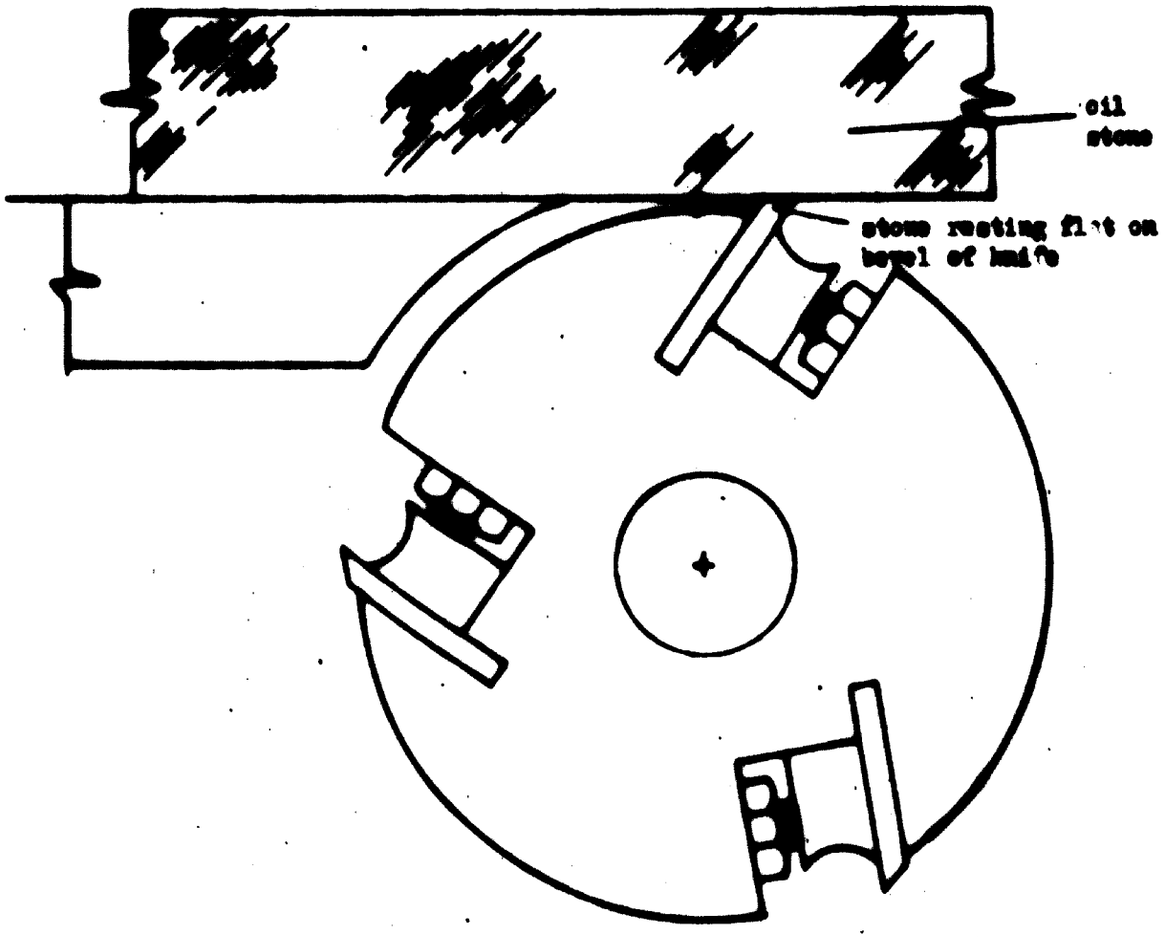


Fig. 6 Knife honing with oil stone resting flat on the bevel of the knife

Turn the cutter head until the stone rests flat on the bevel as shown in figure 6 and fix the head in this position by clamping the bolts to the stand. Hone the knife by stroking the knife lengthwise with the blade treating each knife with the same amount of strokes.

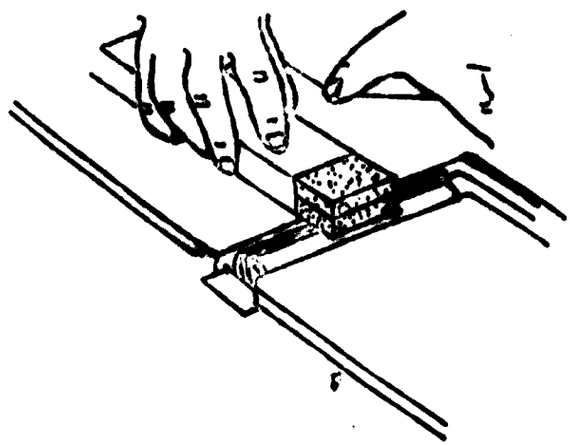


Fig. 7 Knife honing

7. Tightening Knives on Cutter Block

After the knives have been balanced in pairs, they should be set with the balanced knives opposite each other in the head. When tightening the nuts, it is important to tighten each one slightly and go round the cutter head several times until proper tension is on everyone of the bolt. It is important that not too much pressure should be used when tightening the bolt by using a much longer wrench than the one supplied together with the machine.

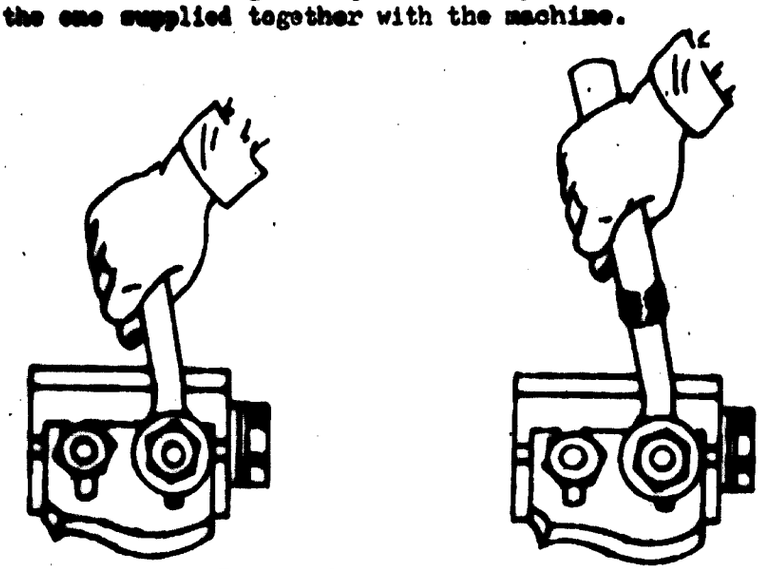


Fig. 8 Tightening knives

8. Knives Jointing

Jointing consists in bringing all the knives of a given cutter head into a true cutting circle. In this operation, the stone is placed on the rear table as shown below and the table lowered until the stone barely touches the knife. The cutter block is then revolved by switching on the motor and the stone is moved across the table. The limiting width for the heel is 0.032" approximately 1 mm as shown.

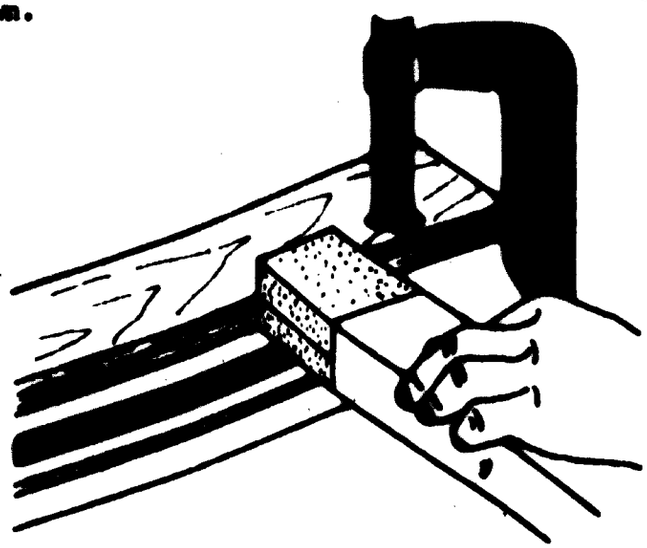


Fig. 9 Knife jointing

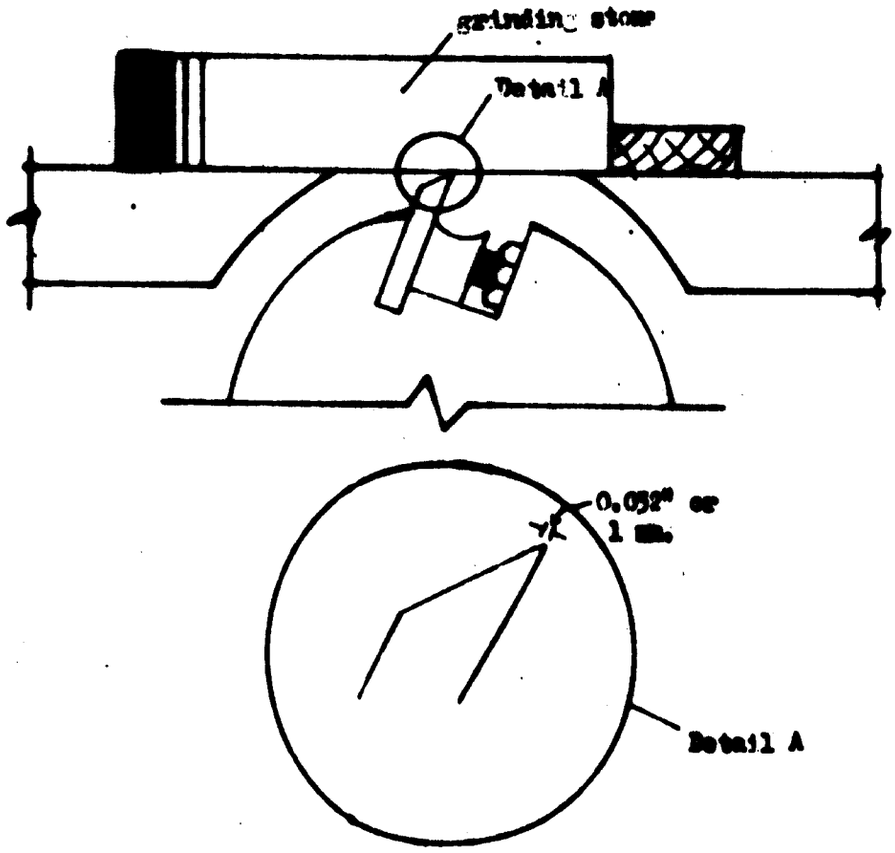


Fig. 10 Width after jointing heel

As the lightest joint is the best one, the importance of setting the knives accurately cannot be overemphasised. In jointing a knife, only a hair line should show across the knife edge the first time it is jointed. The lighter the joint, the keener will be the edge and the longer the wear. When knives are accurately set, the first joint should never exceed 1/64". It must be borne in mind that over jointed knives are extremely dangerous and will produce very rough finish. When a knife is to be jointed, a grinding angle from 30° to 40° should be used. After the freshly ground knives have been put on the cutter head and then jointed, it is necessary that the heels caused by jointing be honed off.

9. Angles of Knives

(a) Cutting Angle or Rake Angle

The cutting angle is the angle between the face of the knife and the line joining the cutting edge to the center of the cutter block. If a front bevel is added, it will be the angle between the front bevel and the line joining the cutting edge to the center of the cutting block. See figure below.

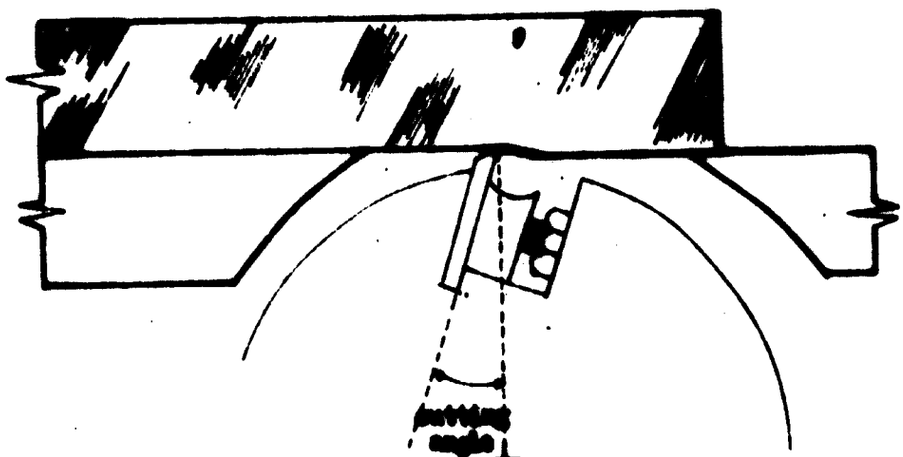


Fig. 11 Cutting angle

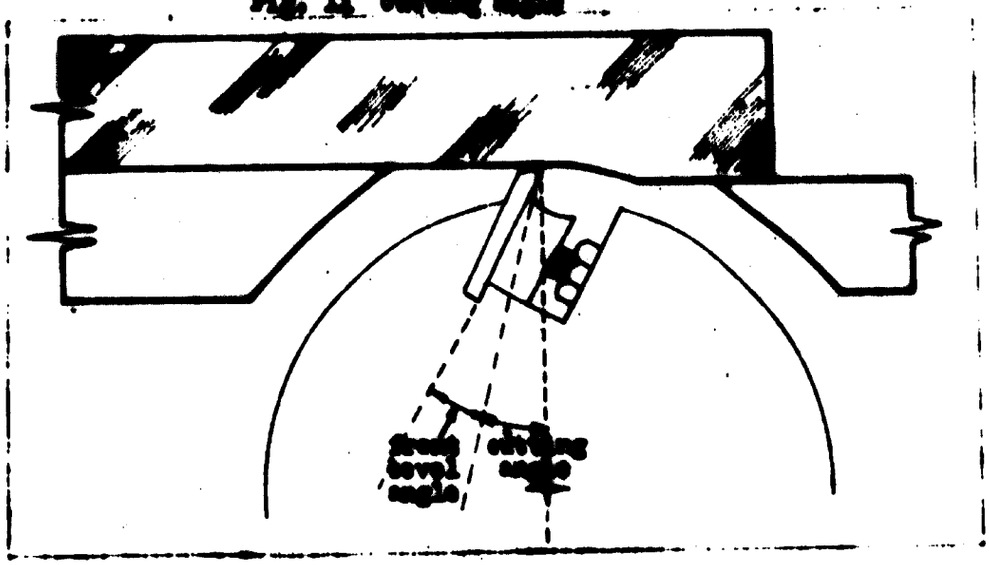


Fig. 12 Cutting angle & front bevel angle

The cutting angle could be measured easily by using a protractor. Firstly, fix the knife at the highest point of its cutting circle. Level the front and rear table by using a protractor, one can then measure the cutting angle $\angle(\alpha)$ as shown in figure below. Common cutting angles are 30° and 35°.

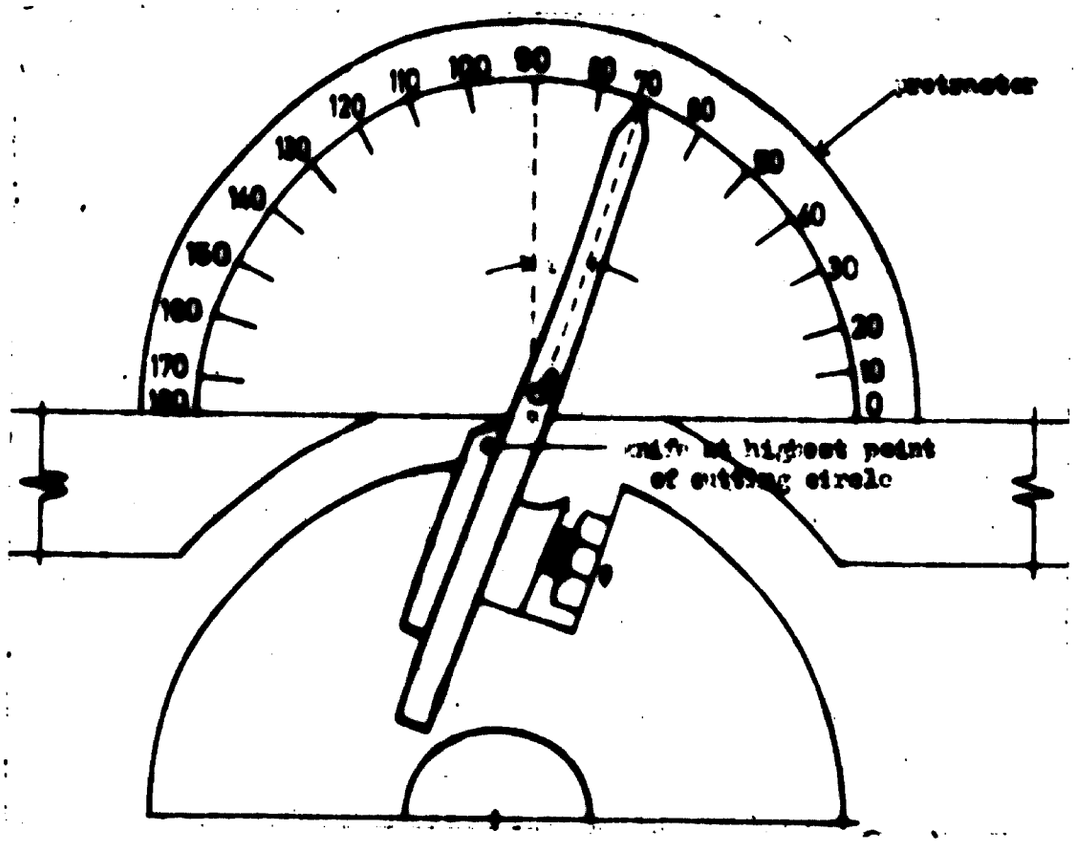


Fig. 13 Measurement of cutting angle

The cutting angle of the knife cannot be increased but it can always be reduced by grinding or honing a front bevel on the cutter.

In order to find out the front bevel required, set up the knife at a table as when measuring the cutting edge of the cutting block. Set the protractor on the cutting angle required and place it near the cutting edge of the knife as shown below. Mark on the knife, the bevel required, and grind or hone to the mark. The marking should be closed to the cutting edge.

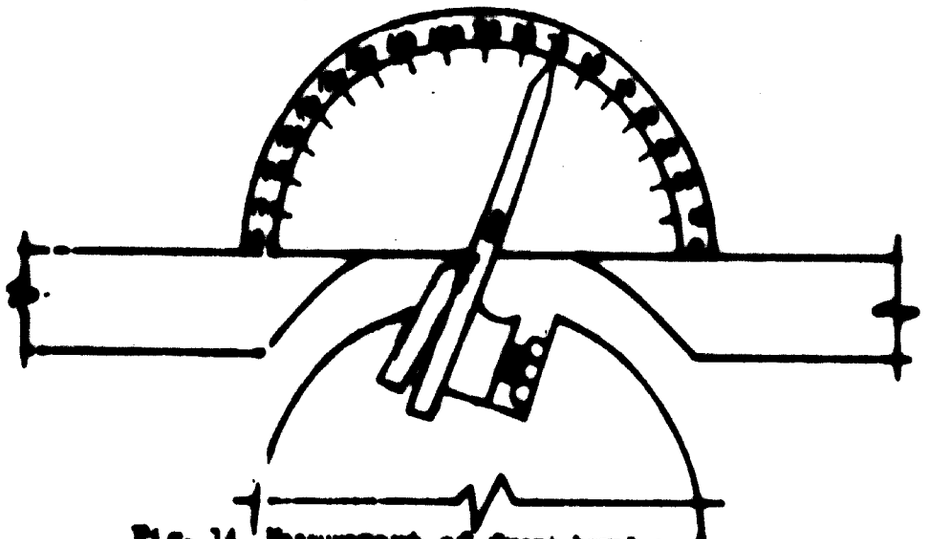


Fig. 14 Measurement of front bevel angle

The cutting angle is related to the power required to plane the timber. Increasing the cutting angle will reduce the power required. Increase the cutting angle from 10° to 30° will reduce the power consumption by 100%, and increase the cutting angle from 20° to 30° will reduce the power required by 25%.

Too big a cutting angle will cause chip bruising which is experienced in some hard wood. The remedy is to reduce the cutting angle. However, if the cutting angle is reduced too much, a woolly surface is obtained with some hard wood. The table below shows the effect of varying cutting angles on the finish.

Kind of Wood	Defect-free pieces at cutting angle of -					
	5°	10°	15°	20°	25°	30°
	%	%	%	%	%	%
Ash	69	70	72	73	79	53
Basswood			52	65	68	65
Birch			71	63	55	
Chestnut			81	76	65	34
Cottonwood	40	37	25	27	12	31
Elm, soft	24	24	48	33	19	18
Blackgum	42	52	47	53	43	37
Hackberry	37	47	75	93	54	20
Magnolia	87	78	78	56	62	61
Mahogany	77	88	76	77	87	
Hard maple			56	56	31	17
Soft maple	43	61	57	33	34	18
Red oak	66	96	95	92	87	65
White oak	74	98	95	93	74	37
Pecan	78	82	76	92	95	57
Sweetgum	35	66	54	51	49	44
Sycamore	25	39	26	23	18	18
Black walnut			64	73	50	
Willow	32	46	50	59	46	10
Yellowpoplar	66	75	75	67	67	48

(b) Clearance Angle

The clearance angle is the angle between the cutting bevel and the tangent to the cutting circle at the cutting edge. See figure below. A clearance angle must be provided in order to avoid rubbing of cutting edge against timber being machined. See figure below.

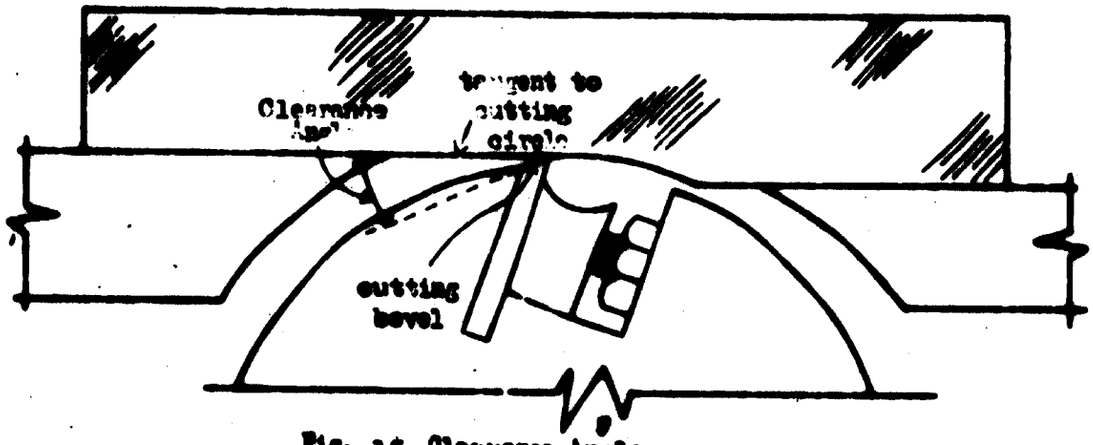


Fig. 15 Clearance Angle

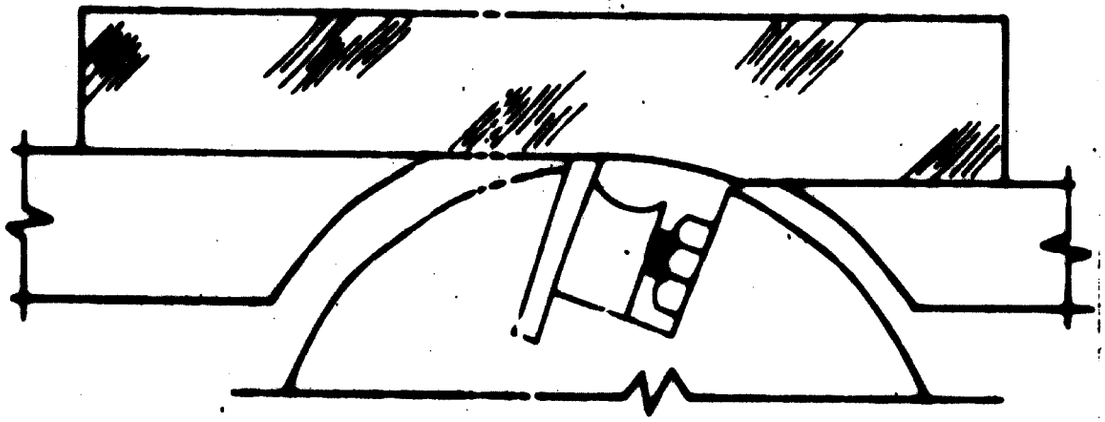


Fig. 16 Knife with no clearance

A 10° to 20° clearance is necessary depending on the amount of timber to be removed. The thicker the amount, a bigger clearance angle is required. In general 10° clearance is sufficient for normal planing. Care must be taken not to provide too big a clearance angle because this will make the grinding angle too sharp and the cutting edge will blunt easily or break off.

10. Cutting Speed

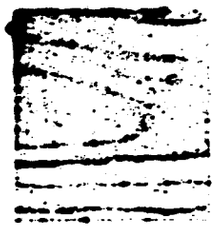
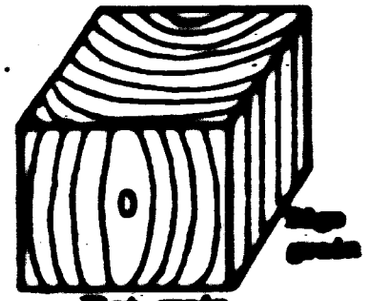
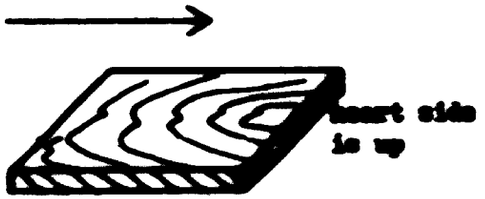
The cutting (or peripheral) speed of knives depends on the diameter of the cutting circle of the head and the speed (RPM's) of the head. For really efficient cutting a speed of not less than 5,000 FPM is needed. The peripheral speed for the general run of mouldings runs between 9,000 and 15,000 FPM. Any speed faster than this causes over-heating of the cutters. For square head work the cutter head speed should be between 5,000 RPM and 5,500 RPM. Tests conducted by the Forest Products Laboratory showed that nearly all wood will give a better finish when machined at a high cutting speed and feed speed (see table below). Certain species of wood will give a woolly finish unless a fast cutting speed is used and unless sharp knives are used. This is particularly true of interlocked or wavy grained material.

Kind of wood	36-foot feed; 3,600 r.p.m.	54-foot feed; 5,400 r.p.m.	Kind of wood	36-feed feed;3,600 r.p.m.	54-feet feed; 5,400 r.p.m.
	Percent	Percent		Percent	Percent
Ash	52	64	Soft maple	19	37
Basswood	53	43	Red oak	72	74
Chestnut	47	65	White oak	60	60
Cottonwood	17	23	Pecan	54	69
Elm	17	26	Yellowpoplar	50	54
Blackgum	37	45	Sycamore	16	22
Sweetgum	41	49	Willow	28	28
Hackberry	39	46			
Magnolia	50	72	Average	40	49
Hard maple	24	43			

[1]Based on 4 cutting angles (15°, 20°, 25°, and 30°) and 6 percent moisture content for each feed-speed combination.

Table showing the advantage of high cutting speed and feed speed.

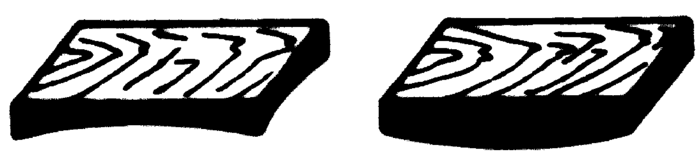
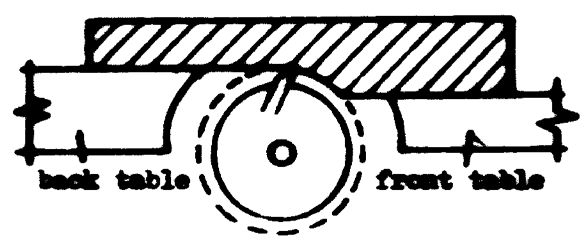
Machining Defects and Remedies

Defects	Reasons	Remedies
1. Raised Grain A) Fibres or parts of fibres project above the surface. B) The whole summer wood or spring wood of the annual ring thickness above the surface, giving it a corrugated effect. C) Edges or tips of the annual ring become loose and raise up above the rest of the surface.  1A   1B	A. 1. Characteristic of certain species B. 1. Dull knives 2. Too little cutting angle 3. Too heavily jointed knives 4. Low feed speed 5. Too deep cut 6. Heavy hold-down pressure 7. Flat-grained lumber   	B. Dull knives 1. Increase cutting angle 2. Reduce knife cuts per inch i.e. increase feed Too little cutting angle 1. Increase the cutting angle 2. Increase the cutter head speed Heavily jointed knives 1. Light jointing 2. Sharp knives Flat-grained timber 1. Machine on the bark side instead of pith side  2. Feed in the proper direction 

Defects	Reasons	Remedies
 1C	8. Too much pressure on feed rollers and/or hold-down bar C. 1. Moisture content not suitable for machining	8. Reduce pressure on feed rollers and/or hold-down bar C. 1. Most wood machine best at moisture content less than 7%
2. **Fuzzy finish** Some tearing out of particles below the line of cut and the particles are not cut off cleanly but are projected from the line of cut. 	1. More pronounced in edge-grained timber than flat-grained timber 2. Moisture content too high 3. Dull knives 4. Heavily jointed knives 5. Cutting speed too low 6. Small cutting angle, small depth of cut and low feed speeds are used	1. Reduce moisture content to below 7% 2. Sharpen knives 3. Re-grind knives and joint lightly 4. Increase cutting speed above 5000 P.P.M. Cutting speed = r.p.m. of cutter head x circumference of cutting circle
3. **Chipped finish** Part of the surface is chipped off in very short particles below the line of cut. 	1. Too much heel on knives 2. Knives revolved against the grain 3. Chipbreakers too far away 4. Timber with "pockets" of short grain on the heart side 5. Refractory hardwood with grain films in different direction 6. Feed speed too fast w.r.t. cutter head speed	1. Reduce heel on knives by grinding 2. Feed the board so that the knives cut with the grain 3. Set chipbreaker to within $\frac{1}{8}$" of the knives or reduce knife projection 4. Use the back side of the timber as face 5. Reduce feed speed w.r.t. cutterhead speed

Defects	Reasons	Remedies
4. **Smooth finish** Similar to 'chipped grain' but is more extreme in degree	1. Cutting angle too big 2. Too little knife cuts per inch 3. Too heavy cuts 4. Chipbreakers too far away 5. Too heavily jointed knives 6. Wood of low moisture content	1. Decrease the cutting angle 2. Increase knife cuts per inch 3. Take lighter cuts 4. Set chipbreaker to within $\frac{1}{32}$" of the knives or reduce knives projection 5. Feed stock so that the knives will 'cut' of the grain 6. Regrind knives and joint lightly 7. For moulding with patterns, arrange the bottom head to cut with the grain and cut the pattern at the bottom. For flat stock, arrange the bottom head to cut into the grain. 8. Heartwood machine much better than sapwood as much as 8 times. If possible use heartwood when quality is required.
5. **Chip Marks or Ridging** Marks on the surface of the wood and not like ground out 	1. Chip marks are caused by chips that cling to the edge of the knives and are carried around and wounded into the wood on the next revolution 2. Too heavily jointed knives or knives jointed without honing 3. Dull knives 4. Surface wet timber 5. Not enough throat room between the head and the cutting circle 6. Improper suction to remove the chips	1. Set chipbreaker closer to the knives 2. Joint knives lightly and remove wire chip by honing 3. Sharpen knives 4. Increase knives projection 5. Increase cutting speed and feed speed 6. Proper suction to remove chips

Defects	Causes	Remedies
6. <u>Glazed Surface</u> Glossy and shiny surface	1. Too many knife marks per inch	1. Choose correct feed speed and revolution of cutterhead from table
7. <u>Chatter Marks</u> Marks of uneven width, depth or height	1. Chipbreaker or hold-down not tight enough 2. Warped knives 3. Knives out of balance 4. Knives with too short bevel (5/8" bevel is usually sufficient)	1. Tighten chipbreaker or hold-down 2. Regrind knives 3. Balance knives 4. Increase bevel
8. <u>Pronounced Knife Marks</u> Knife marks are evenly spaced but they are too deep	1. Knives are not jointed	1. Joint knives while cutterhead is revolving
9. <u>Extra Knife Marks</u> There are knife marks which appear in addition to the regularly spaced marks 	1. Worn bearings 2. Unbalanced knives	1. Replace bearings 2. Balance knives

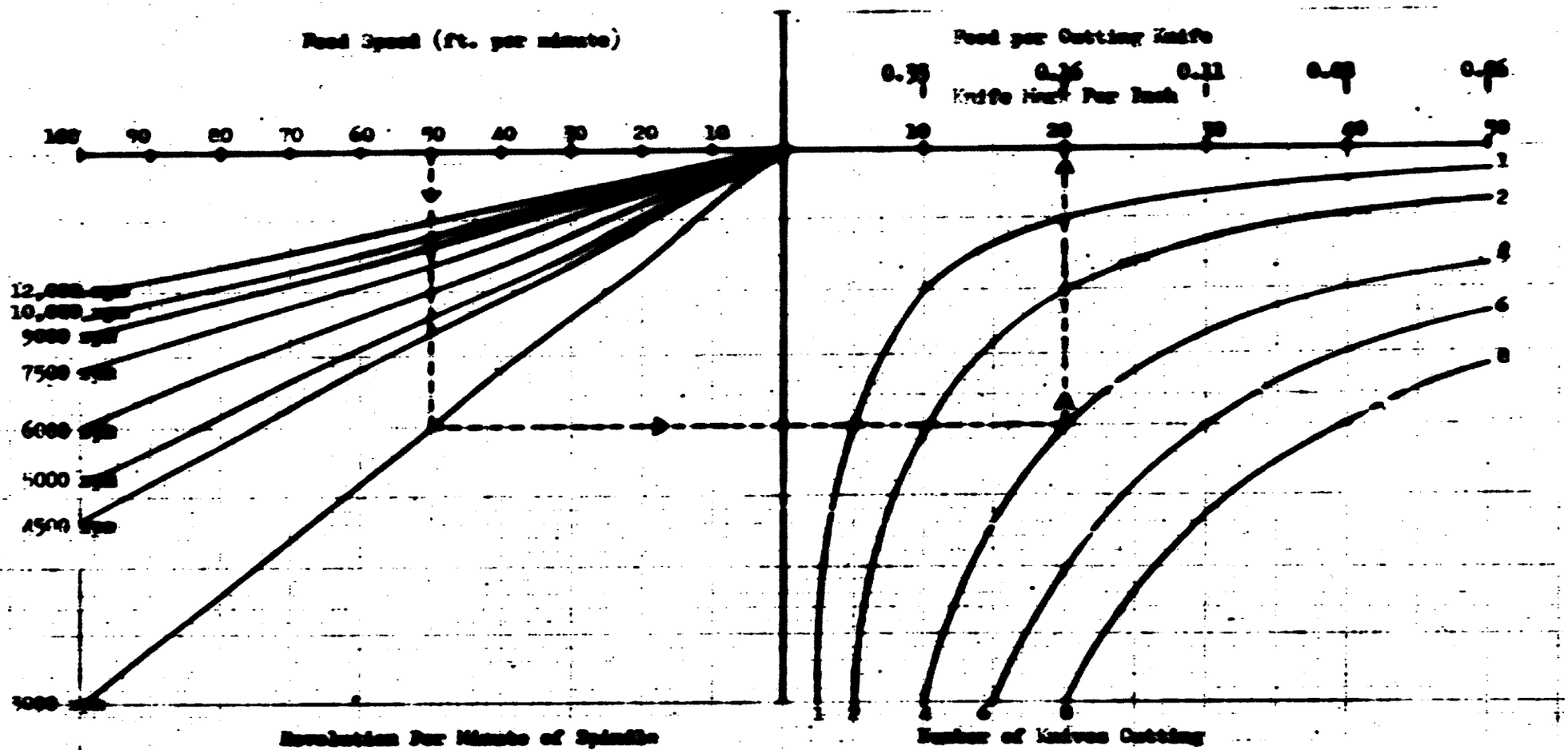
Defects	Reasons	Remedies
10. Knife marks too far apart Knife marks per inch = R.P.M. X No. of knives / Ft. per minute x 12	1. Knives not jointed 2. Revolution of the head too slow 3. Feed speed too fast Quality versus knife marks per inch (see table below)	1. Joint knives lightly 2. Increase revolution of the head 3. Slow down feed speed 4. For very thin stock, increase knife cut/inch by 25 to 30%
11. Cuts in the stock machined deeper than the intended line of cut	A. Front end snipes  1. Back table too high 2. Lower feed rollers too high 3. Guides improperly set B. Back end snipes  1. Back table too low 2. Cutting circle set too high 3. Guides improperly set C. Concave or convex stock 1. The table not properly set. 	A. 1. Set back table level with cutting circle 2. Adjust lower feed roller 3. Adjust guides B. 1. Set back table to correct position 2. Reduce cutting circle 3. Adjust guides C. 1. Set table properly 

Quality versus knife marks per inch

Kind of Wood	Excellent	Good	Fair
All	35	75	13
Hardwood	40	30	25
Softwood	20	22	14

Defects	Reasons	Remedies
12. Rough board finish	1. Knives being driven back in the head 2. Knives too heavily jointed 3. Bevel too short 4. Knives prevented from overhanging 5. Excess vibration from out of balance cutterhead	1. Regrind and set knives properly 2. Balance cutterhead
13. Ridges on depth of cut	1. Quality decreases as depth of cut increases	1. Best result obtained if cut of less than 1/16" is taken
14. Lines appearing on stock	1. Knives probably nicked due to hitting metal objects or temper taken out of knives due to improper grinding	1. Regrind knives properly
15. Other causes of poor work	1. Slip of feed rollers 2. Spindle speed not suited to the type of wood 3. Pitch and gum collected on cutter head 4. Thin edge stock  Thin edge stock	1. Adjust or replace feed rollers 2. Choose suitable r.p.m. for wood 3. Regular schedule of cleaning 4. Machine the edge before the top

Alligament Chart for Establishing Knife Mark Per Inch & Feed Per Cutting Knife

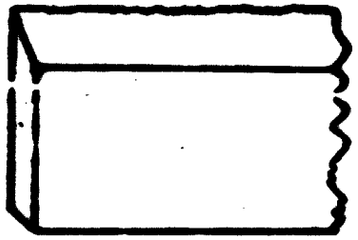
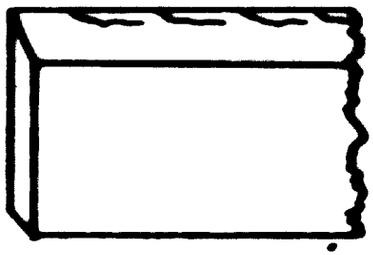


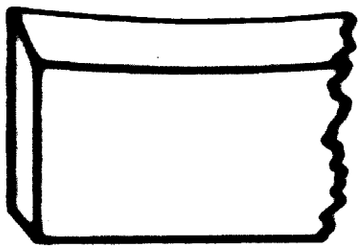
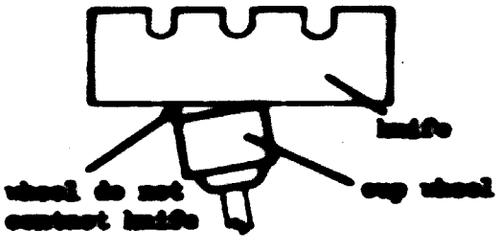
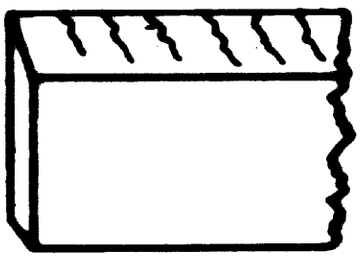
E.g. Feed Speed = 50 ft. per minute, revolution = 3000 rpm. Number of knives cutting = 4

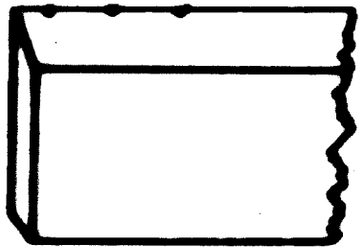
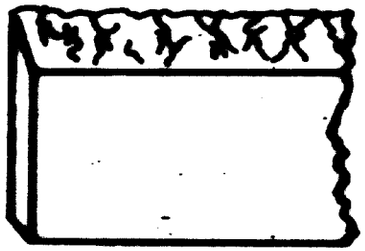
From Chart, knife mark per inch = 20

Feed per cutting knife = 0.164 m.m.

Knife Defects & Remedies

Knife Defects	Reasons	Remedies
1. Irregular Edge A wavy or irregular edge on the knife 	1. Grass feed of the grinding wheel to the knife is too fast. 2. Grinding spindle bearings are bad.	1. Slow down grass feed of the grinder. 2. Replace worn bearing
2. Fine Edge 	1. Over grinding of the knife beyond the point necessary to produce the intersection of two planes.	1. Hone knife using oil stone.
3. Blue Spots 	1. Heat & expansion due to dry grinding 2. Use of improper grinding wheel (too hard & fine grained)	1. Use greater supply of coolant. 2. Use proper grinding wheel.

Knife Defects	Reasons	Remedies
4. **Burnt Knife** 	1. Too fast cross feed of wheel 2. Grinding wheel too hard 3. Grinding wheel too close to knife 	1. Slow down cross feed on grinder. 2. Get a softer wheel. 3. Do not set grinding wheel too close to knife. 4. Loosen all clamps but one to allow knife to spring back after cooling, then tighten clamps and take a final cut.
5. **Burning** 1. Knife edge turns blue or blue spots appear on knife. 2. Knife burned too badly may crack 	1. Grinding wheel too hard or to coarse. 2. Cross feed too fast. 3. Grinding wheel speed too fast 4. Loaded (glazed)grinding wheel 5. Insufficient supply of coolant.	1. Select correct grinding wheel 2. Slow down cross feed. 3. Slow down grinding wheel speed. 4. Dress grinding wheel. 5. Supply enough coolant.

Knife Defects	Reasons	Remedies
6. Chipped knife 	1. Pounding of an unbalanced wheel specially the large straight wheel grinder 2. Grinding angle of a knife too sharp when machining wood	1. Balance the grinding wheel 2. Use proper grinding angle for wood being machined.
7. Chatter & Gouging 	1. Grinding wheel too hard. 2. Stopping the feed when the stock is in the machine. 3. Too much knife projection in the head. 4. Incorrect relation between feed speed & revolution of cutter-head. 5. Excessive vibration of machine due to out-of-balance, poor machine foundation.	1. Use softer bonded and more open structured wheel. 2. Do not stop feed when stock is in machine. 3. Reduce knife projection 4. Work out correct feed & revolution speed. 5. Correct machine faults.

Knife Defects	Reasons	Remedies
8. [redacted]	1. Defective knife e.g. deformed knife shape. 2. Too great projection of knives 3. Pounding caused by dull knife 4. Hitting metal objects in wood	1. replace defective knife. 2. Set projection of knives to recommended distance 3. Grind knives when they become dull. Light, frequent grindings are best.
9. [redacted]	1. Stop feed when the stock is in the machine. 2. Feed speed too slow for cutter head speed. 3. Use of wrong cutting angle & knives. 4. Long, use of knife	1. Do not stop feed when stock is in machine. 2. Use correct feed speed. 3. Use correct cutting angle & knives. 4. Light, frequent grinding.

PARTS OF A BAND SAW

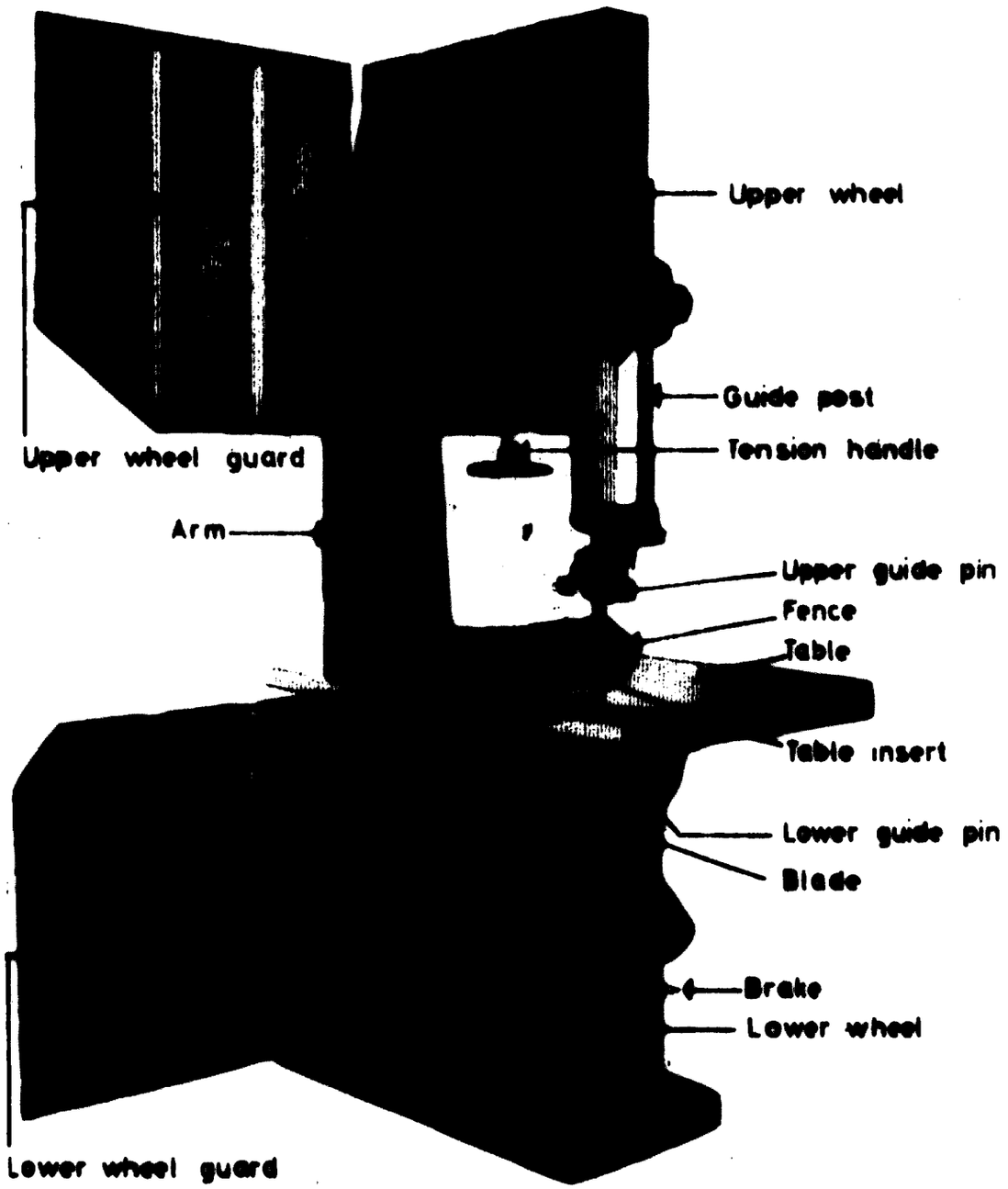


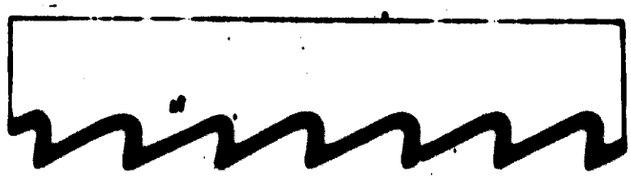
FIG. 1

Band Saw Blade

1. Introduction

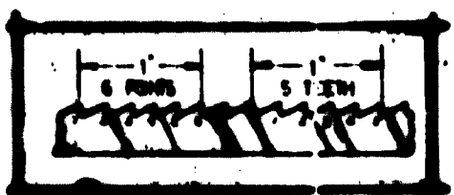
Band saw blades are made in numerous tooth patterns and also vary in the thickness and the amount of set, and they are exclusively used for ripping. Generally, band saw blades up to 30 mm. in width are considered as narrow, and blades wider than 30 mm. as wide band saw blades. The tooth shape for narrow band saw blades is shown below. Generally speaking, there is only one tooth shape for narrow band saw blades, but there are few tooth shape for wide band saw blades. Since we are concerned with band saw for furniture operation only, we shall not touch on the wide band saw blades. The detailed tooth shape for one tooth is shown in Fig. 2. Please note that the hook angle must always be positive, 15° - 35° - the lower degree for set teeth and the higher ones for swaged teeth.

Narrow band saws will have 4-7 teeth per inch. There is always one more point per inch than teeth per inch. A five-tooth blade has six points per inch. (See Fig. 3).



TOOTH SHAPE FOR NARROW BAND SAW BLADES

Fig. 1



IN ANY STYLE OF BAND SAW BLADE, THERE IS ALWAYS ONE MORE POINT-PER-INCH THAN TEETH-PER INCH.

Fig. 2

8. Sharpening, Setting and Tensioning of Band Saws

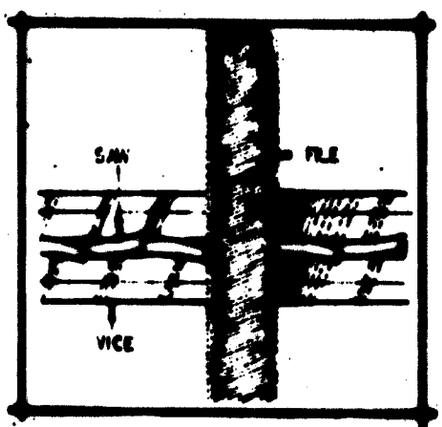
1. Sharpening

A home-made vice (Fig. 4) or purchase vice is needed. A file is preferred to an emery wheel which may cause burning. Filing is done straight across (Fig. 3) and should be square across blade using a triangular saw file and could be tilted slightly to obtain the hook angle (Fig. 5). A slight rounding at the gullet could be obtained automatically by the rounded edge of the file. This is to prevent against cracking and to facilitate the out-flow of saw dust.

Three or four strokes on each tooth should be enough and best results are obtained if the filing is done on both sides of the blade to equalize the slight burr turned over by the file.

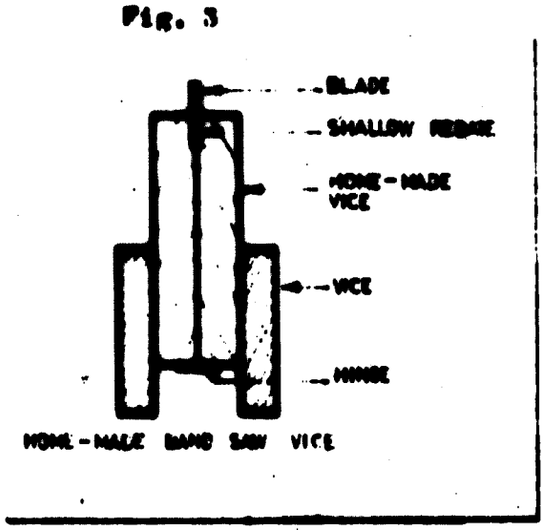
If emery wheel is to be used, take special care with the gullet where nicks and burns will easily cause breakage.

Wheel: Use a relatively soft wheel, grain size 54-60 and hardness L, M or N. Several light passes of the grinding wheel will give a better result than the few heavier ones.



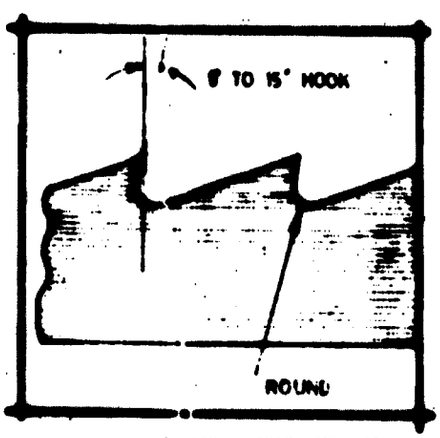
FILING SHOULD BE SQUARE ACROSS BLADE USING A TRIANGULAR SAW FILE

Fig. 3



HOME-MADE BAND SAW VICE

Fig. 4



A SLIGHT ROUNDING AT THE GULLET IS ESSENTIAL TO GUARD AGAINST CRACKING

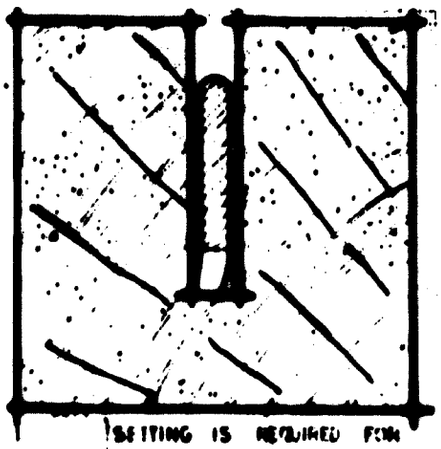
Fig. 5

3. Setting

Setting is required for clearance (Fig. 6) to prevent binding. The set should be not more than half-way down the teeth and must be parallel with the back of the blade (Fig. 7). If the set goes deeper, breakage may result. Amount of set: for hard wood 0.012 ins. - 0.015 ins. (0.3-0.4 mm.) to each side, for medium hard and soft wood 0.016 ins. - 0.024 ins. (0.4-0.6 mm.) to each side. Make sure that the set is even.

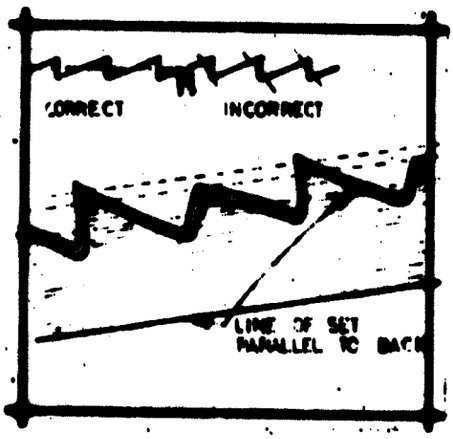
In all cases filing should follow setting. The face angle of the set will be destroyed if the teeth are filed first. When the teeth are filed after setting (the proper way) the face angle of the tooth will be square across as it should be for clean cutting (Fig. 8). Setting can be set with a plier-type of saw set or with an anvil and hammer.

Thick blades require more set than thin blades. For sharp corner curves - increase amount of set. For better straight cuts - minimum set (will bind on curves).



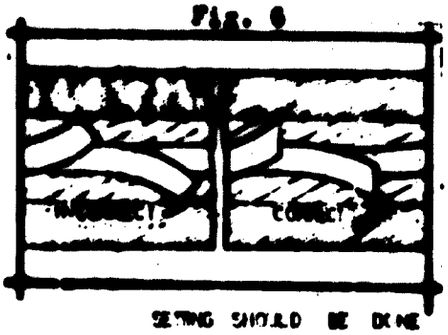
SETTING IS REQUIRED FOR CLEARANCE — THE TEETH MUST CUT A KERF WIDER THAN THE BLADE TO PREVENT BINDING

Fig. 6



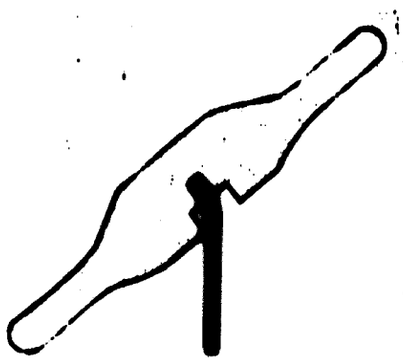
CORRECT SETTING OF BAND SAW TOOTH

Fig. 7



SETTING SHOULD BE DONE PRIOR TO FILING AND SHOULD BE PARALLEL TO THE BACK OF THE BLADE

Fig.8



SETTING WITH SAW SET

Fig. 9

3. **Tensioning**

Included under this topic are straightening, planing, brazing and tensioning of hand saw blades.

a) Straightening:

If the back of the blade is concave, it should be rolled or hammered near the back. If the back is convex, the blade should be rolled near the teeth line, but not too close to the teeth.

b) Planing:

Hammer out the bumps with the greatest care until the blade is perfectly plane.

c) Brazing and welding:

Cut the blade at right angles. File the ends to about ⅜" bevel and leave 0.004" at the edge. Use soldering irons for heating and if possible a special unit for the soldering itself. Let the joint cool slowly so that it doesn't become air hardened. File, polish, hammer and stretch the area around the joint carefully. The joint must have the same thickness as the rest of the blade. Above all, it should not be thicker.

Blades can also be joined together by welding which is the most efficient way. In this case, special welding equipment is required.

d) Tensioning:

The purpose of tensioning, that is elongation of the middle of the blade by rolling, is to make the blade flat to the band wheels properly over its entire width through sawing - with normal friction and heating and with considerable restraint in the machine. When the saw is then stretched on the band wheels, the edges become tight and the saw will cut straight. It is better to hammer or roll lightly twice than too hard once.

3. Steps in Fitting the Band Saw Blade

(1) Remove both lower and upper wheel guards (See parts of band saw)

(2) Remove table insert and table alignment pin (see fig. 2)

(3) Slacken tension on the blade already mounted and remove blade (fig. 3).

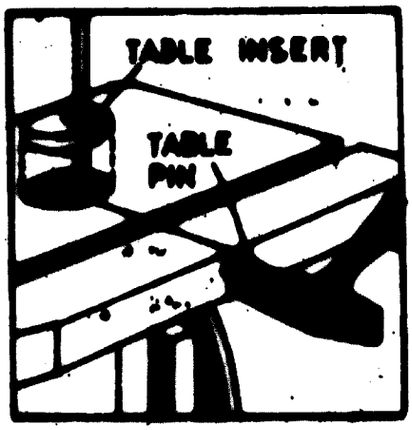


Fig 2

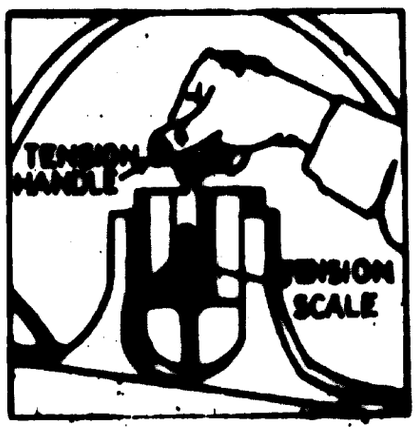


Fig 3

(4) Open up guide pin on both upper and lower guides and run blade support back (fig. 4).

(5) Fit and center the blade by fitting upper wheel as required (the upper wheel is raised by means of the tension adjustment handle until blade is held lightly before centering (refer fig.3)

(6) Set blade to correct tension. This could be done on a given scale on the machine (fig. 3) or tension by feel (fig. 5) (¼" flex on a 6" span) between the table and the upper guide.

Fig 4

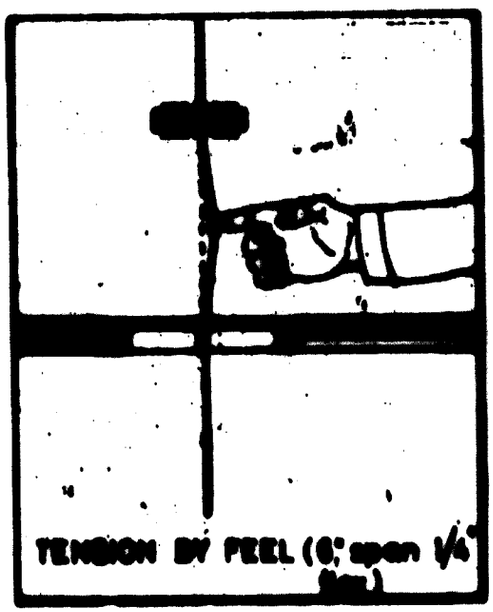


Fig 5

(7) Revolve band saw to check blade crowning. The rims of the band wheels are higher in the middle than at the edges in order to prevent the blade from wandering back and forward (tracking) on them provided the blade is correctly tensioned. Fig. 6 shows the upper wheel of the band saw being tilted too much that will lead to the breakage of the band saw blade.

(8) Set guide pins inwards to thickness of blade with correct clearance to prevent twisting by placing paper strips in between. (Fig. 7)

The front edges of the guide pins are brought just behind the gullets of the saw blade and lock (Fig. 8).

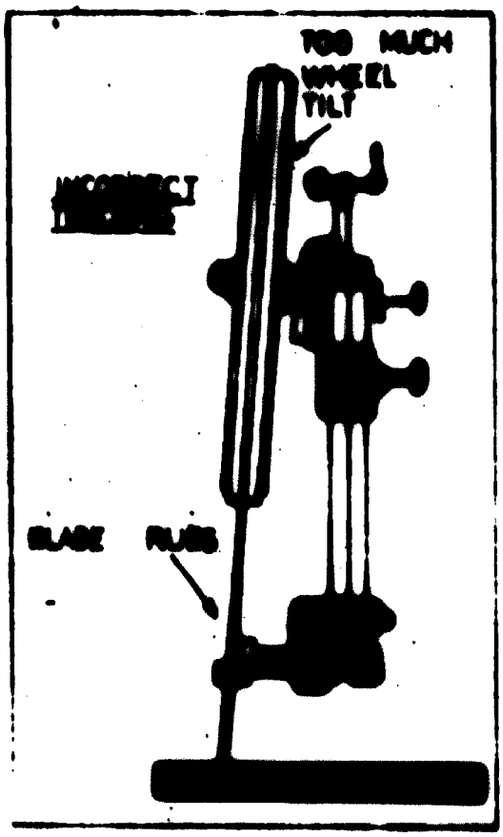


Fig 6

Fig 7

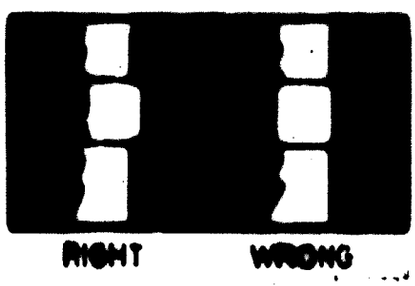


Fig 8

(9) Set blade support with 1/64" clearance from the back of the blade and check setting (fig. 9).

(10) Replace the table insert, alignment pin and wheel guards and the saw is ready for operation.

(11) Fig. 10 shows a common error that will lead to the breakage of the band saw (incorrect alignment).

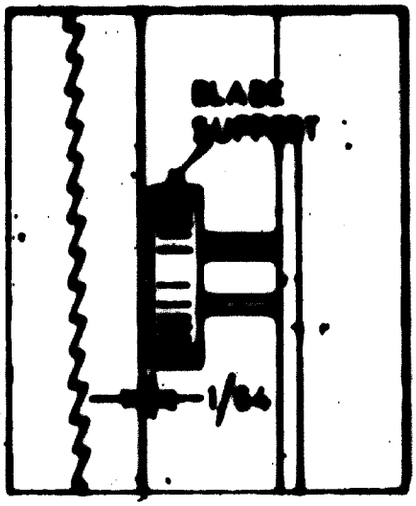


Fig 9

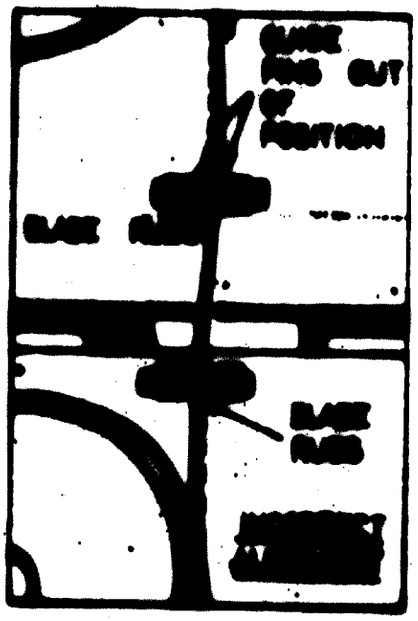


Fig 10

4. Common Defects of the Band Saw Blade

4 - 1 Poor filing, sawing along the side of a nail will result a blade which is dull and poorly set on one side.

4 - 2 **Honing** It can be remedied by lightly honing the side of the blade with a fine stone (fig. 1).

4 - 3 **Effect of Lead** Fig. 2 shows the effect of lead.
Main causes of lead :

(i) improper setting of guide pin

(ii) improper set of blade.

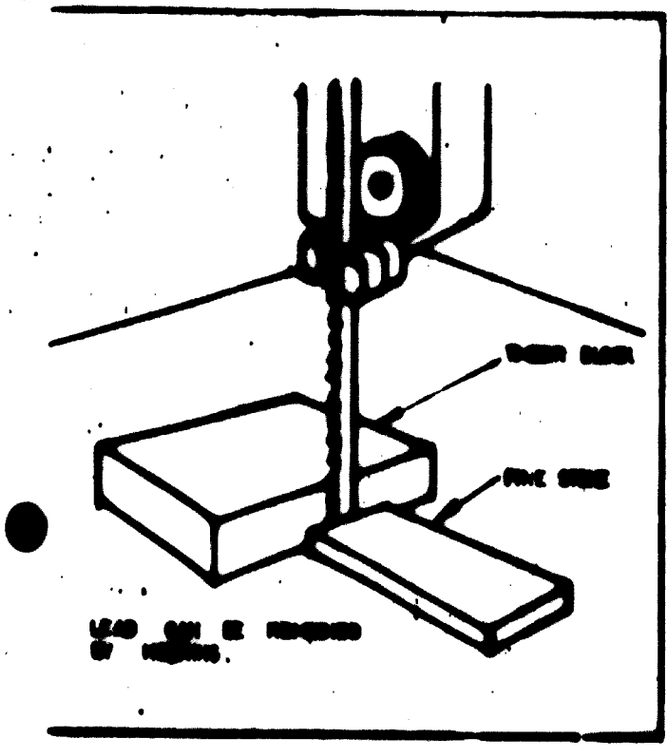


Fig 1

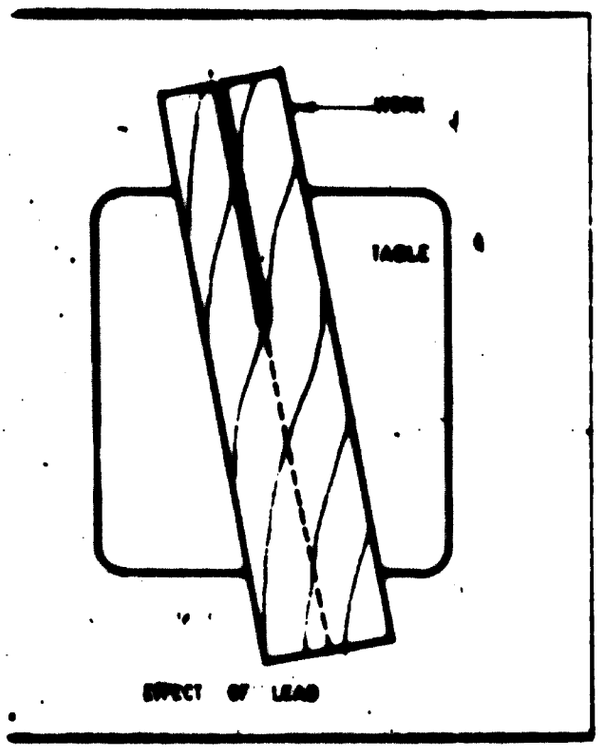
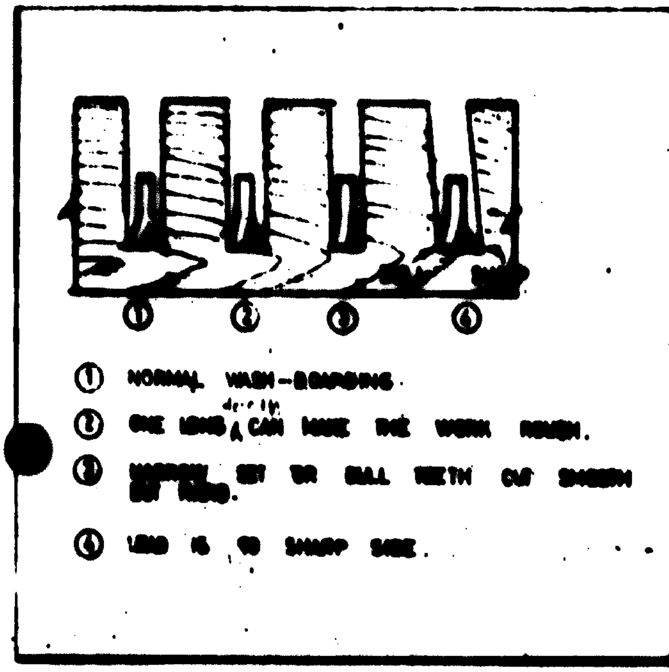


Fig 2

5. Helpful Hints on the Band Saw Blade



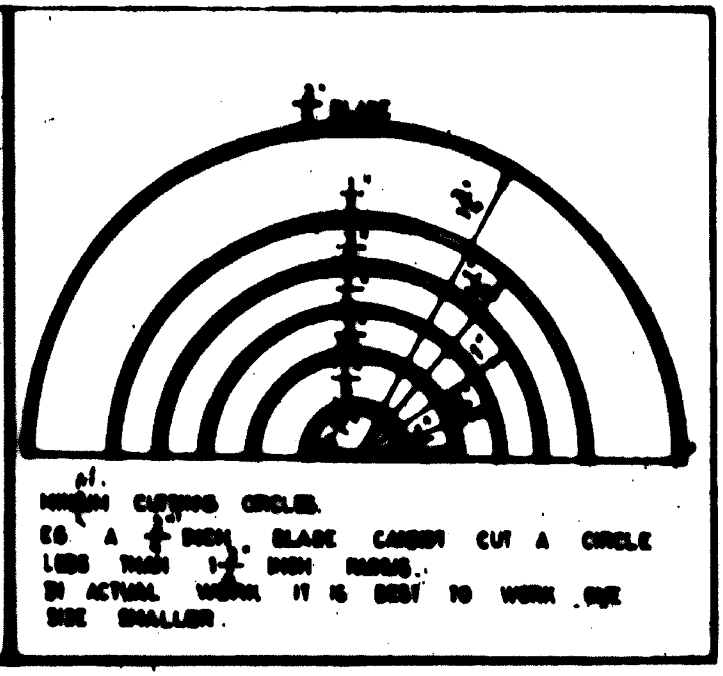


Fig 1 COMMON DEFECTS IN BAND-SAWING

Fig 2 RELATIONSHIP BETWEEN WIDTH OF BLADE AND MINIMUM CUTTING CIRCLES

-100
8.7.71

(6) Some common faults and how to prevent them

(1) Cracks in the gullets

The reasons:

a) Rough edges of gullets, which have not been filed after punching.

b) Burned gullets, caused by faulty grinding.

c) Nicks in gullets, caused by file or emery wheel.

d) Teeth leaning backward with not enough hook provided or there is a negative hook. This may also cause breakage at the back of blade, as the blade must bear hard on the guides in order to cut.

e) The set is too deep, deforming the blade along the tooth line.

f) The blade is crowding the kerf due to coating of sawdust and resin.

g) Too much tensioning in centre of saw, causing too much stress in the tooth line.

h) The saw blade is too thick.

The precautions:

a) File the gullets with a taper saw file with rounded edges. However, it is best to purchase the blades ready filed.

b) Do not use a too hard emery wheel and do not apply too much pressure.

c) Use files and emery wheels with sufficiently rounded edges.

d) Give the teeth forward lean, causing the work to pull against the blade.

e) Do not set more than two-thirds of the teeth from the point down.

f) Keep wheel and saw blade clean by means of brushes and paraffin (kerosene).

g) Do not tension the centre of the blade too much.

h) The thickness of the blade must not be greater than 1/1,000 of the diameter of the wheels. This should be especially observed in the case of midget band saws.

(2) Breakages in back of saws

The reasons:

a) The blade is not properly straightened, the back being shorter than the tooth line.

b) Improper steering, deforming or heating back of blade.

The precautions:

a) Straighten and tension the blade with care.

b) Use back steering of suitable design, properly adjusted.

(3) The blade cuts crooked and is deformed too quickly

The reasons:

a) Unsuitable back steering, or applied too hard.

b) Teeth leaning backward.

c) Incorrect straightening, causing stresses in blade.

d) Too little set, causing friction and heating

The precautions:

a) Use suitable back steering, properly adjusted. It must not bear the blade while idling.

b) Undercut teeth somewhat.

c) Careful straightening, spread over a sufficient portion of blade, immediately deformation is observed.

d) Give the blade sufficient set so that it runs freely in kerf.

How to Specify Band Saw Blades

Narrow band saw blades
⅛ - 2" (3-50mm) width

Section	1. Width 2. Thickness
Blade finish and quantity	1. Coils in "Easy-pull" boxes or jointed, finished blades 2. Exact length of jointed blade 3. Quantity

Standard sizes :

Width approx.		Thickness approx.		Standard pitch tooth shape N approx.		Approx. weight
in.	mm	BWG	mm	in.	mm	Kg./100mm
¼	6	27	0.40	0.16(5/32)	4	1.6
¼	6	25	0.50	0.16(5/32)	4	1.9
5/16	8	23	0.60	0.20(13/64)	5	3.1
⅜	10	27	0.40	0.24(15/64)	6	2.8
⅜	10	25	0.50	0.20(13/64)	5	3.4
⅜	10	23	0.60	0.24(15/64)	6	3.9
½	12.5	25	0.50	0.24(15/64)	6	4.5
½	12.5	23	0.60	0.24(15/64)	6	5.3
⅝	15	27	0.40	0.28(9/32)	7	4.4
⅝	15	23	0.60	0.28(9/32)	7	6.3
¾	20	25	0.50	0.28(9/32)	7	9.0
¾	20	23	0.60	0.28(9/32)	7	9.5
¾	20	22	0.70	0.31(5/16)	8	10.0
1	25	25	0.50	0.31(5/16)	8	9.0
1	25	23	0.60	0.31(5/16)	8	11.2
1	25	22	0.70	0.35(23/64)	9	12.6
1¼	30	22	0.70	0.39(25/64)	10	15.2
13/8	35	21	0.80	0.39(25/64)	10	20.5
1½	40	21	0.80	0.41(13/32)	10.5	23.6
1¾	45	20	0.90	0.43(7/16)	11	26.9
2	50	20	0.90	0.43(7/16)	11	30.4

Band saw blades up to and including 2" can be supplied in coils of approx. 165' and packed in "Easy-pull" boxes. As a rule, the thickness of the blade should never exceed 1/1000 of the pulley diameter.

FSK-lsc

CIRCULAR CROSS-CUT AND RIP SAWS

1. Efficiency Factors

Efficient working of cricular saws depends on the following factors :

(1) True running of spindle and freedom of slackness in the bearings.

(2) Correct periphery speed or cutting speed (see 11)

(3) Correct saw sharpening and setting with gullets of correct shape and depth

(4) Suitable pitch and hook for type of timber

(5) Saw tension for speed of spindle

(6) Use the smallest possible diameter saw which will consume less power, works better and easier to maintain

(7) Suitable sources of power for given size of saws.

Saw Dia.	H.P.
200 mm (7.9")	1
300 mm (11.8")	1.5
400 mm (15.7")	2
500 mm (19.7")	4
600 mm (23.6")	6
700 mm (27.6")	10

2
Tooth shapes for Circular Saws

Fig. 1 describes the various tooth shapes for circular saws.

TOOTH SHAPES FOR CIRCULAR SAW BLADES

A. RIP SAWS FOR TIMBER

B. RIP SAWS FOR TIMBER

C. EDGING SAWS

CU. SAWS FOR SPECIAL MATERIAL (FIBRE BOARD, ETC)

D. RIP SAWS FOR HARDWOOD AND SAWS FOR ABRASIVES

F. CROSS CUT SAWS FOR BILLETS AND LATHS

G. CROSS CUT SAWS FOR TRIMMING BOARDS AND PLANKS

H. CROSS CUT AND RIP SAWS FOR HARDWOOD, BONE, ETC.

I. SMOOTH-CUTTING COMBINATION CROSS CUT AND RIP SAWS

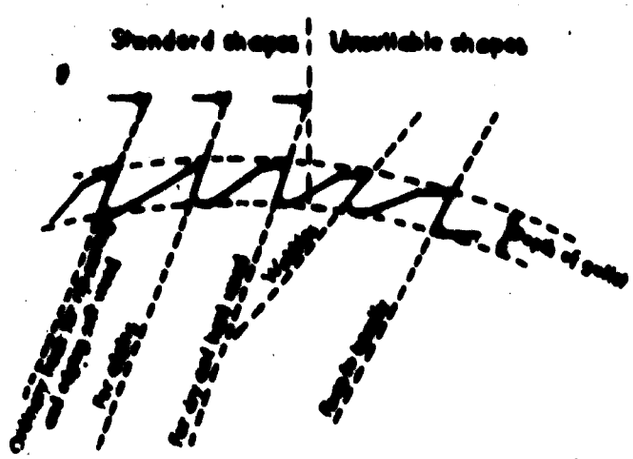
L. SMOOTH-CUTTING COMBINATION CROSS CUT SAWS

M. SMOOTH-CUTTING COMBINATION RIP SAWS

FIG. 1

It may be stated, as a general rule, that the softer the timber, the greater the hook of the teeth and the harder the timber, the smaller the hook. A more perpendicular tooth will retain its sharpness longer and allow the saw to run steadier but at the same time it demands greater power.

Figure 2 shows a rip saw blade with the various tooth shapes A, C, and D and also two unsuitable shapes. The pitch is the same and the depth of the gullet is related to the pitch (the removal of sawdust is governed by the shape of the gullet). To determine the depth of the gullet is to use rather more than half the pitch for fresh and soft wood and rather less than half for hard wood.



Different teeth shapes with the same pitch.

FIG. 2

3
Rip Saw Teeth

Circular saws teeth vary widely for soft wood, medium hard, and hard woods. The hook or rake varies with the density of the timber to be cut, 10° being the minimum for very hard-woods, and from 15° to 25° for the medium hard and softwoods.

Large amount of hooks or rakes to the teeth will tend to produce very rough sawing, resulting

a greater wastage of timber. The greater the hook, up to a point, the less power required, and the easier the timber can be fed.

56 to 60 teeth is the average for general ripping. Saws for hardwoods should have a greater number of teeth than for softwoods to avoid damage to the teeth due to the impact of the teeth on the wood. It is also an advantage when saws are running at a speed slower than normal. Figure 3 describes the terms used in connection with saw teeth.

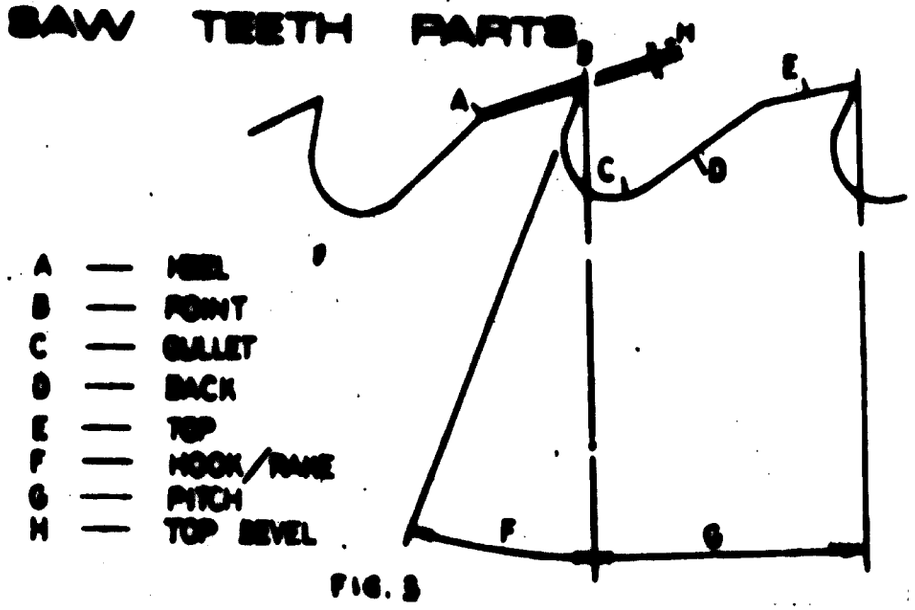


FIG. 3

4
Cross Cutting Teeth

The teeth cutting action varies considerably from that of the rip saw; whereas the rip saw has a chipping motion, the cross/cut saw cuts across the grain in a scribing motion.

The teeth have a backward hook instead of forward, and the points have a sharper angle than rip saws. Generally it is thicker and the number of teeth for a given size of saw will be greater than for ripping.

5
Circular
Saws Setting

There are two methods of setting employed, Spring and Swage set. The swage set is mainly used in the sawmill and hence we will not go into detail on swage set here.

In spring set, the amount needs to be sufficient only to clear the saw plate and prevent friction. Generally green, soft timber will need more sap than dry softwood and seasoned hardwood will need less. Example : The setting on each side of 0,012" - 0,024" (0,3 - 0,6 mm) is only for sawing dry and hardwood, while a setting of 0,024" to 0,032" (0,6 - 0,8 mm) is sufficient for green and loose wood. When setting the tooth, never set the whole tooth but only the joints, as shown. When the whole tooth has been set, it usually become springy. The set that is less permanent, the saw cut will be rough and crooked.

Check carefully with a setting gauge that all teeth has been set to exert to some extent. The saw on which the tooth has a wider set on one side than the other will not give a straight cut.

Swage setting is used only in the sawmills. Each tooth does the work normally done by two spring set teeth. The setting is done on the swage which spreads the points of the tooth to each side of the plate diameter after which the side dresser corrects any inequality in the width of the set. After swaging the teeth must be filed to the correct shape (fig.4). All swage set teeth are ground at right angles to the plate.

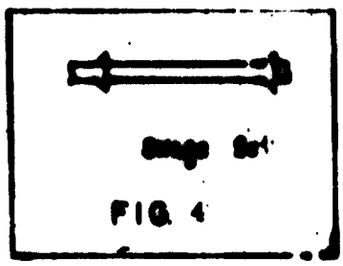


FIG. 4

6
Sharpening
Circular saw
by hand

Greatest care must be taken to obtain uniformity of teeth. At intervals, saws should be jointed to keep the rim uniform. In doing this, the saw is revolved in the bench vice and the piece of emery wheel moved to the saw lightly until all the teeth show signs of contact with the emery. Figure 5 shows a suitable vice for sharpening.

The teeth are then filed until all signs of blunted teeth are removed and the gullets are eased to the correct depth.

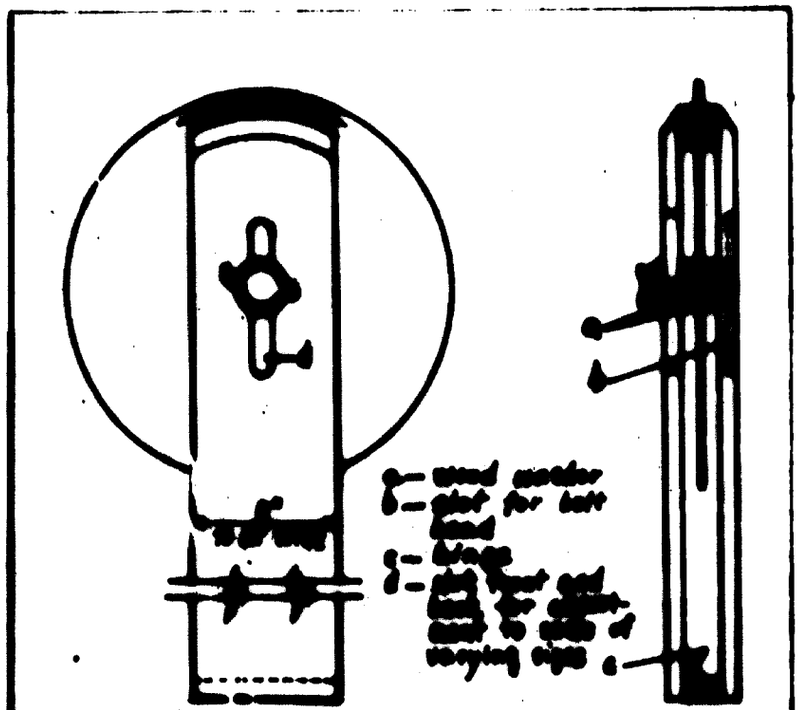
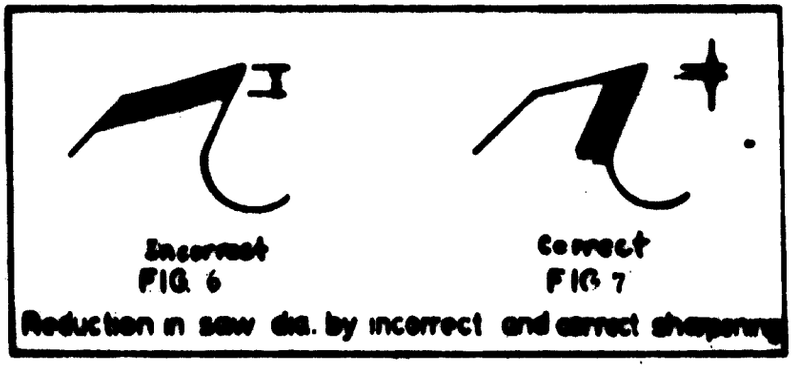


FIG. 5

"Topping Up" or grinding the top of the teeth is bad practice which not only reduces the diameter of the saw, but means that sharpening has been at the wrong place (see figs. 6 and 7) It is the face of the teeth that requires sharpening, not the top.

Always ensure that the gullets are rounded. Square gullets will cause cracks in the saw.



Incorrect
FIG. 6

Correct
FIG 7

Reduction in saw dia. by incorrect and correct sharpening

7
Inserted
Tooth Saws

This type of saw with its replaceable teeth is used in sawmills and has many advantages over the ordinary plate saw, especially in the larger diameters where maintenance is a problem. Fig.8 shows one pattern of the inserted tooth saw.

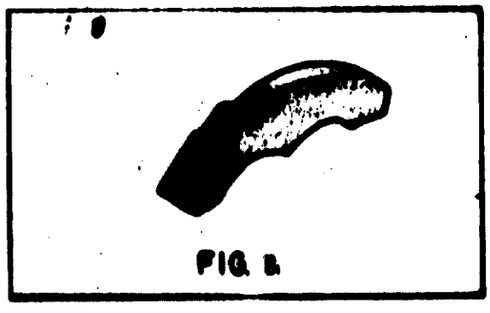


FIG. 8

Its diameters range from 14" to 72" and is the ideal saw for sawmills.

Here are enumerated the advantages of inserted tooth saws :

(1) Long life at constant diameter
(2) The plate does not loss its tension so quickly through the filing and re-gulleting of the saw
(3) Teeth are readily replaced if the saw is damaged
(4) Sharpening the teeth is easier and quicker
(5) The teeth having a fixed hook and gullet are always maintained

/8..

8 Tungsten Carbide Tipped Circular Saws

Carbide-tipped saws are for fast cutting hardwoods, plywood, plastics and many abrasive materials which could dull the edge of the high speed steel tipped saw or alloy steel solid plate saw. Fig. 9. shows an example of a tooth. Its sizes ranges from 6" to 20" dia.

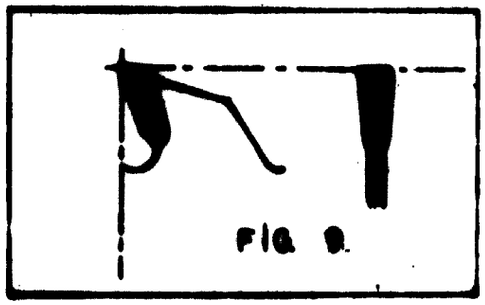


FIG. 9.

Correct and regular maintenance however is also essential if maximum performance are to be acquired. The subject of maintenance of Carbide Tipped Circular Saws is dealt with separately.

9 General Information on Maintenance

(1) Never run circular rip saws at a higher peripheral speed than 47 m/sec. (154 ft/sec)

(2) Retain the original tooth shape and hook and keep the gullets well-rounded. Never burn the tooth points blue when grinding them.

(3) Always keep the teeth well-sharpened. The saw must cut and not wear its way forward.

(4) Never undertake any work of adjustment on the saw, such as boring cut the centre hole, pin hole, and holes to prevent spreading of cracks. Any saws with crack must be replaced.

10 Ordering Circular Saw

Here are enumerated the necessary details when ordering a saw.

(1) Diameter and thickness in inches or millimetres

(2) Diameter of centre hole

(3) Diameter and position of pin or driving hole (measure edge to edge between centre hole and pin hole)

(4) Shape and number of teeth

(5) Revolution of spindle per minute

(6) Hand or power feed

(7) Whether for hard or soft woods

(8) Whether for ripping, cross cutting or general purpose.

The saw maker can definitely produce a saw that will satisfy the customer's requirements on receipt of the above information.

Speed references on standard diameters and thickness

Diameter		Thickness		Suitable speed r.p.m.
mm	approx. ins.	mm	approx. ins.	
250	9.8	1.4	0.055	3600
275	10.8	1.6	0.063	3300
300	11.8	1.6	0.063	3000
325	12.8	1.6	0.063	2750
350	13.8	1.8	0.071	2500
375	14.8	1.8	0.071	2400
400	15.7	1.8	0.071	2250
425	16.7	2.0	0.079	2100
450	17.7	2.0	0.079	2000
475	18.7	2.0	0.079	1900
500	19.7	2.3	0.091	1800
525	20.7	2.3	0.091	1700
550	21.7	2.3	0.091	1600
575	22.6	2.6	0.102	1550
600	23.6	2.6	0.102	1500
625	24.6	2.6	0.102	1400

Carbide-tipped circular saw

1. Introduction

Carbide-tipped circular saw blades are gaining steadily in popularity. The introduction of more stable machines - designed especially with carbide-tipped saw blades in mind and better understanding of the use and care of these blades have resulted in increasingly improved economy.

2. Cutting speed

The table below gives recommended cutting speeds for various types of materials. The cutting speed for each group can be given only within relatively broad limits because of the difference in diameter. At the upper limits, it is necessary for the machine to be stable enough to ensure fibration-free blade running.

Cutting speeds in different materials

Material	Cutting speed	
	ft/sec.	m/sec.
Softwood	200-300	60-90
Hardwood	160-230	50-70
Plywood	200-260	60-80
Hardboard	230-300	70-90
Chipboard	200-260	60-80
Veneered board	200-300	60-90

The table showing the relationship between blade diameter, cutting speed and speed of rotation is given below :

Diameter mm.	Cutting speed m/sec.							
	40	47	50	55	60	70	80	90
	Rev/min							
150	5100	5990	6370	7010	7640	8920	10190	11470
200	3820	4490	4780	5250	5730	6690	7640	8600
250	3060	3590	3820	4200	4590	5350	6110	6880
300	2550	2990	3180	3500	3820	4460	5100	5730
315	2440	2860	3050	3350	3650	4260	4890	5490
355	2180	2570	2730	3000	3280	3820	4370	4910
400	1910	2250	2390	2630	2870	3340	3820	4300
450	1700	2000	2120	2340	2550	2970	3400	3820
500	1530	1800	1910	2100	2290	2680	3060	3440
550	1390	1630	1740	1910	2080	2430	2780	3130
600	1270	1500	1590	1750	1910	2230	2550	2870
650	1180	1380	1470	1620	1760	2060	2350	2650
700	1090	1280	1360	1500	1640	1910	2180	2460
750	1020	1200	1270	1400	1530	1780	2040	2290

3. **Feed speeds**

Choosing the correct feed per tooth is essential. If the feed per tooth is too small, no proper chips will form and there will be excessive wear on the tooth. To reduce the wear it is best to apply the large feed per tooth. However, if excessive feed speed is used the cutting force may become so large that the stinted carbide in the cutting edge is broken off. Of course the required finish of the section will always be an important factor in selecting feed speed.

The feed per tooth should be between 0.002-0.012" (0.5-0.30 mm) according to the material being worked and the standard of finish required. It can be calculated using the formula:

$$\text{[illegible]} = \frac{s \times 1000}{n \times z}$$

where [illegible] = feed/tooth in mm.
s = total feed in m/min.
n = r.p.min.
z = no. of teeth working on the section in question.

Examples on how to choose the correct feed speed are shown in the next page.

4. **Height of blade over work**

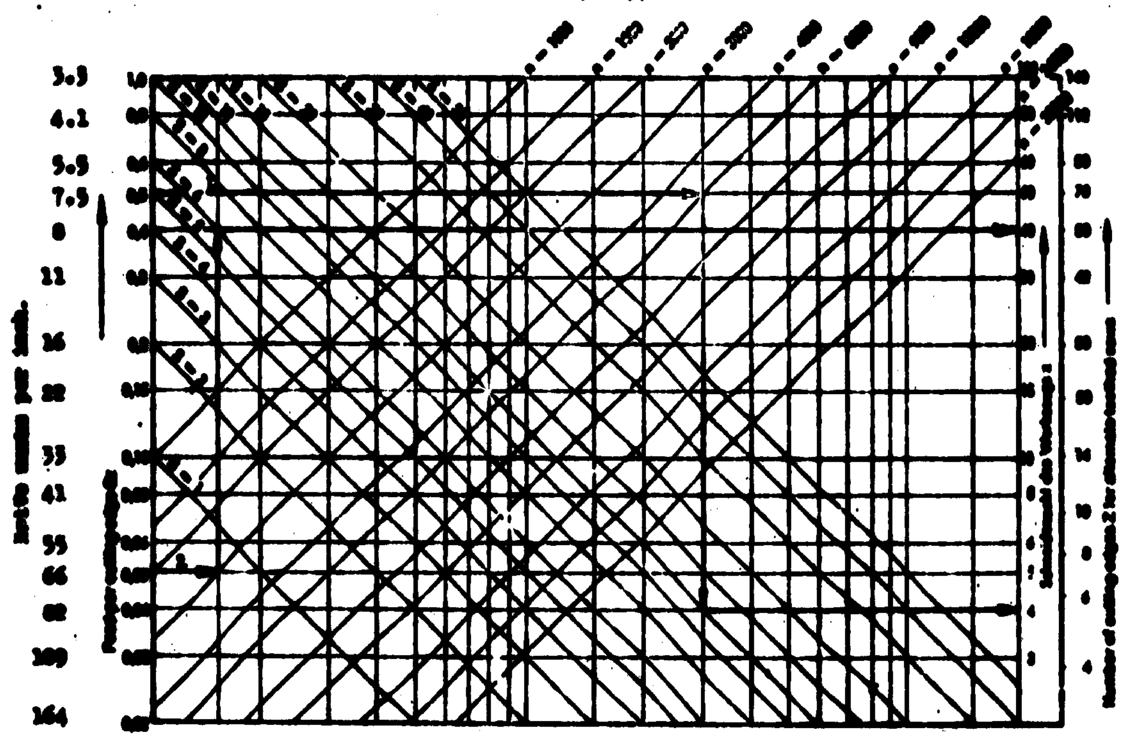
The hook angle of standard catalogued carbide-tipped blades is usually designed for a blade height over the work of 3/8-5/8" (10-15 mm).

The drawing below shows how the angle of attack of the tooth against the material varies as the height of blade is changed. In other words, by varying the overhang it is possible to influence the finish of the section to some extent. This is especially true of materials faced with plastic laminates or veneers. The optimum height of blade must be established by trial in each case.

Generally speaking, the greater the overhang the worse will be the break-through at the underside of the material, while the top face will be better. Reduced overhang, on the other hand, results in breakthrough on the top side but a fault-free underside. The former situation gives a shorter cutting

Graphic illustration

[illegible] the requisite number of teeth Z of the tool to be determined as a function of the approximate feed value per cutting edge (f_z see [illegible] below) the spindle speed (n) and the feed rate of the workpiece (u).



Example 1:
[illegible] milling - solid wood
[illegible] per cutting edge from table of approx. values — f_z = 0.5 mm
[illegible] speed of machine — n = [illegible] rpm
[illegible] rate of feed unit — u = [illegible] m/min.
Result: number of teeth — Z = 4 teeth

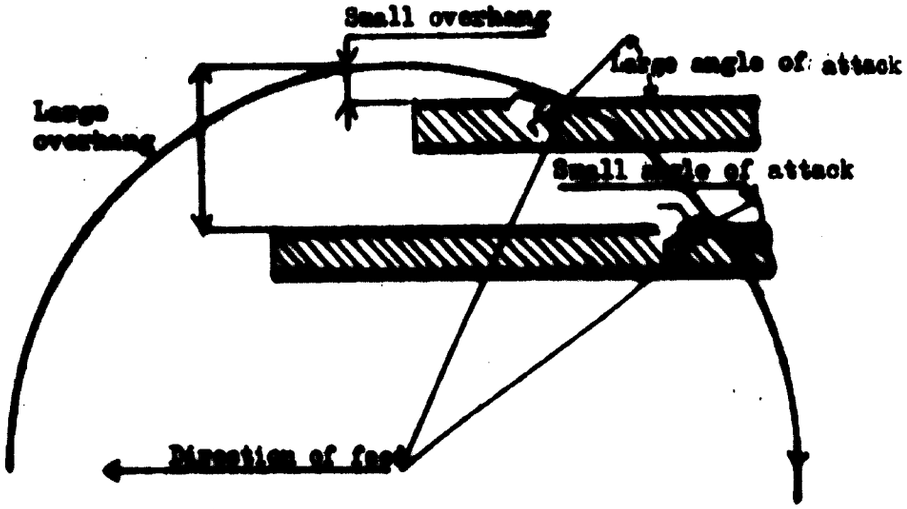
Example 2:
[illegible] compressed hard wood
[illegible] per cutting edge from table of approx. values — f_z = [illegible] mm
[illegible] of circular saw shaft — n = [illegible] rpm
[illegible] feed approx. — u = [illegible] m/min.
No. of teeth for straight or hollow toothed saw — Z = [illegible] teeth
No. of teeth for staggered toothed or alternately angled saws — Z = [illegible] teeth

Approximate values for feed per cutting edge in mm

Sawing	
[illegible] wood, with and across the grain	0.1 … 0.2
Chipboard and plywood	[illegible] … [illegible]
Veneered wood and sheets, with and across the grain	[illegible] … 0.1
Compressed hardwood, hard fibre sheeting	[illegible] … [illegible]
Thermoplastic materials	[illegible] … [illegible]
Duroplastic materials	[illegible] … [illegible]
Plastic coated sheeting	[illegible] … [illegible]
Finish milling	
Solid wood, with the grain	[illegible] … [illegible]
Plywood, chipboard sheeting, hardboard	[illegible] … 0.4
Plastic coated sheets	0.15 … 0.25
Compressed wood	0.1 … 0.2
Rough milling	
Solid wood, with the grain	[illegible] … 1.0
Chipboard, hardboard	[illegible] … [illegible]
Solid wood, across the grain	0.2 … 0.4
Fine finish milling	
Solid wood, laminated wood	0.15 … [illegible]
Hard wood, across the grain, hard fibre sheets	[illegible] … [illegible]
Compressed hardwood	0.1 … 0.2
Thermoplastics	[illegible] … 0.1
Duroplastics	[illegible] … [illegible]
Parting, slotting, multiple blade sawing	
Solid wood, laminated wood	0.05 … 0.3

The indicated values apply to medium cut depths (approx. 10 … [illegible] mm), for larger cut depths the lower values should be aimed for (or still lower values adopted) while for smaller cut depths the upper values should be aimed for or even exceeded. For small tool diameters, the lower values are selected and vice versa.

path through the material, meaning less feed force and, in theory, reduced edge wear. The latter case, however, results in smoother blade running and therefore a better finish in the cut.



5. Angles

The drawing below shows the commonly accepted angle designations for carbide-tipped circular saws and also ordinary circular saws.

The clearance angle is kept between 10°- 12°.

The tooth point angle should not be less than 45° for the sake of strength.

The hook angle lies between 0° and 30°.

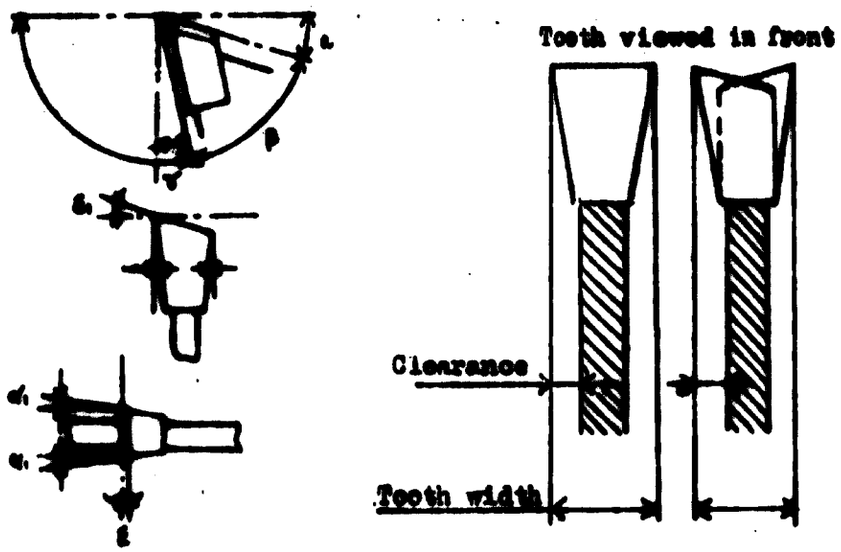
The larger hook angle is used for ripping softwood and the smaller angle for cross cutting. In general reduction in cutting force on a tooth will reduce the hook angle.

The tangential clearance angle is normally between 3° and 4°.

The radial clearance angle is kept between 1.5° and 2°. However, if blade tends to pick up deposits of wood chips this angle should increase to 3°. On carbide-tipped blade the front bevel is employed for mitre cutting and also for plywood and veneer board. In these cases it is never greater than 5°.

A blade with back bevel requires less power and less feed force. The angle is between 5° and 15°. As a rule carbide-

tipped blade has a left-hand bevel and right-hand bevel. This applies to both front and back bevel. This practice results in smoother blade running than if all teeth were bevelled alike, though this would be desirable in some cases for the sake of a good finish in the cut.



α = clearance angle

β = tooth point angle

γ = hook angle

α_t = tangential clearance angle

α_r = radial clearance angle

ε = front bevel angle

ε_1 = back bevel angle

The hook angles which are most suitable for sawing different materials.

0° = Cross-cutting of wood in pendulum saws. Pre-sawing of veneered board.

8° = Sawing of hard plastics and veneered board and lamin board. Sawing of metals.

8° = Sawing of lightweight concrete and klinker brick.

16° = Cross-cutting of wood. Squaring of fibre building board, plaster and particle board, veneered board.

18° = Sawing of veneered board, plywood, veneer, bobbins, and mitre cutting of wood.

20° = Re-sawing of dry wood and sawing of soft plastics.

25° = Re-sawing and edging of green wood.

30° = Grooving

6. Care and maintenance of carbide-tipped saws

A carbide tipped saw blade is a costly tool which must be handled with the greatest of care. The blade is not exactly fragile, but it must be in absolutely top shape in order to produce what you demand of it.

During storage, the sintered carbide tips must be protected against knocks and bumps. A carbide tipped saw must not be placed on a hard surface such as concrete, since this might damage the sharp tips.

A carbide tipped saw must be kept clean. Resin or other matter clinging to the blade may cause blueing and thereby shorten the life of the blade. Effective cleaning calls for a cleaning agent of the highest grade. Make regular use of BARONOL-HS which has also anti-corrosion properties and is gentle to the skin. You will then be assured of increased life and productivity for your carbide tipped saw blades.

The feed of the workpiece must be parallel to the blade since otherwise the carbide cutting edge may disintegrate, resulting in a poor cut.

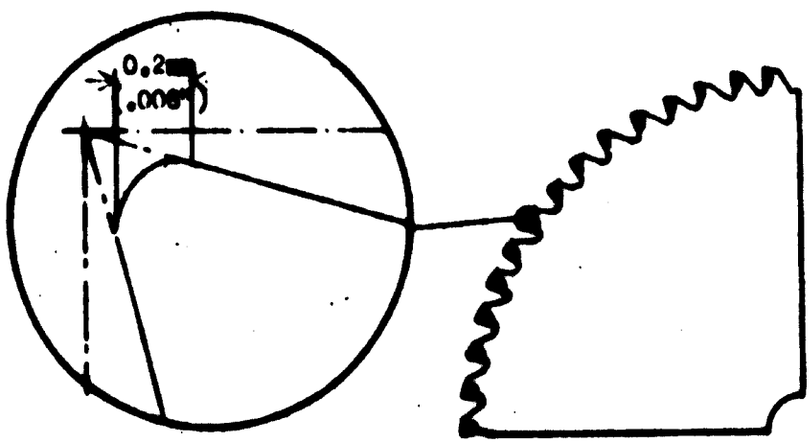
Carbide tipped blades are most effective in stable machines, with firmly clamped workpieces. Vibrations cause increased blade wear and uneven cut surfaces. The material to be cut must naturally also be free from foreign matter.

It is important that the flange diameter be as large as possible and preferably 1/3 of the blade diameter. The flange must be flat and be kept free from sawdust, chips, etc. Further more, the run-out of the flange should not exceed 0.02 mm (0.0008 in).

Even when given proper care, a carbide tipped saw blade will sometimes require sharpening. This should be done in time, before the inserts become excessively worn. The most economical time for regrinding is when the wear land amounts to approx. 0.2 mm (0.0079 in). Wear lands can readily be checked by means of a graduated magnifying glass.

When regrinding, for which a diamond wheel should be used, grind the leading edge first and then the back. As will be seen in the picture, wear arises quite a long way down at the working corner, despite the radial clearance angle. If grinding is confined to the back only, a relatively large amount of the carbide tip must be removed to restore the edge to full satisfaction.

For coarse grinding a 150-grain wheel is recommended, and for finishing a 400-grain wheel. The grinding machine must be stable and the blade securely fixed, preferably with a support close to the point of grinding.



Grinding of Twist Drill

1. Twist Drill Terms (See Fig. 1)

1 - 1 Point	The whole cone-sloped end surface of the twist drill is called the point.
1 - 2 Cutting Lip	The cutting lip is the cutting edge of the twist drill. The cutting lip should be the only part of the twist drill in contact with the material when drilling. The two cutting lips must be of the same length.
1 - 3 Heel of Cutting Lip	This is the other edge of the cutting face.
1 - 4 Lip Clearance Angle	This should be 12° to 15° and is the angle of climb of the face of the drill.
1 - 5 Point Angle	This is the angle between two cutting lips. The point angle has been established at 118° for general work and between 82° to 60° for wood.
1 - 6 Chisel Edge	The small flat edge at the end of the point is called the chisel edge.
1 - 7 Dead Centre	The centre of the chisel edge is called dead centre.
1 - 8 Web	The web is the thinnest part of the drill when one look along the drill in the direction of the shank.
1 - 9 Chisel Edge Angle	This is the angle between the cutting lip and the chisel edge.
1 - 10 Margin	This is the hardened portion of the drill.
1 - 11 Helix Angle	This is the angle of climb of the margin.
1 - 12 Flute	The flute is the hollow portion of the drill.

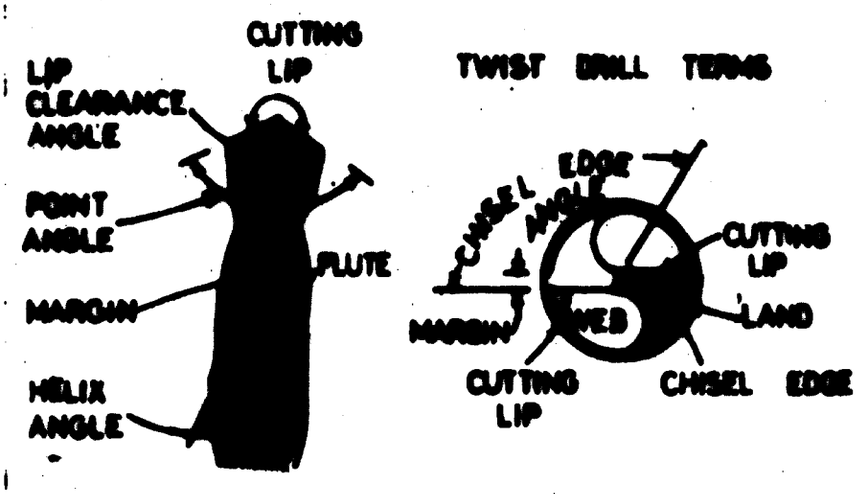


FIG. 1

2. Measuring the important dimensions

2 - 1 Measuring the Point Angle

The point angle can be easily checked by a drill point gauge as shown in the Fig. 2. For different materials, the required point angle will be different.

FIG. 2

2 - 2 Measuring the cutting lips

The cutting lips must be of the same length as mentioned earlier. If they are not of the same length, the hole drilled will be out of round and larger than the drill as shown in Fig. 3.

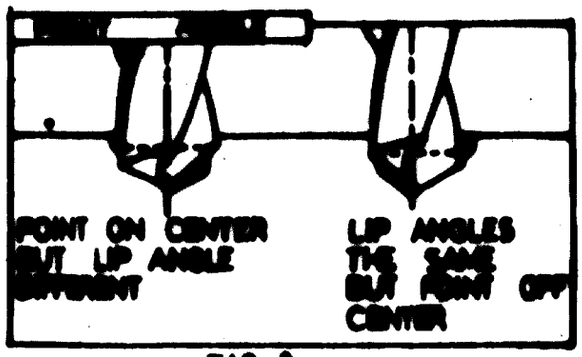


FIG 3

To measure the cutting lips, the same drill point gauge as the above can be used. The markings or the gauge is for measuring the length of the cutting edge.

2 - 3 Measuring the lip Clearance Angle

Again the same sort of gauge can be used. The difference between the angle made by the cutting lip and the heel of the cutting should be 12° as shown in Fig. 2. An idea of clearance can also be observed by holding the drill as shown in Fig. 4 and noting the difference between the lip and heel of the point.

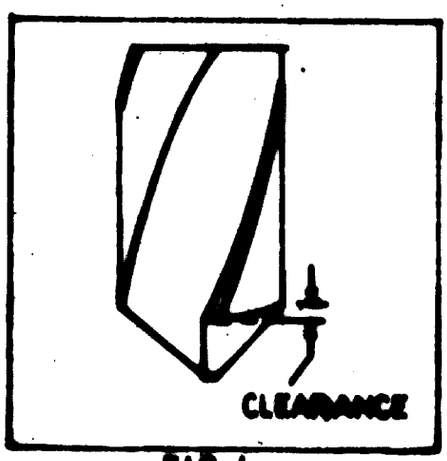


FIG 4

There must be clearance behind the cutting lips at every part of the conic recess which the drill cuts. With proper clearance the drill cuts at the cutting lips, leaving every part of the point behind the lips in the clear. The appearance of the chisel edge gives an indication of the clearance angle. If the clearance is correct 12°, the chisel edge will make an angle of 45° with the cutting lip. Fig. 5 shows the proper lip clearance in drill grinding.

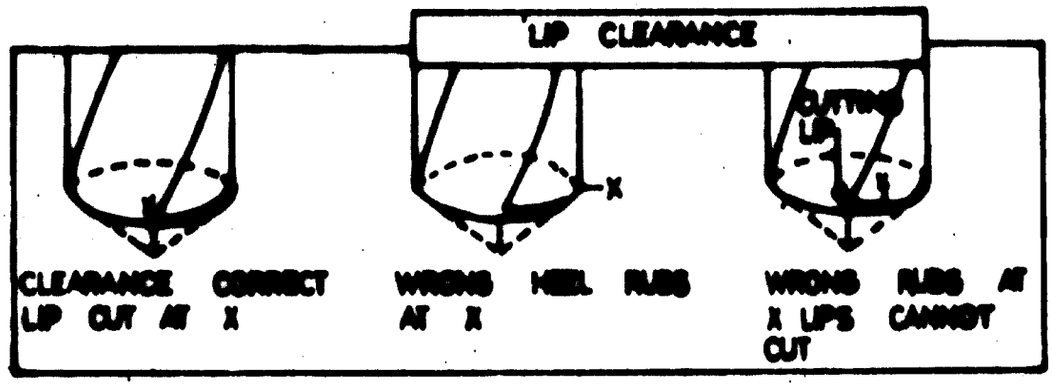
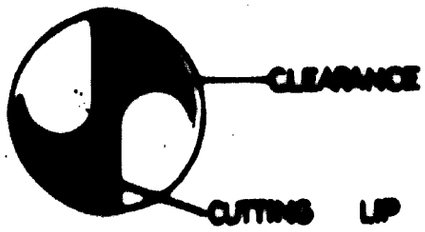


FIG. 5



3. Drill Grinding

3 - 1 In drill grinding the most important thing is to have the correct point angle and the lip clearance. Experienced mechanics with their long experience go through their motions almost mechanically and they can obtain good results without any mechanical guides or other aids. The worker who only occasionally grinds a drill should always use some form of guide. Some of these are illustrated below.

3 - 2 Grinding with the help of guide line To grind drills in this manner clamp a wood table to the tool rest of the grinder and on this table nail a guide block at an angle of 59° with the side of the grinding wheel as shown in Fig. 6 below.

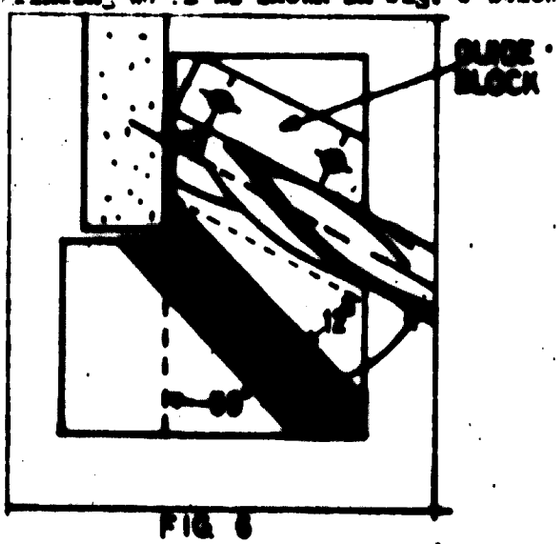


FIG. 6

Mark off a series of parallel guide lines, each of these being an angle of 12 degrees (the clearance) with the guide block as shown above. Now if the

cutting lip is placed against the side of the grinding wheel, with the body of the drill against the guide block, the proper point angle will be obtained. From this position the drill is rotated about 1/16 of a full turn at the same time moving to a position parallel with the parallel guide line. Each lip is treated in turn, checking with the drill gauge to see that both are the same exact length. If desired, the grinding can be reversed, starting from the heel to the cutting lip. In this way it has the advantage of that the surface being ground can be seen at all times, but it has the disadvantage of producing a heavier burn at the cutting lip. Care must be taken, in any case, not to rotate the drill too much, since over rotation will bring the lip on the opposite side with contact with the wheel.

3 - 3 Grinding with the help of special attachment

Perfect drilling point of any standard angle can be obtained by using a drill grinding attachment on the bench grinder (See Fig. 7). In order to do a good work with the drill grinding attachment, it is necessary to have a true and smooth grinding wheel. This is of such importance for good work that a diamond dresser and holder are commonly sold as part of the drill grinding attachment. The point of the dresser should be on or slightly below centre and should be on a drag angle of about 10 degrees. When dressing the wheel, pass the dresser rather quickly across the face in order to keep the wheel open and free-cutting. Do not use more than 0.001 inch infeed on the dresser per pass.

DRILL GRINDING ATTACHMENT

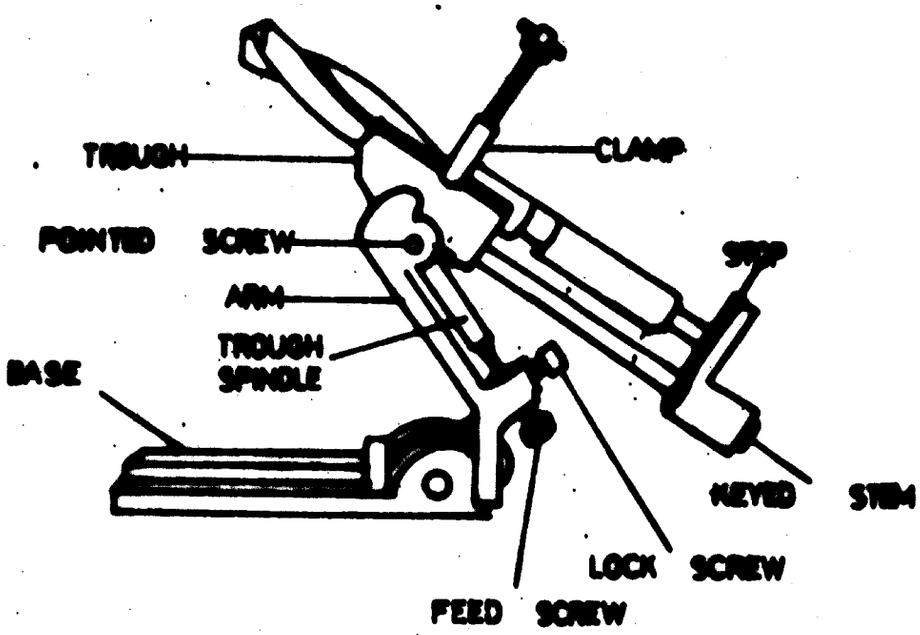


FIG. 7

3 - 4
Web
Thinning

As shown in Fig. 8 the web of the drill becomes thicker as it approaches the shank. It follows therefore that the point of the drill becomes thicker as the drill is being used up. A thick web will require more power to force the drill through the work. To eliminate this, the web should be thinned. However for drill less than ¼" diameter this is usually not necessary.

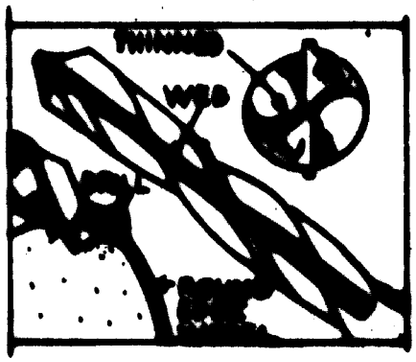


FIG. 8

This operation is usually done on a round-face grinding wheel, the drill being held so that the wheel cuts in the flutes. The web can be thinned to about ⅓ of its original thickness.

The web can also be thinned on an ordinary square-face wheel. In this form of web thinning, the grinding is done on the back of the lips, the grinding being carried up to the centre of the point on each side. (See Fig. 9)

FIG. 9

3 - 5
Care in
grinding
a drill

When sharpening or using a carbon-steel drill, extra care must be taken not to let it get hot enough to lose the temper. If the cutting edge shows blue, it indicates that the temper has been lost in that part and the blue must be ground away.

When grinding a high-speed steel drill, never dip it in water to cool it, because this likely crack the lips.

Rake

Rake angle is determined pretty much by the manufacturer. However it can be changed to suit different material. Very hard steel requires that the rake be reduced in order to increase the support behind the cutting edge. Brass and bronze require no rake. (See Fig. 10)

FIG. 10

4 - 1
Drill point angle

The point angle vary for different materials from 60° - 150° with about 118° for average work.

4 - 2
Speed & feed of twist drill

The cutting speed for wood is between 300 to 400 f.p.m.

The suggested feeds for various sizes of drills are as follows :-

Dia. of Drill (inches)	Feed (inch per revolution)
Under $\frac{1}{8}$	0.001 to 0.002
$\frac{1}{8}$ to $\frac{1}{4}$	0.002 to 0.004
$\frac{1}{4}$ to $\frac{1}{2}$	0.004 to 0.007
$\frac{1}{2}$ to 1	0.007 to 0.015
1 in. and over	0.015 to 0.025

NOTE: It is best to start with a moderate speed and feed, increasing either one, or both, after observing the action and condition of the drill.

4 - 3
Some common causes for drill failure

Some common causes for drill failure / Effect	Feed too heavy	Too much clearance	Not Enough Clearance	Too much speed	Margin	Crooked hole
Cutting edge break off	✓	✓				
Drill split	✓		✓			
Rapid drilling especially at the corner of the lip		✓		✓		
Drill squeaks					✓	✓

Effect & Causes of Common Failure

Specification & Selection of Grinding Wheel

1. Grinding Wheel Specification (American Standard Association)

1-1 Standard Marking System

A standard system of marking grinding wheels, recently adopted by the American Standards Association, is shown in the accompanying chart. Although the standard greatly facilitates ordering, there is no assurance that competitor's wheels marked alike will cut the same. Manufacturers can further describe the wheel and quality by the first and last symbols of the identification marking.

1-2 Standard Marking System Chart

Standard Marking System Chart

Sequence

	1	2	3	4	5	6
Prefix	Abrasive Type	Grain Size	Grade	Structure	Bond Type	Manufacturer's Record
51 -	A -	36	- L -	5	- V -	03

Manufacturer's Symbol indicating exact kind of abrasive (use optional)

Aluminium Oxide - A

Silicon Carbide - C

Manufacturer's private marking to identify wheel (use optional)

Coarse	Medium	Fine	Very Fine
10	30	70	220
12	36	80	240
14	46	90	280
16	54	100	320
20	60	120	400
24		150	500
		180	600

Dense	to open
1	9
2	10
3	11
4	12
5	13
6	14
7	15
8	Ete

(use optional)

V-Vitrified
S-Silicate
R-Rubber
B-Resinoid
E-Shellac
O-Oxychloride

Soft — Medium — Hard

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Grade Scale

1-3
Abrasive Type

There are two common types of abrasives namely aluminium oxide and silicon carbide.

Aluminium oxide abrasive stays sharp longer on material of high tensile strength like hardened steel.

Silicon carbide abrasive, on the other hand, is suitable for material of low tensile strength e.g. glass.

1-4
Grit Size

This represents the approximate number of openings per linear inch in the final screen used to size the grain.

The most commonly used grit sizes are from 24 to 80.

coarse			to		fine
8	16	36	70	120	240
10	20	46	80	150	280
12	24	54	90	180	320
14	30	60	100	220	400
					500

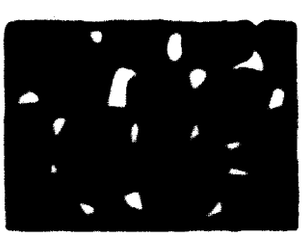
1-5
Grade

Grade or strength of bonding indicates the holding power of the bond which holds the abrasive grains in place. When the amount of bond is increased, the hardness of the wheel also increases.

The grade letters range from A to Z in the order of increasing "hardness" as shown below.

SOFT ⟶	MEDIUM	⟶ HARD
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z		

Abrasive grains with light bond coating and weak connecting bond posts as in a relatively soft grade wheel (Light areas are the pores required for chip clearance



Abrasive grains of same size but with heavier bond coating and thicker stronger bond posts as in a harder grade wheel.

1-6
Structure

The structure number indicates the grain spacing in the wheel. When the abrasive grains are close together relative to their size, the wheel has a denser structure.

DENSE ⟶ OPEN														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Usually in wheel selection the structure number is omitted. Experience has proved that for each grit size and grade, there is a best structure and the manufacturer is the person with the right information.

1-7
Bond

There are 5 basic types of bond and they are :-

(a) Vitrified, the most common type of bond. Porosity and strength of the wheels made with this bond give high stock removal and their rigidity helps in the attainment of high precision.

They are not affected by water, acid, oil, and ordinary temperature variation.

(b) Resinoid, used for high speed wheels in foundries, welding and billet shop. They are also used in cut-off and thread grinding operations.

(c) Rubber, used for cut-off wheels where burr and burn must be reduced to a minimum. Also used for snagging* with portable grinders where finish is important as on stainless steels welds.

* Snagging - Grinding the gates, fins and sprues from castings.

(d) Shellac, used for wheel producing high finishes on camshafts and also for some cut-off wheels.

(e) Silicate, used where heat generated in grinding must be kept at a minimum and also for very large wheels.

2. Selection of Grinding Wheels (Silicon Carbide & Aluminium Oxide

2-1 Introduction

Most grinders are supplied with a general purpose wheel and this wheel will handle most of the work encountered in a small production shop. Where, for some reason, a special wheel is required, the user can select a workable grinding wheel by following the rules listed below. The eight factors to consider when selecting grinding wheel are :-

2-2 Factors

1. Hardness and type of material
2. Finish required
3. Amount of stock to be removed
4. Wet or dry grinding
5. Wheel speed
6. Area of grinding contact
7. Severity of grinding operation
8. Horsepower of grinder

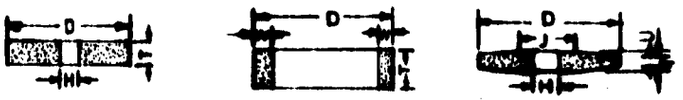
FACTORS	ABRASIVE	GRIT SIZE	GRADE	STRUCTURE	BOND
1. Hardness and type of material	Aluminium oxide for H.T.S. material White aluminium oxide good for H.S.S. Silicon carbide for L.T.S. material Green silicon carbide good for hard alloys	Finer grit for harder and more brittle material e.g. H.S.S.- 60 M.S.- 20	Harder grade for softer material e.g. H.S.S.- J M.S.- Q	Open structure for softer material	-
2. Finish required	-	Finer grit for higher finish e.g. for milling cutter finish use 60 e.g. for weld grinding use 20		Open structure for coarser finish	Vitrified bond for rough finish. Resinoid, rubber and shellac for higher finish.
3. Amount of material to be removed		Finer grit for small amount e.g. for cutter finish use 60 e.g. for weld grinding use 20			Vitrified bond for large amount. Resinoid, rubber and shellac for small amount.
4. Wet or dry grinding		Wet grinder permit one grade harder than for dry grinding			

FACTORS	ABRASIVE	GRIT SIZE	GRADE	STRUCTURE	BOND
5. Wheel Speed					Standard vitrified wheel up to 6500 s.f.p.m. Resinoid, rubber & shellac for 6500 to 16000 s.f.p.m.
6. Area of grinding contact		Coarser grit for larger area	Harder wheel for smaller area		
7. Severity of grinding operation	Tougher abrasive for severe condition				
8. Horsepower of grinder			Harder grade for higher horsepower		

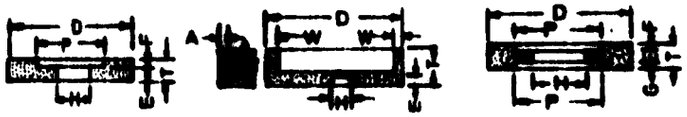
* H.T.S. Materials are steel, steel alloys, malleable iron, wrought iron
\+ L.T.S. Materials are grey iron, brass and soft bronze, aluminium, copper

2-5
Size and Shape of Wheel

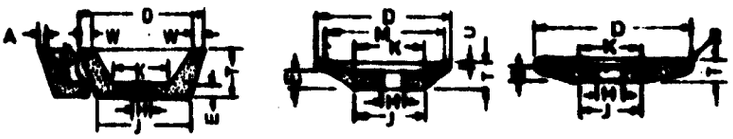
The principal grinding wheel shapes have been standardised by the United States Department of Commerce and the Grinding Wheel Manufacturers' Association. Standard shapes which are available are shown below. Grinding wheels of the straight wheel type have been standardised according to the wheel face as shown below. These wheels are used for grinding special contours and sharpening saws.



Type No.1 STRAIGHT | Type No.2 CYLINDER | Type No.4 TAPERED TWO SIDES

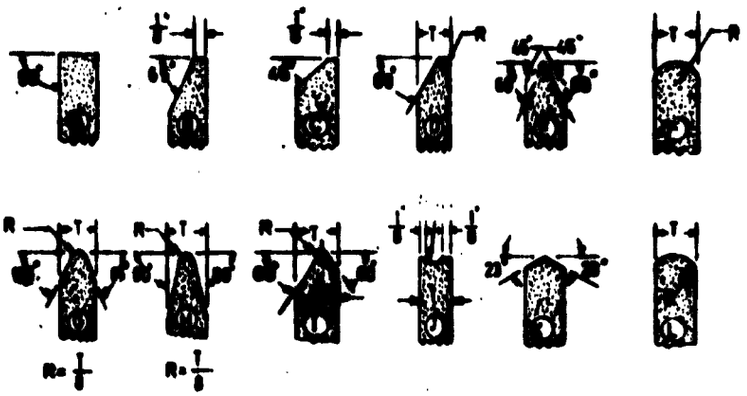


Type No.5 RECESSED ONE SIDE | Type No.6 STRAIGHT CUP | Type No.7 RECESSED BOTH SIDES



Type No.11 FLARING CUP | Type No.12 DISH | Type No.13 SAUCER

Standard grinding-wheel shapes



Standard grinding-wheel faces

GRINDING WHEEL SELECTION *				
WORK	ABRASIVE	GRIT	GRADE	BOND
Aluminum (surfacing)	Alum. Oxide (white)	46	Soft	Vitrified
Aluminum (cutting-off)	Alum. Oxide	24	Hard	Resinoid
Brass (surfacing)	Silicon carbide	36	Medium	Vitrified
Brass (cutting-off)	Alum. Oxide	30	Very Hard	Resinoid
Cast Iron	Silicon Carbide	46	Soft	Vitrified
Chisels (woodworking)	Alum. Oxide	60	Medium	Vitrified
Copper (surfacing)	Silicon Carbide	60	Medium	Vitrified
Copper (cutting-off)	Silicon Carbide	36	Hard	Rubber
Cork	Alum. Oxide (white)	60	Soft	Vitrified
Cutters (moulding)	Alum. Oxide	60	Medium	Vitrified
Drills (sharpening)	Alum. Oxide (white)	60	Medium	Vitrified
Glass (grinding)	Silicon Carbide (Green)	150	Hard	Vitrified
Glass (cutting-off)	Silicon Carbide (Green)	90	Hard	Rubber
Glass (cutting-off)	Diamond	60	Medium	Copper
Leather	Silicon Carbide	46	Soft	Vitrified
Plastic	Silicon Carbide	60	Medium	Rubber
Rubber (hard)	Silicon Carbide	46	Medium	Resinoid
Saws (gumming)	Alum. Oxide	60	Medium	Vitrified
Steel (soft)	Alum. Oxide	60	Medium	Vitrified
Steel (high speed	Alum. Oxide (white)	60	Soft	Vitrified
Tile (cutting-off)	Silicon Carbide	30	Hard	Resinoid
Tubes (steel)	Alum. Oxide	60	Hard	Rubber
Welds (smoothing)	Alum. Oxide	36	Hard	Vitrified
Wood (hard)	Silicon Carbide	30	Soft	Vitrified

* Adapted from tables by The Norton Company

Recommended WHEEL SPEEDS	
Chisel Grinding	5000-6000 s.f.m.
Cut-off Wheels	6000-8000 s.f.m.
Surface Grinding	4000-6000 s.f.m.
Polishing	6000-9000 s.f.m.
Polishing (soft rubber wheels)	4000 s.f.m.
Buffing	6000-9000 s.f.m.
Scratch Brushing (rough finish)	600 r.p.m.
Scratch Brushing (satin finish)	4000-6000 s.f.m.
General Grinding	5000-6500 s.f.m.
Internal Grinding	2000-6000 s.f.m.

Recommended BELT and DRUM SPEEDS	
48 inch abrasive belts	3100 s.f.m.
6 to 10 ft abrasive belts	2800 s.f.m.
10 to 16 ft abrasive belts	2400 s.f.m.
48 inch polishing belts	4000 s.f.m.
3 inch drums (coarse grit abrasive)	1800 r.p.m.
3 inch drums (fine grit abrasive)	2400 r.p.m.
1 inch drums (closed coating)	1200 r.p.m.
1 inch drums (open coating)	1800 r.p.m.
10 to 12 inch abrasive disks	1800 r.p.m.
Abrasive disks	4500 s.f.m.

	GRINDING WHEEL SPEEDS IN R.P.M.							
DIAMETER OF WHEEL	R.P.M. FOR STATED SURFACE SPEED							
	4000sfm	4500sfm	5000sfm	5500sfm	6000sfm	6500sfm	7000sfm	7500sfm
1	15,279	17,189	19,098	21,008	22,918	24,828	26,737	28,647
2	7,639	8,594	9,549	10,504	11,459	12,414	13,368	14,328
3	5,093	5,729	6,366	7,003	7,639	8,276	8,913	9,549
4	3,820	4,297	4,775	5,252	5,729	6,207	6,685	7,162
5	3,056	3,438	3,820	4,202	4,584	4,966	5,348	5,730
6	2,546	2,865	3,183	3,501	3,820	4,138	4,456	4,775
7	2,183	2,455	2,728	3,001	3,274	3,547	3,820	4,092
8	1,910	2,148	2,387	2,626	2,865	3,103	3,342	3,580
10	1,528	1,719	1,910	2,101	2,292	2,483	2,674	2,865

CARE AND MAINTENANCE OF DIAMOND ABRASIVE WHEELS

Diamond abrasive wheels should be used in accordance with recommended methods if maximum efficiency and effectiveness are to be realized. A few simple suggestions are offered here as a guide to the proper handling of this tool.

Mounting. It is important to mount straight diamond wheels so that they run true on the machine spindle and collet. To avoid excessive dressing and consequent loss of valuable diamond dust, the arbor holes of straight diamond wheels are made a few thousands oversize to provide for shifting on the individual mountings, so that the periphery may be brought into running truth. On a straight diamond wheel this may be done as follows: Place the wheel on the spindle and tighten the flange lightly by hand, sufficiently to maintain its position and yet not tight enough to prevent shifting under gentle tapping. Locate the point of greatest projection with an indicating gauge. Tap this point lightly (on the periphery) using a small block of wood to cushion the blow. Test again with the gauge. Repeat this procedure until the periphery runs true within .0005-inch, then tighten the flanges firmly against the wheel.

For best results, wheels should be mounted on collets having a tapered hole to fit the tapered spindle. After the wheel has been brought to running truth, it should remain on its collet and removed as a unit. This permits remounting without the necessity of retruing.

To bring the side or face of a cup wheel into running truth, the flanges must be ground to axial running truth and mounted on a spindle free from end play. Shimming of the flanges is not recommended.

For the vitrified bonded diamond wheels, loose blotters are supplied with peripheral type wheels. The supporting flanges should be as large as possible, and it is essential that they be properly relieved and matched as well as machined to flat, smooth bearing surfaces.

Dressing and Truing. Diamond wheels remain sharp for long periods of time and seldom need dressing when properly lubricated. When they are allowed to run dry or to grind on the shank, they become glazed and loaded. The resinoid bonded diamond wheels of the straight type can be easily cleaned by brushing with kerosene or dressing lightly with a cake of pumice stone.

Metal bonded diamond wheels and the newer type of vitrified bonded diamond wheels are dressed with silicon carbide abrasive sticks, 60 to 180 grit, J, K or L grade of hardness, or by grinding carefully with a silicon carbide vitrified grit wheel of medium hardness and about 60 grit. This wheel is mounted in a tool post grinder, tool and cutter grinder or a small cylindrical grinder, and is followed by a light application of a dressing stick. If used with care, a portable flexible shaft grinder mounting a silicon carbide wheel of medium hardness and 60 grit can be used and held by hand against the face of the wheel.

Cup and dish type wheels should have the diamond face trued by lapping the diamond section on a cast iron plate with plenty of water and silicon carbide of a grit size approximating that of the diamond wheel. Use light pressure with a figure eight motion of the wheel. Repeat the operation after turning the wheel 90 degrees.

Care should be taken so that the back of the wheel and the diamond face remain parallel. Best results are obtained if the back of the wheel is ground on a surface grinder, after lapping the face.

The best method for truing diamond peripheral wheels is to mount the wheel between centers and grind the diamond section. A vitrified bonded silicon carbide wheel of medium hardness and of a grit size generally used for cylindrical grinding to obtain good commercial finish is best suited for this operation. Normal wheel speeds for the grinding wheel should be used with the diamond wheel revolving slowly. Table traverse should be as fast as practicable and a good flow of coolant should be used. Wheels may be formed to shape in this manner.

Coolants. It is best practice to grind wet when using diamond wheels. For resinoid or vitrified wheels kerosene or plain water, (which is not strongly alkaline) is recommended. A small amount of soluble oil can be added when using water. Plain water or soda water solution is recommended as coolant for metal bonded diamond wheels.

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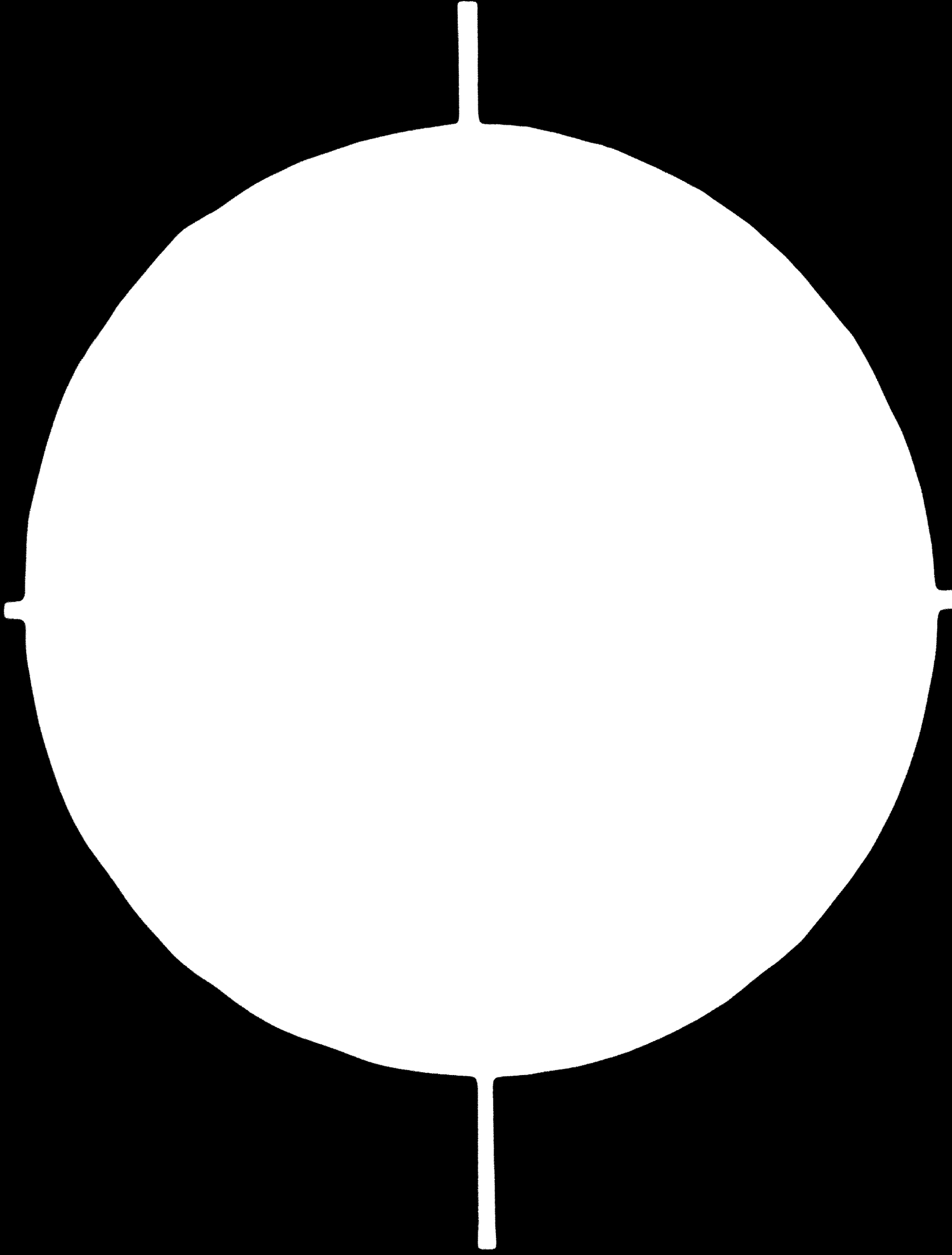

There are several methods for applying the coolant to the wheel. Where a small number of tools are worked, the coolant can be applied with a brush, but this has the disadvantage of the possibility of the wheel becoming dry. A more positive method is the use of a felt wick held in contact with the wheel face by means of a light spring. (Note illustration at right).

Where large quantities of tools are being ground, the machine should be adapted for wet grinding by providing a pump and means for the piping of the coolant to the wheel.

Wheel Speeds. The recommended wheel speed range for diamond wheels is from 5000 to 6000 feet per minute. Excessive speeds may generate sufficient heat to cause cracking of cemented carbide materials. Too low a speed increases the stresses on the wheel and causes rapid wear and breakdown.

Caution. The maximum speeds shown on the tags which are attached to the wheels are not the recommended speeds for all jobs and under all conditions. The recommended speeds for grinding with diamond wheels is, as has been stated above, 5000 - 6000 feet per minute.

Feeds. In off-hand grinding of single point carbide tools, the tools should be applied to the diamond wheel with ample pressure, at the same time moving the tool back and forth over the face of the wheel. Too light a pressure should be avoided as this will cause the wheel to glaze and retard the cutting action.

For surface grinding with the periphery of the diamond wheel, down feeds not in excess of .001-inch for roughing and .00025-inch to .0005-inch for

finishing per pass should be used, depending on such factors as the hardness of carbide, cleanliness of wheel, grain size and bond, etc. Table traverse feeds of 100-inch to 500-inch per minute with a cross feed of .030-inch to .060-inch are recommended.

Down feeds on chip breaker grinders should be between .0003-inch and .0005-inch with a low table feed.

On machines where the tools is rigidly supported against the rim of a cup wheel, the down feed should not be more than .001-inch per pass to avoid excessive heating of the wheel.

Grinding the Shank. Diamond wheels should never be used to grind the shank of carbide tipped tools. Shanks should be ground back with aluminum oxide or silicon carbide wheels before grinding the carbide insert. The clearance angles on the shank should be ground back between 3 to 5 degrees in excess of the desired angle on the carbide tip.

Storage and Handling. The storage and handling of diamond wheels is an important consideration in their proper care. These wheels come from the manufacturers in solidly constructed containers which provide an excellent means of storing the wheels when not in use. These boxes have removable felt or cotton batting pads which provide a cushion for the wheels. It is recommended that these containers also be used for storing the wheels which are mounted on individual collets when such wheels are removed from the machines.

NOTE: The foregoing material was digested from Industrial Notes No.31, 20 January 1945, Industrial Division, Office of Procurement and Material, Navy Department, Washington, D.C. This digest may be reproduced provided that the above acknowledgment is included.

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1. Application of Oil Lubricants

1-1 Introduction

Methods of application of oils are of two kind. On the one hand those in which a charge of oil is continuously re-used, and on the other hand the so-called 'total-loss' systems in which fresh oil is continuously consumed. The former methods include splash lubrication and bath lubrication. The latter methods include the other non-mechanical lubricators (see section 2).

1-2 Total loss system

In total-loss lubrication of bearings, oil is feed to the bearing in periodic small amounts and drains away to waste. The oil has little opportunity to act as a coolant but it does not remain in the bearing long enough to deteriorate excessively.

1-3 Circulation system

Circulating systems are particularly suitable for cases where the oil has a major function as coolent in addition to lubricator. If necessary the oil can be passed through a cooler before returning to the bearing.

2. Non-mechanical Lubricators

2-1 Introduction

Oil can be supplied to bearings by many different methods. Such devices may be extremely simple, such as the common oil can, or may be completely automatic and equipped with safety devices to warn of lubrication failure or excessive bearing temperatures. We are interested, at the moment, in non-mechanical lubricators only.

2-2 Non-Mechanical Lubricators

Apart from oil-cans, the non-mechanical devices most often used are the bottle oiler, wick-feed oiler, drop-feed oiler, ring oiler, bath oiling and splash lubrication.

2-3 Oil can

The common oil can, one of the oldest methods of applying oil in use today, is one of the worst offenders. It is not reliable or efficient. The effectiveness of lubrication, when the oil can is used, depends upon how well the person using it understands what he is doing.

If you use it properly, you don't just stick the spout into the oil hole and squeeze the bottom of the can. Try to put in the amount recommended, and not to flood the oil hole. If the bearing

/2...

requires a few drops, put in a few drops. A great deal of care is necessary to be sure the bearing is not over-lubricated or under-lubricated. It all depends upon the individual using the can.

2-4 Bottle Oiler

A typical Bottle Oiler is shown below. As the name indicates, these oilers consist of an inverted bottle-shaped reservoir with a threaded neck for mounting on top of a bearing. A metal spindle or plunger feeds the oil from the reservoir to the journal on which it rides.

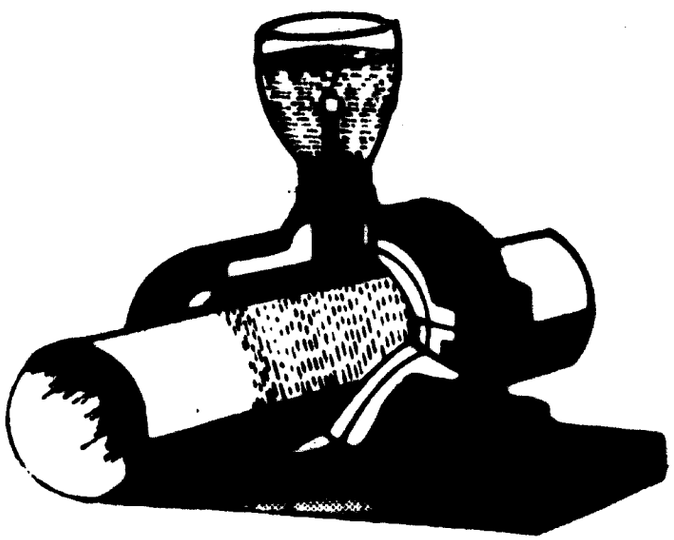


Figure 1.

Starting and stopping of the oil feed is entirely automatic, controlled by the rotation of the journal. Slight irregularities on the surface of the journal, combined with the rotating motion, cause the plunger to be alternately raised and lowered. This vibrating action causes oil to flow down the plunger to the journal through the restricted opening around the plunger in the oil hole.

A precaution we should always observe with this type of oiler is, never fill the bottle completely full. You can see that a full bottle would not have an air space as shown in Figure 1. The lack of air space caused by filling the bottle completely full can retard the flow of oil from the bottle.

As we see from the action of the bottle

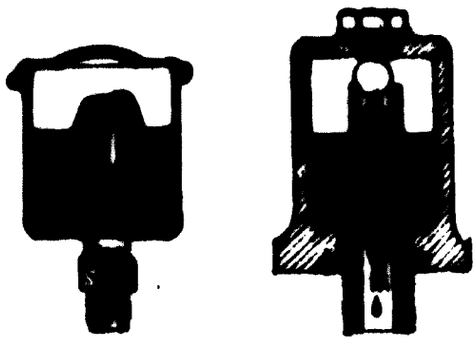
/3...

oiler, it can only be used on horizontal bearings. It is not suitable for bearings exposed to wide temperature ranges, or high speeds. It is well suited for bearings which require only a small continuous supply of oil. It is widely used on overhead line shafting, particularly where bearings are difficult to reach for re-lubrication.

2-5 Wick-Feed Oiler

In figure 2 we see another type - the Wick-Feed Oiler. This oiler employs the principle of syphoning oil by the capillary action of a porous material such as the strands of yarn in a wick.

There are two types of wick-feed oiler, namely, the 'tail siphon' and 'plug' types.



Tail siphon oiler

Plug oiler

Figure 2

The former is used in stationary positions and the latter in certain applications when the bearing is a member of a moving assembly.

The oil-soaked wick, with one end immersed in the oil in the reservoir and the other end extending into the bearing housing, carries the oil to the proper place. The flow of oil is regulated by varying the number of strands of wicking used, and by varying the height between the oil level in the reservoir and the lower end of the wick.

Whenever the machine is shut down, the flow of oil should be stopped to prevent over-lubrication and waste of oil. To stop the flow of oil, the upper end of the wick must be removed from contact with the oil in the reservoir. Even then, the oil will continue to flow until the wick has drained.

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It is important that the right type of wicking is used. Wool waste is better than cotton waste as cotton tends to pack down.

During operation it is important that there should be sufficient wick in the oil reservoir and that a sufficient length is inserted in the central well. The flow of oil will be impaired if the wick is rammed too tightly into the feed tube, or if it is wet or dirty. The oil reservoir should again be kept clean, and the cover should always be replaced after filling. The wicks act as filters and should therefore be removed periodically and either replaced with new ones or washed in white spirit. The wick should never be allowed to touch the shaft, or it will char and this will stop the feed.

The plug oiler does not depend on siphonic action. It consists of an oil reservoir, of robust construction, with a central tube again extending above the oil level. The plug, which may be made of woollen yarn or fine wire, fits into the delivery tube but is clear of the oil reservoir; oil reaches the plug through splashing due to movement of the bearing housing, and the function of the plug is simply to regulate the rate of flow. An important point is that the cover should have a small hole drilled in it to prevent development of a partial vacuum as oil is expelled. As with tail siphons, the plugs should be cleaned from time to time.

2-6
Drop-Feed Oiler

The Drop-Feed Oiler, another device for applying oil is shown below. It is widely used on all types of machinery for lubricating bearings, gears, chain drives, etc.

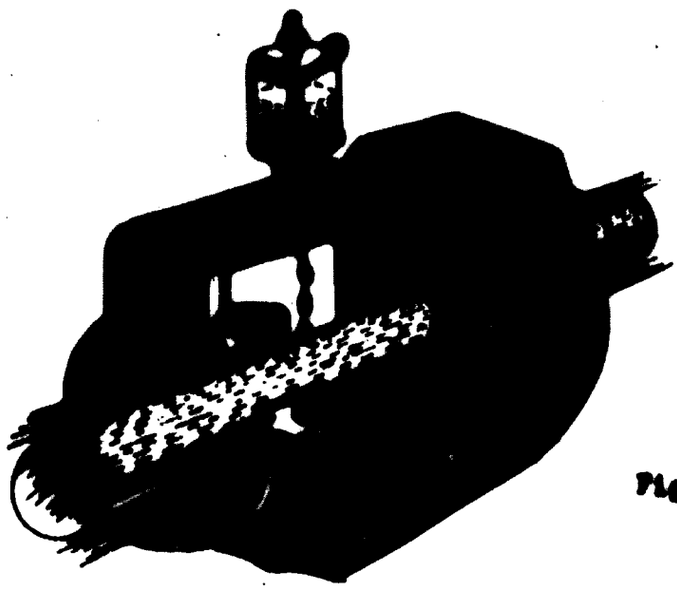

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Figure 3

In this drop-feed oiler, oil flow is controlled by an adjustable needle valve. A snap lever on top of the cap permits starting and stopping the feed of oil. This lever must be kept in the off position when the machine is not running, to avoid over-lubrication, and must always be turned on before the machine is started. The lever should also be in the off position when filling the oiler so that any bubbles which form will not be drawn into the needle valve area, thereby blocking the flow of oil. The transparent portion in the base of the oiler permits a visual check on the flow of the oil to the bearing. The flow should always be checked after servicing to be sure the proper rate is maintained.

The drop-feed oiler has a few disadvantages.

(1) The rate of oil feed is affected by changes in the oil level and the oil temperature in the reservoir.

(2) The regulating needle-valve may become clogged by particles of dirt which restrict the oil feed.

(3) The drop-feed oiler requires considerable attention in filling and regulating the flow of oil.

2-7
Ring Oiler

In Figure 4 we see a typical Ring Oiler.

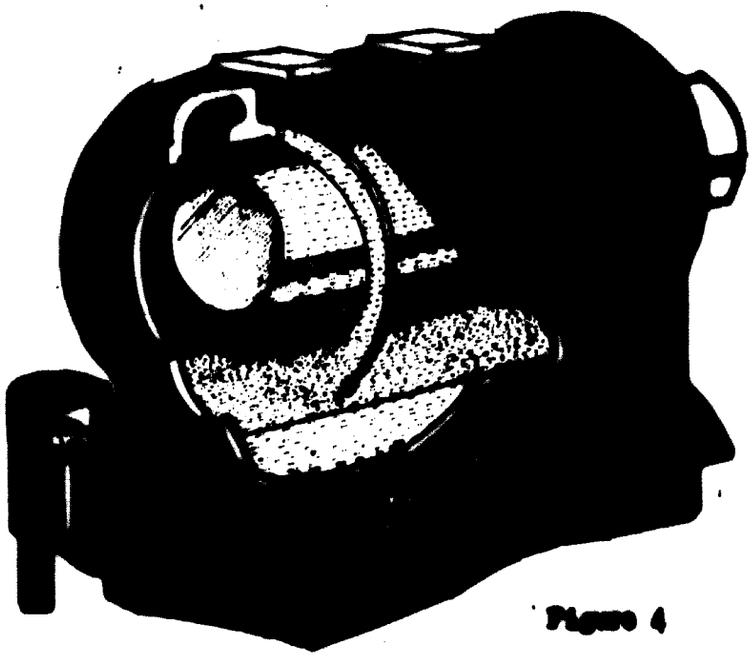

Figure 4

The principle of the ring oiler is simple. Lubrication is accomplished by means of rings around the journal having a larger I.D. than

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the O.D. of the journal. The bearing is provided with an opening or slot in which the ring freely rides, with a hinged cover over the upper half of the journal. As the shaft rotates, the ring is also rotated. The lower half of the ring is immersed in the oil in the reservoir below the journal.

As the ring rotates, it picks up oil from the reservoir. The oil is wiped off as it passes over the top of the journal and enters the bearing area from the top, or low pressure side.

The ring oiler is used extensively on horizontal bearings, such as line shafts, electric motors and generators, small steam turbines, steam engines, and outboard bearings on air compressors and refrigeration machines.

The particular advantage of the ring oiler is that it automatically supplies a large quantity of oil to the journal as long as there is oil in the bearing, and as long as the rings are free to rotate and distribute oil to the journal. There may be one or more of the rings depending upon the size of the bearing. This ring oiler cannot be used on high-speed bearings, for the ring would slip at the top where it contacts the journal and would not carry up enough oil to lubricate effectively.

Chain Oiling is another adaptation of ring oiling. In this case, a chain is used in place of the ring. The flexibility of the chain allows it to contact more surface of the journal than does the ring. As a result, the chain will supply greater quantities of oil at low speeds than would be supplied by the ring.

Periodic checks must be made of the oil level in the reservoir to insure that the ring or chain is properly immersed in the oil. The oil in the reservoir must be kept clean and free from contaminants by periodic oil changes and flushing. Otherwise, sludge resulting from oil breakdown or contamination can retard free movement of the ring and prevent proper distribution of the oil to the journal.

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2-8 Bath Oiling for friction bearings

Bath Oiling, as illustrated in Figure 5, is another means of applying the lubricant to the bearing area. In bath oiling, the bearing is run in contact with the journal in an oil bath. This type of lubrication is very economical and requires no attention other than regular inspection of correct oil level, and a periodic draining and refilling of the oil reservoir.

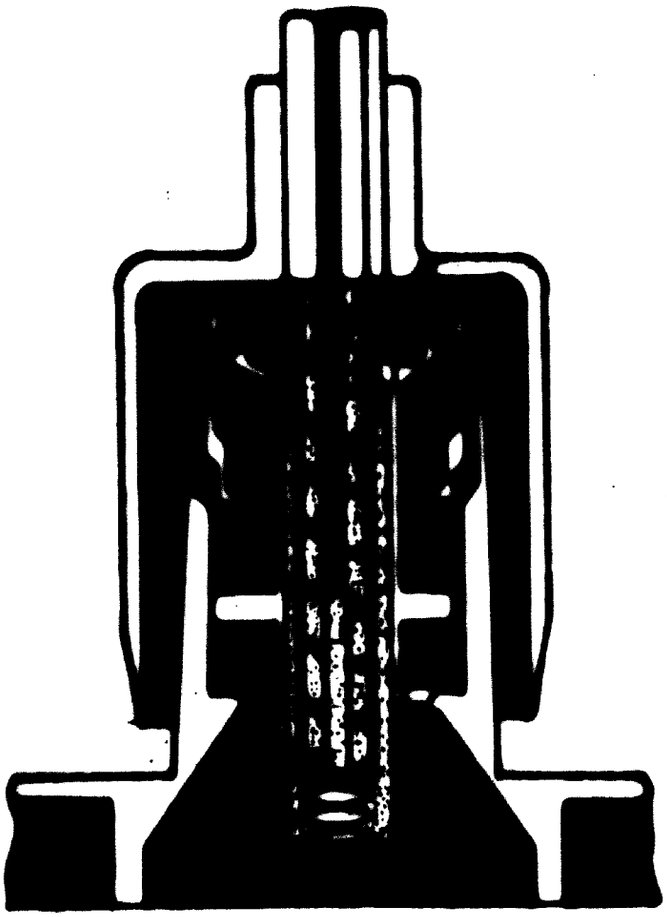

Figure 5

2-9 Bath Oiling for anti-friction bearings

Oil level, when ball or roller bearings use bath lubrication shown in Figure 6, should be maintained so that between 1/3 and ½ of the lowest ball or roller is immersed in the oil. Too high a level results in excess churning of the oil by the rotating parts and results in heat generated by internal friction in the oil itself. This can raise bearing temperatures too high with resultant damage to the bearing parts. On the other hand, if the oil level is allowed to drop too low, insufficient lubrication will result.

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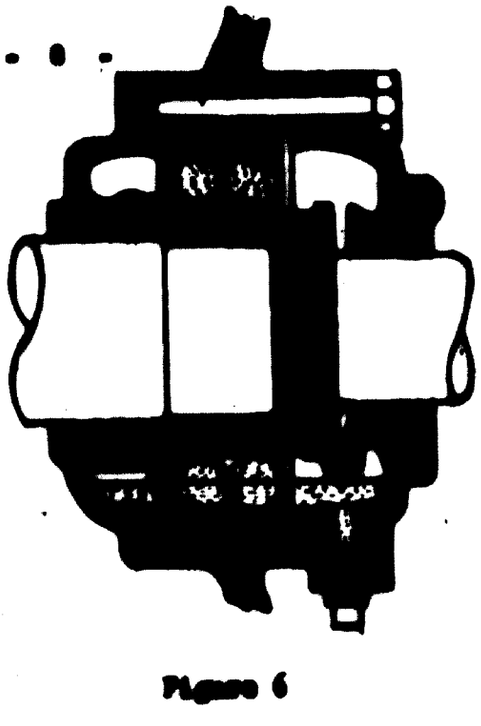

Figure 6

In Figure 7 we see another lubricating system known as the [illegible] System. The rotating and reciprocating parts dip into the reservoir and splash the oil into bearings or into troughs or pipes from which it flows in mist form by gravity to the various parts requiring lubrication.

Here again, proper oil level in the reservoir must be carefully maintained. Regular periodic oil changes must be scheduled to insure good lubrication with clean oil. Schedules of oil changes will depend on operating conditions, and location of the equipment. In dirty or dusty locations, oil changes should be made more frequently than in clean locations.

The splash system is widely used for machinery having cranks, and other moving parts enclosed in oil-tight housings which serve as oil reservoirs. Such machinery includes air compressors, refrigeration compressors, and steam engines.

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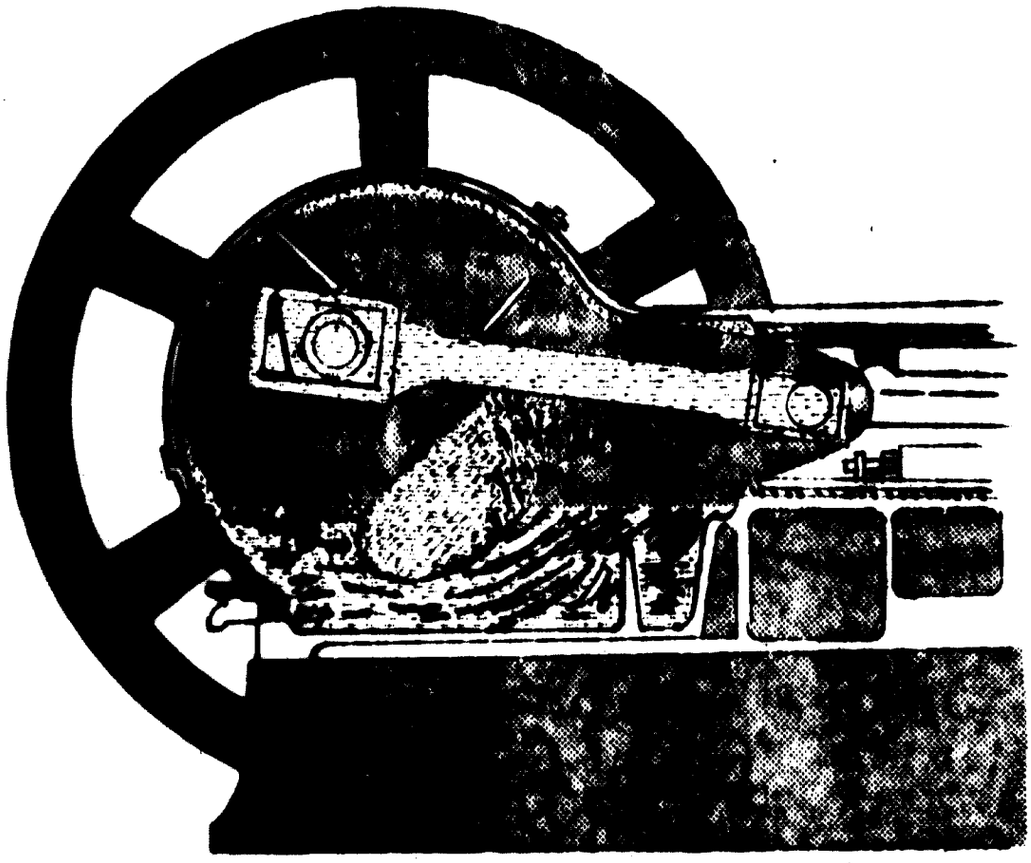


Figure 7

2-11 Conclusion

All of these methods of lubricating that we have just discussed are used for applying oil to single or several bearings, and they are all accomplished by hand or with semi-automatic devices. When we lubricate by some of these methods, it requires considerable time and attention. This is particularly true where large numbers of bearings are involved, and frequent relubrication is required.

3. Oil Cups

3-1

On older types of woodworking machines and transmission the lubricant was fed to the revolving shaft simply through a hole bored through the top of the bearing. On newer machines various types of oil cups which exclude the dust and grit have been devised. Some of the most common of these are shown below.

3-2 Types of oil cups

(a) oil-hole covered with hinged lid

(b) revolving-sleeve oil-hole cover

(c) ball-valve oil-hole cover

(d) oil cup with sight glass

(e) Constant-lever

(f) cover anchored with ball chain

1. Greasing the Bearings

1-1 Introduction

There are a few ways of applying grease to rolling bearings. They are :-

(a) Replenishing of the grease
(b) Repacking the bearing
(c) Flushing and refilling with grease

Usually, the grease in the bearings is replenished at prescribed interval for a period of six months or a year, depending on the loading of the bearings. After that, the bearings are either repacked with grease or flushed and refilled with grease.

1-2 Replenishment of the grease

Replenishment meant addition of fresh grease. The fresh grease can be introduced by either :-

(a) Using a grease gun for housings with nipples
or
(b) Screwing down the grease cups if they are used instead of nipples.

For bearings at high speeds and without relief valves, the addition of fresh grease should be limited to say 15% of the correct charge. Sufficient time must be allowed for this to work its way out before any further injection.

1-3 Repacking the bearings

This method involves :-

(a) Dismounting & cleaning the bearings
and
(b) Packing the assembly with grease

(a) Dismounting & cleaning the bearings

It is most important that the bearings and housings should be absolutely free from dirt. To ensure this, they should be properly washed in turpentine and dried by a clean piece of cloth. For bearings to be operated at high speed, after they are cleaned and dried, they should be dipped in a suitable oil of low viscosity. The oil must be drained off before the bearings are packed with grease.

(b) Packing the assembly with grease

Firstly the bearings must be packed as fully as possible. Next the spaces in the bearing covers are filled with grease. Then about one third to one half of the amount of grease applied to the bearings are removed from the spaces in the bearing covers. This is to ensure

/2...

that excessive grease from the bearings can escape to the spaces in the bearing covers. With the correct amount of grease in the assembly the bearings will run hot for the first hour. Afterwards the temperature will drop to a few degrees above ambient. ⁂ If it does not do so, the machine should be stopped and the bearings allowed to cool; on restarting, the bearings should operate normally. If they still run hot the assembly is overfilled and some grease need to be removed from the covers.

1-4 Flushing and refilling with grease

This method of refilling grease does not involve dismounting the bearings. It is only suitable when flushing is capable of removing all deposits and dirts that may be present. There are two ways in applying this method :-

(a) For bearings with closed covers are removed and the bearing flushed and packed with fresh grease. The used grease in the covers is replaced, leaving an appropriate free space.

(b) For bearings with escape valve and provision for flushing.
These bearings may be refilled by injection of sufficient new grease to displace the bulk of the used grease.

2. Grease lubrication

2-1 Slab

This is the simplest type of greasing method and is used to pack some bearings with grease before assembly. To avoid dirt getting into the bearing, a clean slab should be used in applying the grease.

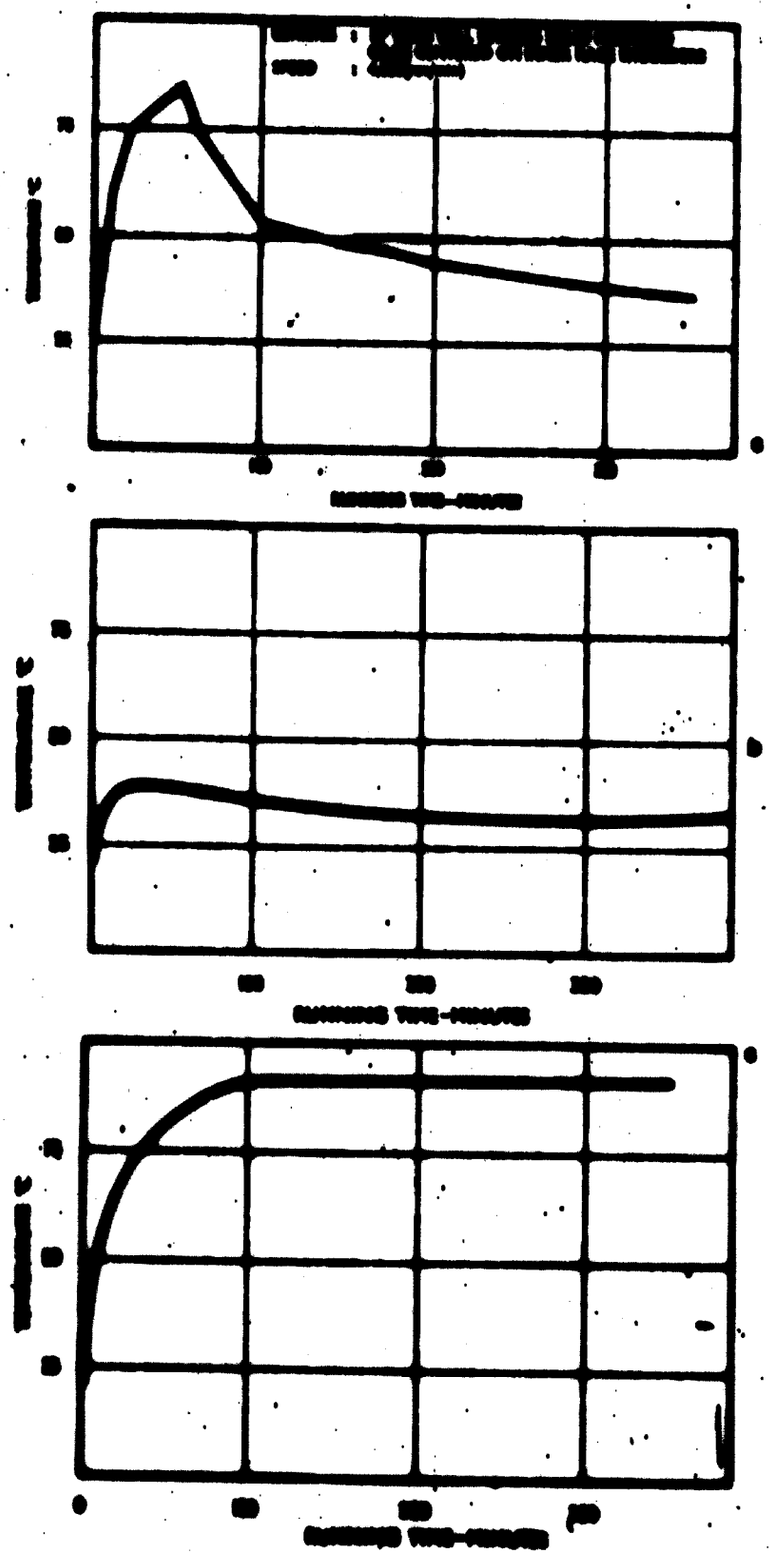
2-2 Compression grease lubricator

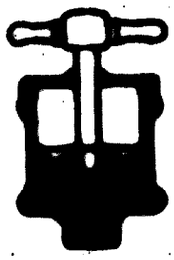
There are two types of compression grease cup, namely, screw-cap lubricator & screw-piston lubricator. These are worked by screwing the cap or piston down to force the grease into the bearing. See figure below.

Screw-cap lubricator

⁂ See diagram

/3...

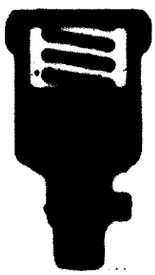




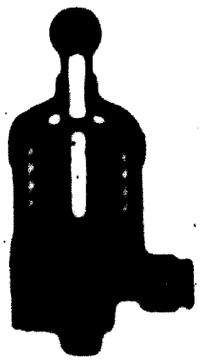
Screw-piston lubricator

3-3
Spring-feed grease lubricators

These work on the same principle as the compression grease cups. The plunger in this case moved down by the force of a spring. The flow of grease is adjusted by a screw in the outlet tube. Sometimes the adjustment is automatic.



Spring-feed lubricator, cap filling



Spring-feed lubricator bottom filling

Measured-shot lubricator

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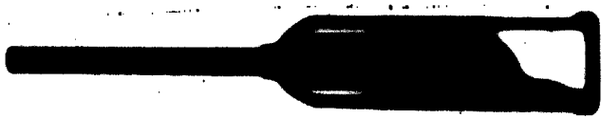
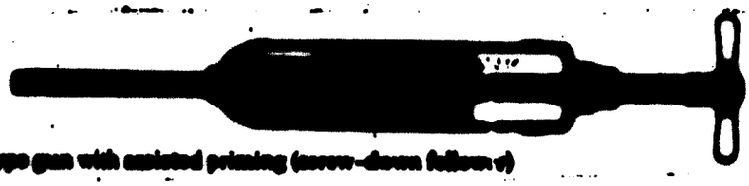
3-4
Grease guns

There are two main types of grease-guns. One is the push-type and the other is the lever-type.

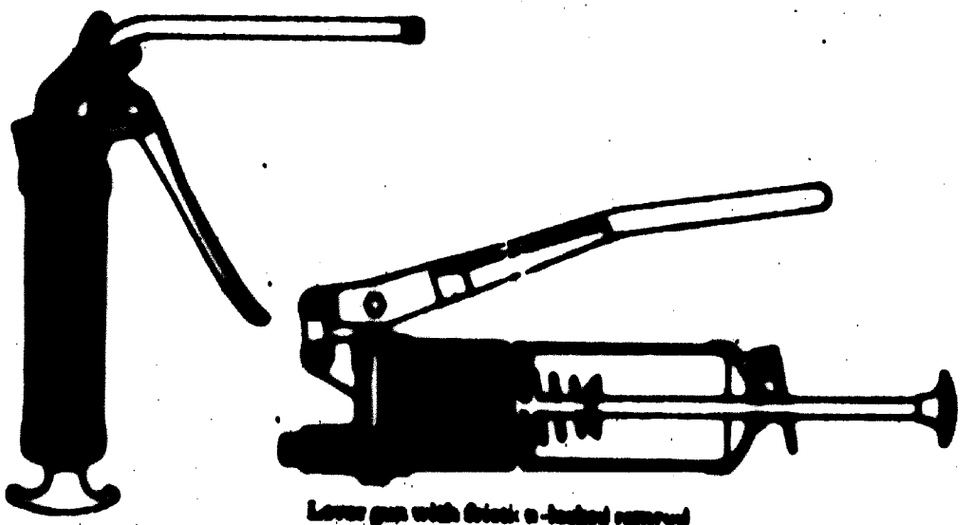


Push-type gun with suction priming



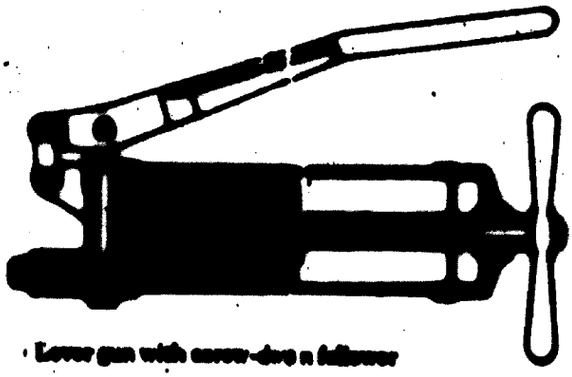
Push-type gun with assisted priming (screw-down follower)

Very often they are with assisted priming e.g. by screwing down a follower piston.



Lever gun with flick o-locked removal

Lever gun with



Lever gun with screw-down follower

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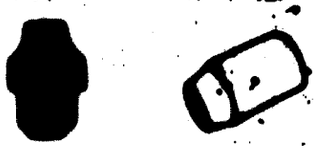
Grease-guns are used in conjunction with fixed grease nipples. They are used for charging the bearings directly as well as charging some spring-loaded grease lubricators.
On filling grease - great care must be taken to exclude air pockets and contamination. It is preferable to fill the gun direct from the container by means of a pump.

2-5
grease nipples and gun-connectors

Various forms of grease nipples and the associated gun connectors have been developed, the common ones are the lubricating plug type and the push-on type.

Lubricating plug

The main difference among the grease nipples is whether the ball valve projects beyond the head.

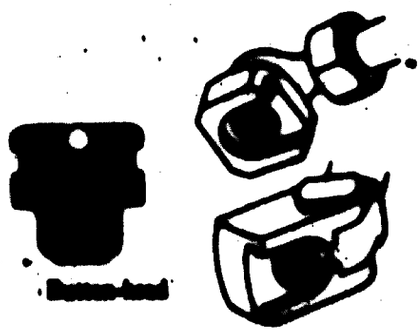


Push-on

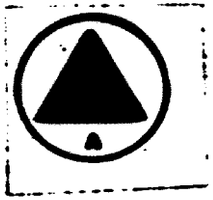
For efficient greasing the correct gun-connector must be used for the various grease nipples.

Hydraulic

M...



The hydraulic, button-head and bayonet type provide better sealing purposes than the nut.

Lubricant Code & Symbol	Lubricant type	Equivalent Lubricant Grades	Lubricant Description & Properties	Lubricant to be used for :
A  (Spindle Oil)	Oil	1. Shell Tellus Oil 15 2. Mobil Velocite Oil 6 3. BP Energol HLP 40 4. Esso Spinesso 34 5. Castrol Hyspin 34 6. Caltex Spindura AA	1. A good quality mineral oil 2. Viscosity : 60 - 70 SSU @ 100° F 3. Contains oxidation inhibitors to prevent gum and varnish formation	1. Ball & roller bearings over 4000 RPM 2. Oil Mist Lubrication 3. Cut spray 4 Air Cylinder
B  (Lubricating Oil)	Oil	1. Shell Tellus Oil 33 2. Mobil Vactra Oil Heavy Medium 3. BP Energol HLP 100 4. Esso Teresso 52 5. Castrol Hyspin 100 6. Caltex Regal Oil PC	1. A good quality turbine type mineral oil 2. Viscosity : 290-330 SSU @ 100°F 3. Contains oxidation inhibitors to prevent gum and varnish formation.	1. Ball & roller bearings under 4000 RPM 2. Plain bearings under 4000 RPM 3. Roller Chains 4. Friction points, ways, slides, etc.
C  (General Purpose Oil)	Oil	1. Shell Tellus Oil 33 2. Mobil Vactra Oil (Heavy Medium) 3. BP Energol EM 125 4. Esso Coray 50 5. Castrol Magna ED 6. Caltex Aleph Oil	1. A straight mineral oil where long periods of continued use is not required and an inexpensive oil is desired. 2. Viscosity : 290 - 330 SSU @ 100°F	1. Roller chains 2. Friction points, ways, slides, etc.

Lubricant Code & Symbol	Lubricant type	Equivalent Lubricant Grades	Lubricant Description & Properties	Lubricant to be used for :
D  (Hydraulic Oil)	Oil	1. Shell Tellus Oil 27 2. Mobil D. T. E. Oil Light 3. BP Energol HLP 65 4. Esso Terresso 43/NUTO H64 5. Castrol Hyspin 70 6. Caltex Rando Oil A	1. A high quality hydraulic oil 2. Viscosity : 140 - 160 SSU @ 100°F A high viscosity index is essential 3. High Chemical stability - contains anti-oxidation agents 4. Foam resistance - contains anti-foam agents	Low pressure hydraulic systems
E  (Worm Gear Oil)	Oil	1. Shell Macoma 82 2. Mobil 600W Cylinder Oil 3. BP Energol AC 600-C 4. Esso Cylesso TK 140 5. Castrol Cresta VA 6. Caltex Merope Lubricant No. 6	1. A high quality industrial gear oil capable of withstanding extreme pressure conditions 2. Viscosity : 140 - 180 SSU @ 210°F 3. Contains 5 to 10% animal fat	1. Enclosed worm gears
F  (Gear Grease)	Grease	1. Shell Simmia Grease 'O' 2. Mobil Grease 400 3. BP Energrease HTO 4. Esso Beacon EP 1 5. Castrol Impervia MS6O Grease 6. Caltex Marfak No. O	A high quality long fibre, soda soap grease of semi-fluid or 'O' consistency	1. Enclosed spur gears 2. Enclosed worm gears

Lubricant Code & Symbol	Lubricant type	Equivalent Lubricant Grades	Lubricant Description & Properties	Lubricant to be used for :
G 	Grease	1. Shell Alvania Grease 2 2. Mobilux Grease 2 3. BP Energrease LS2 4. Esso Multi-purpose Grease H 5. Castrol spheerol AP1 Grease 6. Caltex Marfak Multi-purpose No. 2	1. A high quality water-resistant multi-purpose grease 2. A lithium soap grease of No. 2 consistency	1. Ball & roller bearings over 4000 RPM 2. Plain bearings 3. Exposed screws & gears
H  (General Purpose Grease)	Grease	1. Shell Alvania Grease 3 2. Mobilux Grease 2 3. BP Energrease LS 2 4. Esso Fibrax 200 5. Castrol spheerol S Grease 6. Caltex Marfak 2 HD	1 A high quality water-resistant multi-purpose grease 2 A fibrous type grease between Nos: 2 & 3 consistency	1. Ball and roller bearings under 4000 RPM 2. Plain bearings 3. Exposed screws & gears 4. Reaching sectional roll sections

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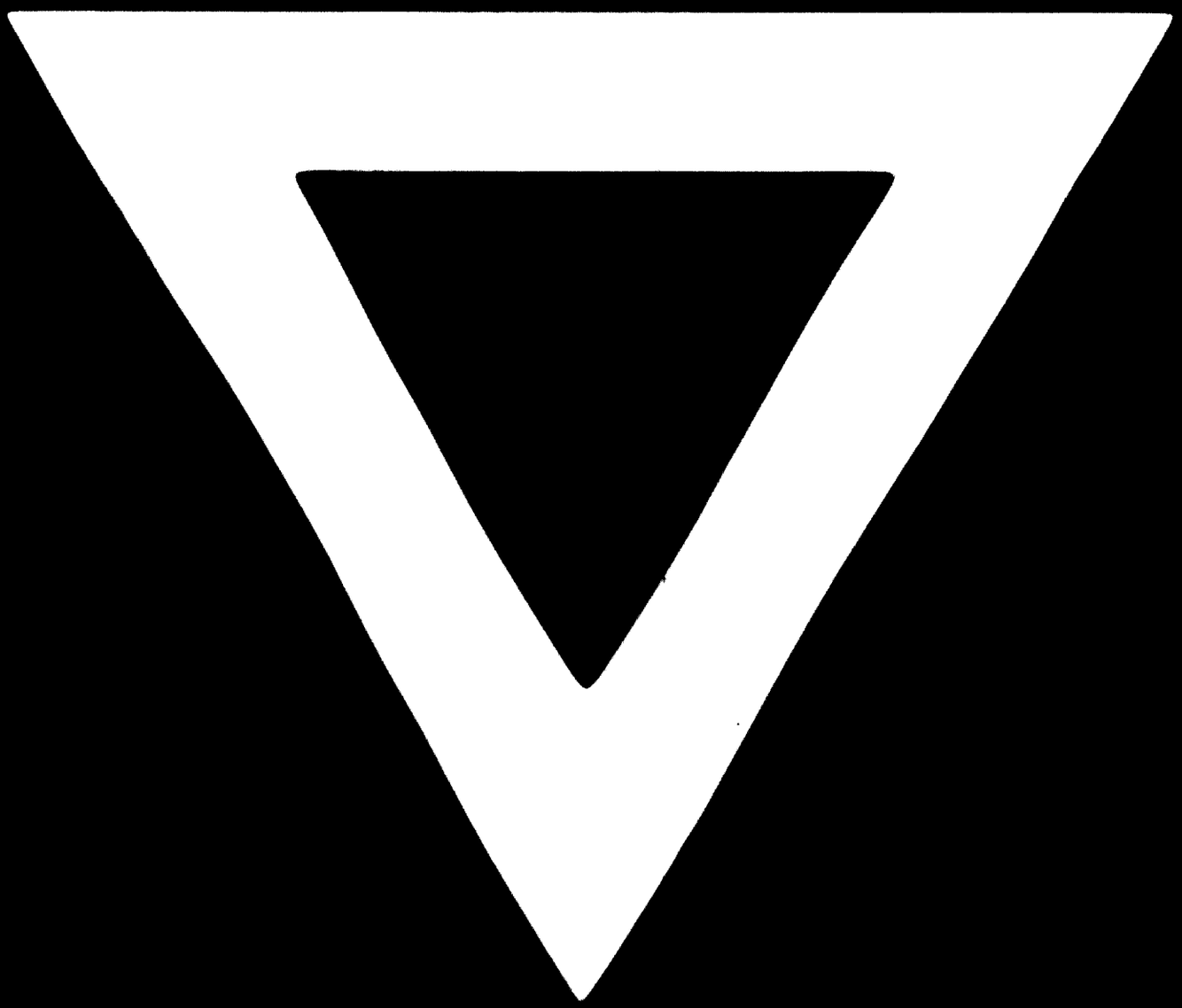

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