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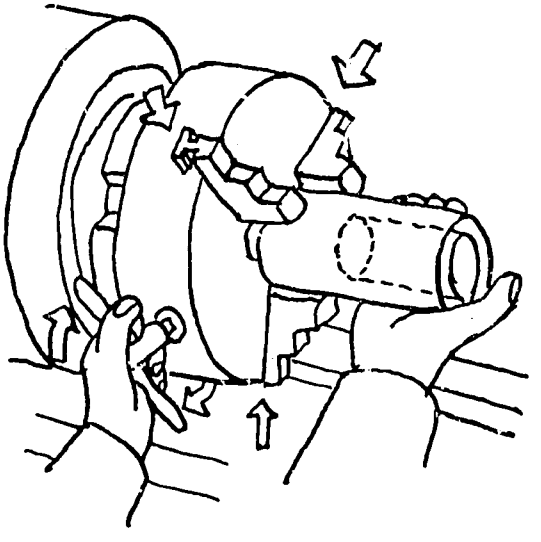
কর্মশিবির অনুশীলনী

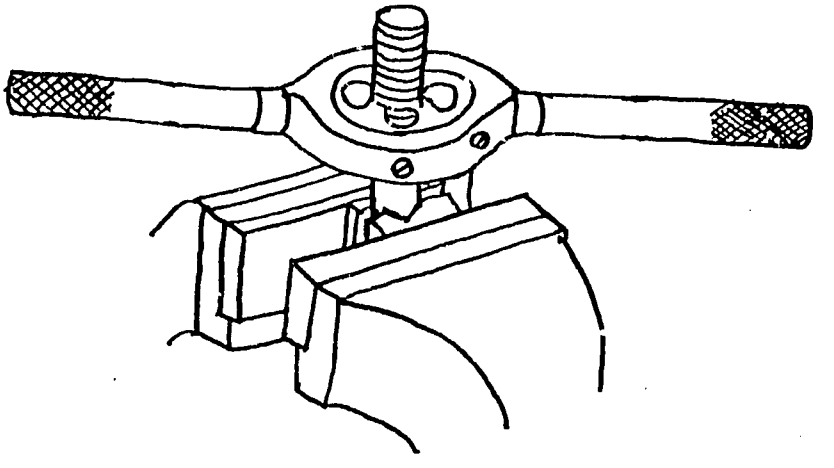
WORKSHOP PRACTICE

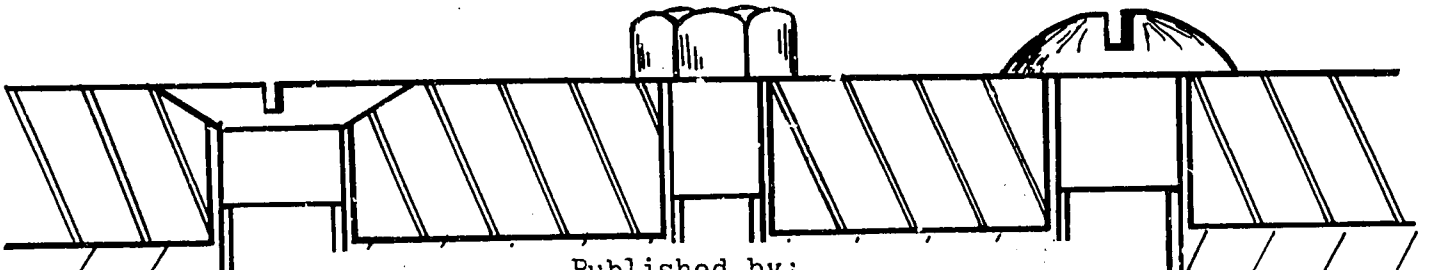
A MANUAL FOR
ENGINEERING INSTRUCTORS

BY
JIM BYRNE MALCOLM WILLIS

©







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FOREWORD

For the want of a nail, a horseshoe was lost.
For the want of a horseshoe, a horse was lost.
For the want of a horse, a rider was lost.
For the loss of a rider, a battle was lost.
All for the want of a horseshoe nail.
(Poor Richard's Almanac 1757)

Technologies, "hard,""soft," and "intermediate" operating separately and in combination are used increasingly in Bangladesh. From its inception, ADAB has sought to identify those technologies which are "appropriate" for agricultural development, bearing in mind the surfeit of rural labour, the relative scarcity of western raw materials and natural resources, and the poverty of the average villager.

"Hard" technology is employed for instance in the Taejgoan (Dacca) machine shops and manufacturing plants, in the large jute mills in Khulna, in the deep-well projects of the Northwest and in those TCCAs which rent tractors and power tillers to members of cooperative societies. The deep tubewell and tractor technologies are appropriate provided they are used on projects farmed cooperatively and/or on a "block" basis. However the lack of spares and especially the shortage of trained operators, mechanics and maintenance personnel evidences a shortage of skilled labour appropriate to the technology. This shortage of skilled personnel has made a once appropriate technology, totally inappropriate, as demonstrated by machines, tractors, trucks, pumps, etc. laying idle and rusting throughout the country.

The average small farmer employs the same labour-intensive "soft" technology used by his grandfather. Few such farmers can afford the simple "intermediate" types of machines and farming implements being produced by the Comilla Cooperative Karkhana.

The employment of any level of technology presupposes that someone can "fix" it when it goes wrong. In most every village there is a person who can repair the simple traditional farming implements. But when we move to the "intermediate" level the "know how" and the repair facilities are in short supply. In today's Bangladesh there is a shortage both of competent instructors in technology and of instructional materials for trainees.

WORKSHOP PRACTICE was produced while the authors were instructing would-be mechanics and their technical trainers. No suitable training materials being available, they created their own. Thus this book was produced of necessity, after having been revised on the basis of "feed-back" from trainees. It is being offered to the training profession as the missing "nail" which hopefully will enable them to do a more adequate job of instructing the technicians Bangladesh needs to maintain its machines.

CONTENTS

PAGE

1. Introduction ..... 1.

2. Preparing Visual Aids..... 4.

3. Bench Fitting Educational Materials..... 6.

4. Developing Workshop Exercises..... 25.

5. Developing Machineshop Material..... 34.

6. Preparing Machineshop Exercises..... 59.

7. Preparing Lesson Plans..... 64.

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ACKNOWLEDGEMENTS

We wish to thank all those people, international and Bangladeshi, who made the publication of this manual possible. As it is merely the first shot of its type in a war against technical backwardness which must continue for a long time to come, we hope that similar assistance will be afforded to those combattants who follow us.

In particular we would like to thank Dr. Winburn T. Thomas for publication, and Ms. Nancy M. Straughan for editorial assistance.

Mr. Habibur Rahman and Mr. Bupendro C. Mondal, craft instructors in machineshop and bench-fitting at the Marine Diesel Training Centre, Narayanganj, were most helpful in facilitating the introduction of the educational system outlined in this manual and in experimenting with improvements and modifications.

The imported publications on mechanical engineering, teaching techniques, workshop practice, etc., which stimulated the work included in this manual are too numerous to list. However, we would like to acknowledge in particular the usefulness of the complete range of Engineering Industry Training Board (UK) manuals on mechanical engineering and workshop practice.

Translation of the visual aid materials into Bengali was efficiently provided by Mr. Abdur Rob and Mr. A. Aziz (M), who are both instructors at the Marine Diesel Training Centre, Narayanganj.

Jim Byrne & Malcolm Willis

*

I. INTRODUCTION

This pamphlet was produced to meet the objectives set below. It was prepared on a budget of 250 Taka, (£10 sterling or $US 15), up to the point of printing, and completed in one week.

Neither of the authors has any developed technical skills in the field of printing, and no technical assistance was sought.

Objectives

The objectives of this pamphlet are based on experiences gained by the authors over the course of 1977 whilst designing and setting up a machine shop course at the Marine Diesel Training Centre, Narayanganj, as part of an ILO/NORAD project.

They are:

1.. To provide some basic visual-aid information sheets for use in workshop instruction.

2. To demonstrate the fact that the production of "home-made" educational materials is cheap and relatively easy, using resources already available to most training centres.

3. To emphasise the need for relevance(or appropriateness) in the design of workshop exercises and the outline of the course.

4. To develop among instructors the ability to integrate theory and practice, i.e. the ability to link everything from the blueprint, through the operation sheet to the lesson plan.

5. To begin, in a very small way, to provide the means of establishing teaching/learning standards in vocational education.

Cheap and Easy

The materials used in preparing this pamphlet are mostly available at all training centres: A4 paper, a pencil, a 12" ruler (or scale), two small bottles of library paste, a pair of scissors, a ball-point pen and a duplicating machine. The only item which is not likely to be available is a felt-tip pen, which can be bought for 10 Taka, (75¢ or 40p).

One of three approaches may be followed in preparing visual-aids.

(a) Information sheets could be produced as in the the case of those shown in this pamphlet, using electro-stencils.

(b) A wax stencil could be used, or

(c) Display sheets drawn on large sheets of paper card, (say 3 feet by 4½ feet), could be developed; bound in a wooden holder at the top and hung on a blackboard easle.

(See explanation in Section 2. "Preparing Visual Aids").

The cost of system (c) in the first year would be substantially the same as the wax stencil system, but would fall to half in the second year because system (c) materials are reusable. At the end of five years it would be 1/5th of the cost of the wax stencil system, but would probably need to be completely replaced at that point.

The authors estimate the cost of implementing the three systems, described in the next section, at 1,000 - 500 and 100 Taka respectively, ($66, $33 and $6), per course per year.

Appropriate Technical Education

Appropriate technology is a fluctuating concept. What is appropriate for a village workshop will not necessarily be appropriate for a modern training centre. The technological needs of a training centre in Bangladesh will differ from the needs of, say, a European centre.

In a society where most of the private working of metal utilizes hand tools, and where huge quantities of modern equipment are left to rust for want of proper maintenance, the emphasis must be on the technology of maintaining a modern workshop/machineshop.

The skills to be developed must include:

(a) A solid foundation in the use of hand tools for the production of parts for use in the workshop.

(b) Practical experience in the use of machine tools for the production of equipment useful for maintaining and developing the workshop.

(c) Coil winding and the repair of electrical circuits and fuses.

(d) Machine maintenance, including oiling and greasing, cleaning, aligning and adjusting parts, etc.

In short, the student must develop a harmony with the machine shop environment comparable to the farmer's raport with nature and his draught animals. No farmer would leave an ox without water for a day - indeed the animal is even washed with a startling frequency. But instructors and students from the same family will leave a machine without oil - not for a day or a month, but for many years. The machines die of thirst and abuse.

The Brinell Hardness number ? - or how to use a hammer

Instructors have at the moment no established stock of educational material from which to teach skills. There is not an integrated system of instruction (including related theory). This is a great disservice to the student who wants to learn practical skills and a waste of educational investment. At the same time, in theory class, under the present "system", the student who does not yet know how to hold a hammer correctly may be "learning" about Brinell Hardness numbers, because the instructor, who is completely unguided, will teach subjects in which he is interested.

The student who leaves a training centre with a thorough training

in basic metal working will develop his skills in industry. The one who acquires only superficial knowledge of advanced exercises or learns advanced theory and very little practical skill, will not last as an employee in a workshop.

This pamphlet advocates and elaborates a system of integrated educational materials development, geared to the needs of appropriate technical education and with the aim of avoiding discontinuous, patchy, education.

Basically it consists of:

(a) Examining the workshop environment to establish what items of equipment are required which can be made by the student.

(b) Preparing a drawing.

(c) Preparing an Operation Sheet from the drawing, on the basis of the instructor's knowledge of the skill breakdown.

(d) Incorporating the skill breakdown into lesson plans.

In this way the related theory classes will be in line with the students' needs; the work of the student will be appropriate to the needs of his environment, and the work of the instructor will have an efficient structure, which will raise the standard of education in his section.

In addition, it will give the academic leadership a measure of control which currently is lacking.

Standards

The implementation of the system outlined here would establish an initial, general standard:

> "Students will gain experience in all production processes necessary for the maintenance and development of their workshop."

From this crude standard, learning objectives can be set, and the standard could be modified over time to suit the requirements of manufacturing industry.

It is the opinion of the authors, though not necessarily that of any organisation with which we are associated, that the provision of expensive equipment, and textbooks in the English language, to local training centres, is not nearly so helpful as assistance with self-help programmes, initiated and implemented by the competent authorities in technical education circles in Bangladesh.

This pamphlet is a contribution in that direction.

Jim Byrne

Malcolm Willis

December 1977

2. PREPARING VISUAL AIDS

The production of information sheets of the type in this pamphlet is a cheap and easy method of providing visual aids to technical students. Two methods may be used. Both start from the same point.

1. Take a number of technical textbooks which cover the subject you want to teach.

2. From the information in your curriculum, mark those sections which are relevant to your course.

3. Within those sections, mark the drawings which you think would be of greatest educational value in simplifying the subject for the student.

4. Prepare a rough sketch or a tracing of those drawings.

5. Modify the text to suit the new form of the visual display.

Now follow Method 'A' or 'B'

Method 'A' (cheap)

6. Take a wax stencil, (e.g. Gestetner) and spread it open on a sheet of glass, with the brandnamed side uppermost.

7. Place a sheet of black carbon paper over the waxed sheet.

8. Place your sketch or tracing over the carbon sheet and trace over the lines lightly with a pencil. (This will transfer an image of the drawing on to the waxed sheet..

9. Remove the drawings and carbon sheet..

10. Place the carbon sheet under the waxed page of the stencil with the carbon side facing up.

11. Take a ballpoint pen and draw over the image carefully but firmly until clear black lines come through from the carbon sheet below. (A ruler or scale should be used for all straight lines).

12. When all the drawings are complete, the text and title of the information sheet can be typed on the waxed stencil.

13. The stencil is then "run off" on a duplicating machine. (Produce enough copies for one or two years.)

(Rough estimate of the cost of this system: About 500 Taka per course per year).

Method 'B' (expensive)

6. Take a sheet of good quality white paper.

7a. Either trace the drawing on to it, or

7b. Sketch the drawing lightly with a dull pencil. Then draw over the sketch marks with a ball point pen and rub out the pencil lines.

8. When the drawings are complete, type in the text and title. (The title can also be drawn on with a felt tip pen.

9. Place the sheet of paper, which is now referred to as a "master", on the drum of a stencil cutting machine and cut an electro-stencil.

10. The stencil is then run off as in point 13 of method 'A'.

(Guestimated cost of this system: 1,000 Taka-plus per course per year.)

If neither of the above approaches are appropriate, because they involve having access to duplicating machines and their soft-ware, an even cheaper method can be used. This involves producing teaching charts instead of information sheets. Steps 1 through 5 above will remain the same:

Method 'C' (cheapest)

6. Take a sheet of stiff white card, (or thick paper), about 3 feet by 4½ feet, and pin it to a drawing board or table top.

7. With a dull pencil, mark out the sheet to suit the desired layout.

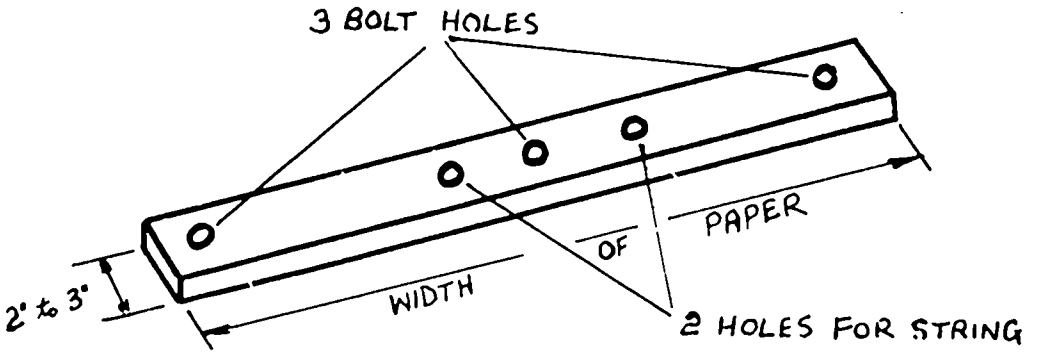
8. Again with a pencil, sketch in the drawings and draw in guidelines for the text.

9. Take a felt-tip pen and complete the drawings. (All straight lines should be done with a ruler (scale), but circles, arcs, etc., can be fabricated.)

10. Again with the felt-tip pen, write in the text in Bangla.

11. The pencil lines should be rubbed out carefully several hours later.

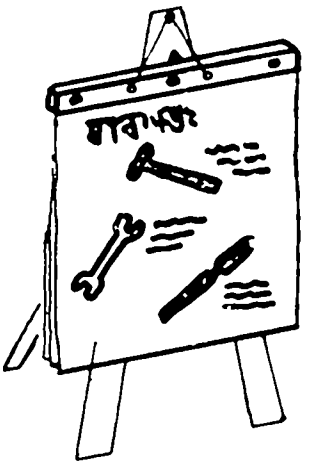
12. Prepare a drawing for a teaching chart holder with the following features:



Two of these can be cheaply made by a carpenter. Three suitably sized bolts and two feet of string will complete the holder.

13. When a selection of teaching charts on a particular subject have been completed, they are placed between the two batons of the holder. Three holes are punched through the card with a sharp object. The three bolts and nuts are used to clamp the holder and the teaching charts together.

14. When the string has been tied in the remaining holes, the set of charts may be hung on a blackboard easel for display.



3. BENCH FITTING MATERIAL

Some of the drawings in this section are originals by Malcolm Willis. Others he developed from a number of modern publications which emphasise the use of visual aids in technical education. The text was developed by both authors.

The information sheets contained here constitute about 25% of those developed for a six month course in bench fitting. The information sheets to be developed are a matter of judgement on the part of the instructor. He will know which processes, operations, nomenclature, etc., he has difficulty teaching by verbal instruction.

The yardstick to be used in deciding whether to produce visual aid information sheets is:

(a) Will it simplify the process of learning for the student, or

(b) is it necessary that the student have a record (reference/ memory jerker, etc.,) for use at a later date, either during training or in his working life.

It is intended that the information sheets contained here should serve as examples of reasonably well produced amateur visual aids which meet the aims of :

(a) minimising text, and
(b) maximising visual clarity,

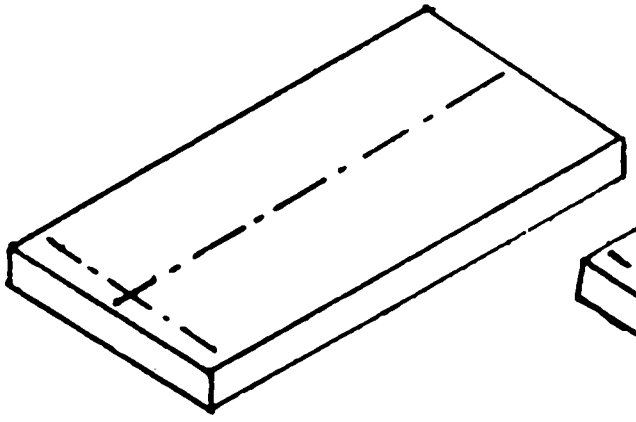
apart from being a basic stock of educational material on which training centres can build.

The instructor should examine this section critically. He should examine the difference between sheets. He should ask himself: How much of the material is instructive; how much descriptive ? Are the pictures memorable ? Clear ? Could I develop better sheets ? If he is not interested in developing educational materials he should put this pamphlet back in the drawer and return to his present confusion. He will gain nothing by reading the pamphlet unless he wants to work on educational materials, or someone else makes him work on it.

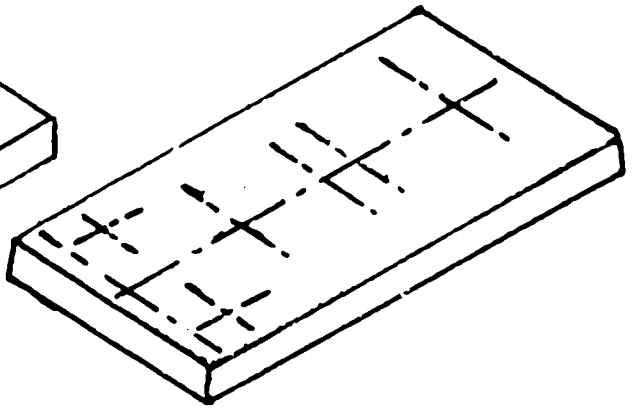
***

MARKING OUT PROCEDURE

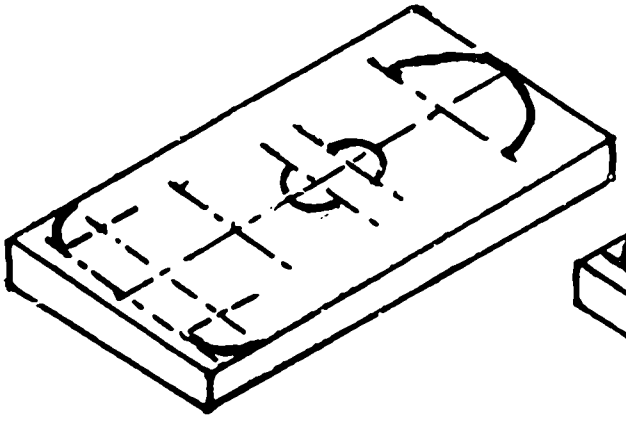
দাগাংকন পদ্ধতি



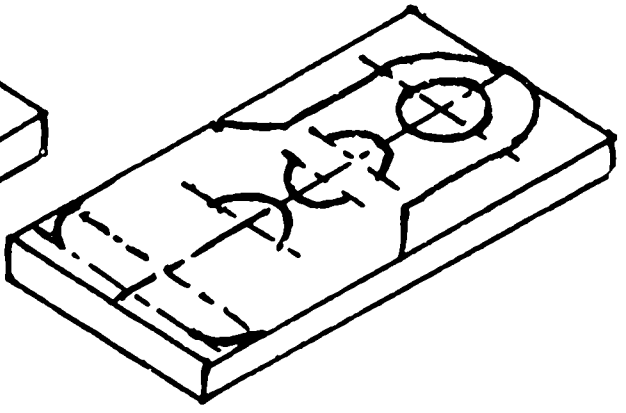
ভূরেখা নির্ণয় কর এবং দাগ কাট ।



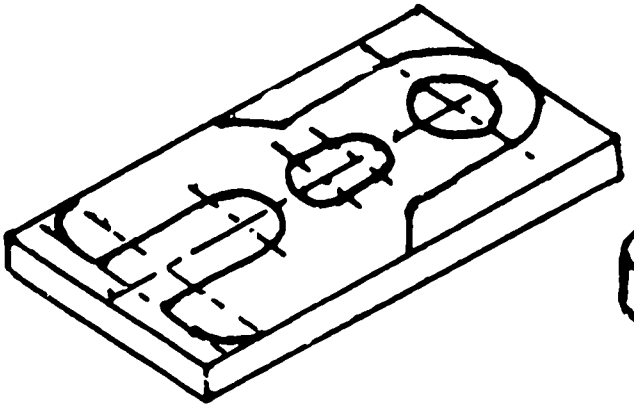
সমস্ত বৃত্ত এবং চাপের কেন্দ্র রেখা নির্ণয় কর ।

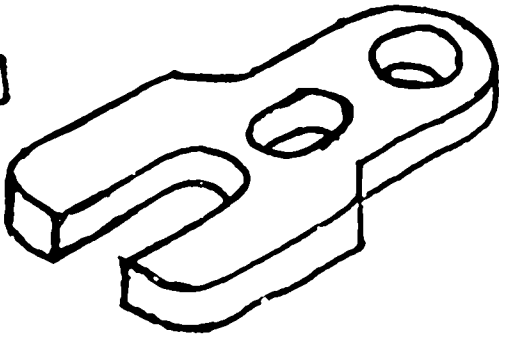


সমস্ত বৃত্ত ও চাপ গুলি অংকন কর ।



কৌনিক রেখা গুলি বাহির করিয়া অংকন কর ।



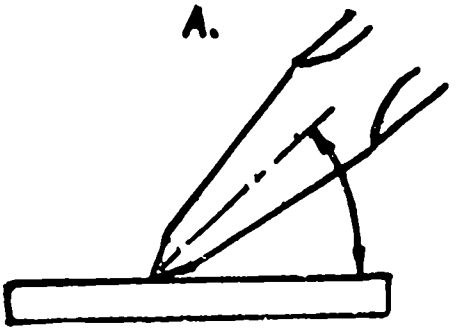


যখন দাগাংকন শেষ হইবে তখন প্রকৃত কাজের স্বরূপ ফুটিয়া উঠিবে কিন্তু চোখের দৃষ্টিতে চেক করা যথেষ্ট নহে । সমস্ত মাপ, কোন, ব্যাসার্ধ ইত্যাদি ব্লু প্রিন্টের সহিত মিলাইয়া দেখিতে হইবে ।

INTRODUCTION TO CHISELS

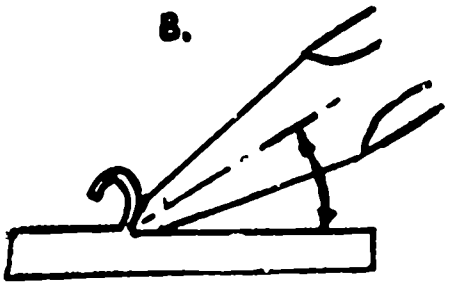
ছেনির সহিত পরিচিতি ।

A.



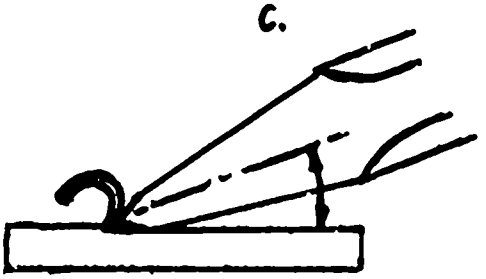
কাটন আরম্ভ ।

B.



ইপ্সিত গভীরতায় কাটা সংরক্ষন ।

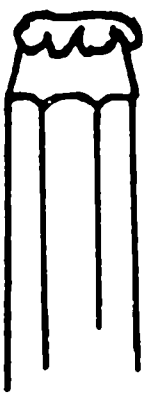
C.



ছেনিকে পর্য্যায় ক্রমে উপরে নীচে চালনা করিয়া
কাটন সংকির্ন করুন :-

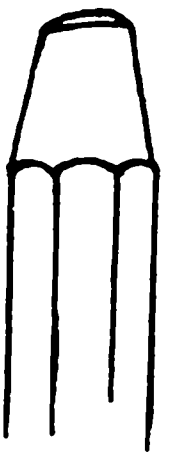
ছেনির কেন্দ্রিয় রেখা এবং কাজের সাথে যে কোন উৎপন্ন হইবে, উহা বিশেষ গুরুত্ব পূর্ন এবং ইহা কাজের সাথে সঠিক ভাবে রাখিতে হইবে ।

D.



বেংগের ছাতার মত মাথা বিশিষ্ট ছেনি বিপদ জনক ।

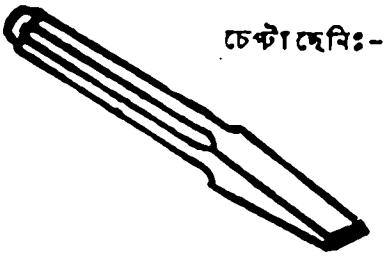
E.



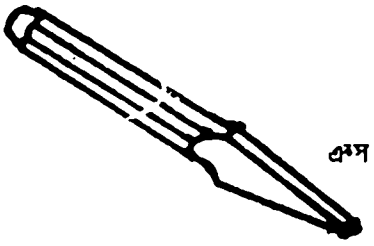
সমতল মাথা বিশিষ্ট ছেনি নিরাপদ ।

TYPES OF CHISELS AND THEIR USES

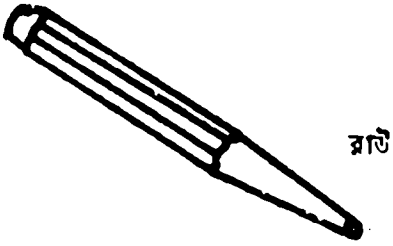
ছেনির প্রকারভেদ ও তাহাদের ব্যবহার ।



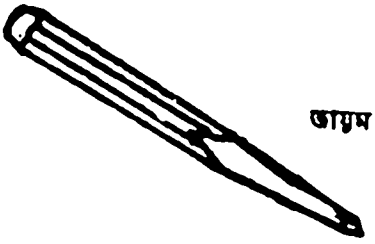
চেপ্টা ছেনি:- ইহা সাধারন কাটা ছেড়ার কাজে ব্যবহৃত হয় ।



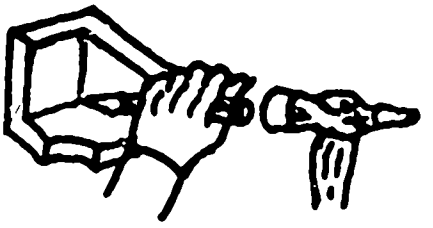
এস কাট ছেনি :- (কেইপ ছেনি) খাঁজ কাটিবার জন্য ইহা ব্যবহার হয় । চেপ্টা ছেনির তোল অপেক্ষা ইহার তোল বেশ চিকন ।



রাউন্ড নোজ ছেনি :- ব্যাসার্ধ অথবা বিয়ারিংয়ের মধ্যে গর্ত অর্থাৎ তৈল প্রবাহের নালা কাটিবার জন্য ব্যবহৃত হয় ।



ডায়মন্ড পয়েন্ট ছেনি :- প্রধানতঃ কোনকে সঠিকভাবে কাটিবার জন্য ব্যবহৃত হয় ।



ডায়মন্ড পয়েন্ট ছেনির সাহায্যে একটি কোনকে ঠিকভাবে কাটিয়া তোলা হইতেছে ।

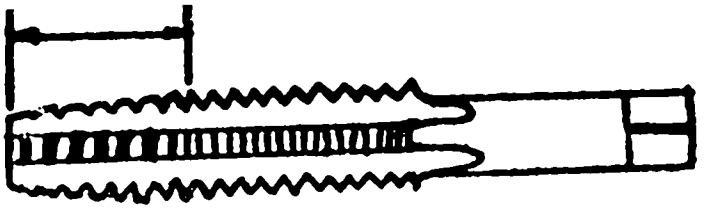
এস কাট ছেনির সাহায্যে একটি খাদ কাটা হইতেছে ।

TAPPING AND SCREWING

ট্যাপিং এবং স্ক্রুয়িং ।

প্রথম ট্যাপ (লম্বা সরু অংশ বিশিষ্ট)

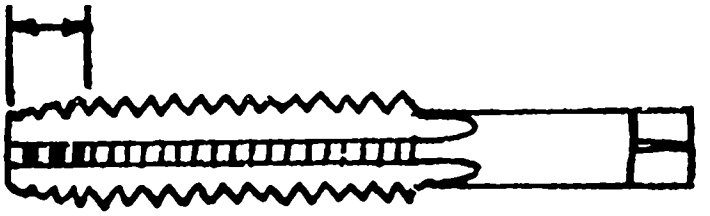
৮ হইতে ১০ পেঁচ ক্রমশঃ সরু ।



প্রথম যে ট্যাপ ব্যবহৃত হয় তাহা ৮ থেকে ১০ পেঁচ ক্রমশঃ সরু । ইহার অর্থ এই যে সম্পূর্ন পেঁচ ধীরে ধীরে কাটা হয় ।

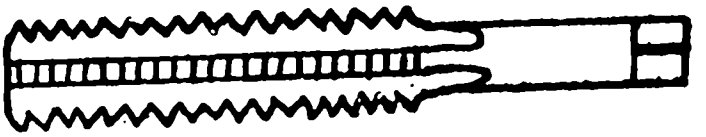
দ্বিতীয় ট্যাপ (কম সরু অংশ বিশিষ্ট)

৩ হইতে ৪ পেঁচ ক্রমশঃ সরু ।



দ্বিতীয় ট্যাপ হিসাবে যে ট্যাপ ব্যবহৃত হয় উহাকে মধ্যম ট্যাপ বলা হয় । ইহার অগ্রভাগের দুই তিন প্যাঁচ ধার মুক্ত থাকে । দ্বিতীয় ট্যাপ প্রকৃতপক্ষে একটা গর্তের আগাগোড়া শেষ করিতে পারে ।

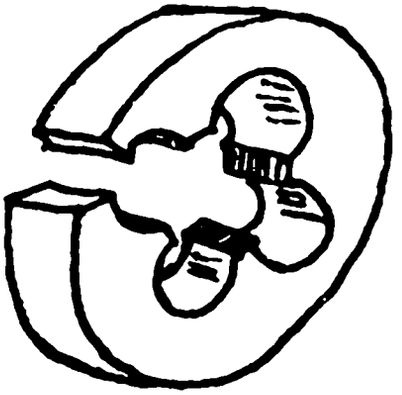
তৃতীয় ট্যাপ (কোন সরু অংশ নাই)



প্লাগ ট্যাপের শেষ পর্যন্ত পুরা মাপের অসরু প্যাঁচ আছে এবং ইহা প্রধান পরিসমাপ্তি করন ট্যাপ । অছিদ্র একটি গর্তের ক্ষেত্রে অবশ্যই প্লাগ ট্যাপ ব্যবহার করিতে হইবে ।

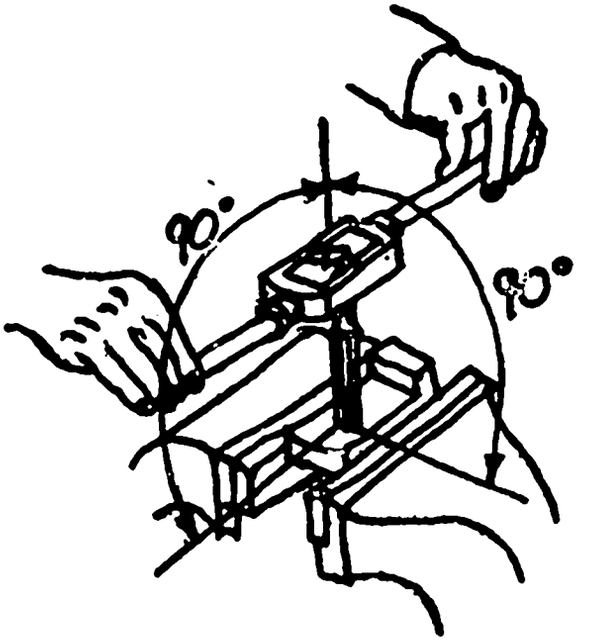
TAPPING AND SCREWING - II

ট্যাপিং এবং স্ক্রুয়িং



একটি ডাই নাট

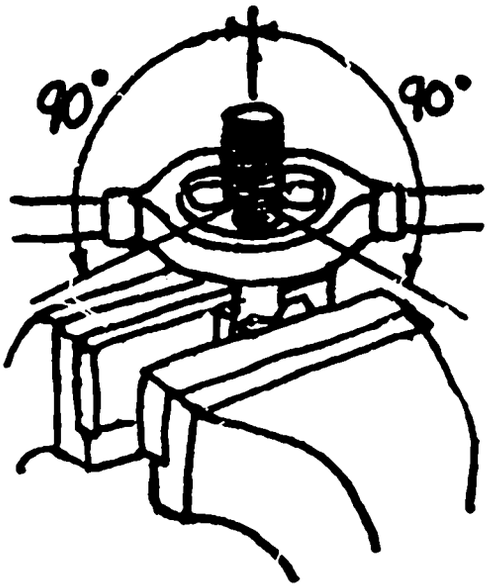
ইহা বাহিরের দিক দিয়া প্যাঁচ কাটিবার জন্য ব্যবহৃত হয় । ডাইটি ডাই ষ্টকের ভিতরে বসানো হয় যাহা নিম্নে দেখানো হইল ।



ট্যাপের ব্যবহার

যে প্যাঁচ কাটিতে হইবে সেই প্যাঁচের কোর ডায়মেটারের মাপের সমান করিয়া একটি গর্ত্ত ড্রিল করিতে হইবে ।

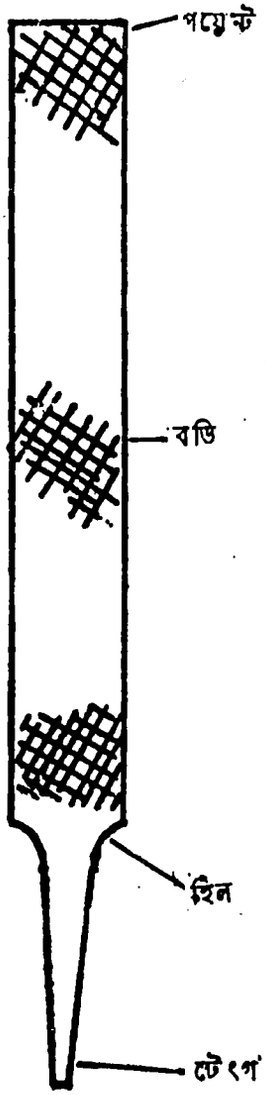
ট্যাপ অবশ্যই ওয়ার্কিং পিসের সহিত ৯০° তে থাকিতে হইবে । অবশ্যই কাটিং ফ্লোইড (অথবা ট্যাপিং কম্পাউন্ড) ব্যবহার করিতে হইবে ।

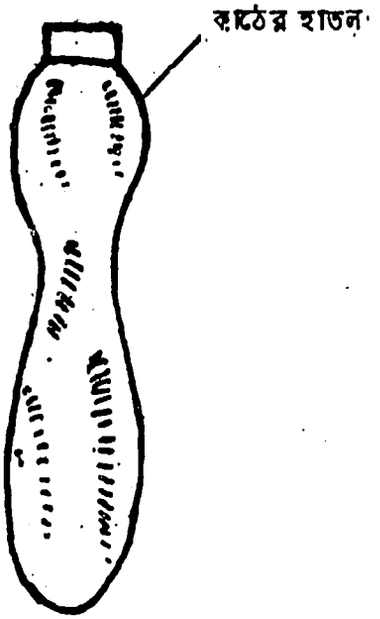


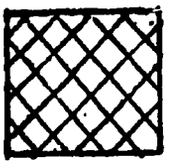
ডাইসের ব্যবহার :

ওয়ার্কিং পিস ডাইসের ভিতর অবশ্যই খাড়া ভাবে থাকিতে হইবে । বার এর এক্সিস এর সহিত সঠিক ভাবে প্যাঁচ আরম্ভ করিতে বিশেষ যত্ন নিতে হইবে । কাটিং ফ্লোইড অবশ্যই ব্যবহার করিতে হইবে ।

HAND FILES হ্যান্ড ফাইলস ।

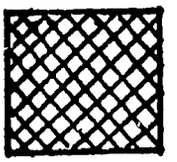






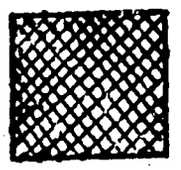
রাফ ফাইল ।

রাফ কাজের উপর হইতে মেটালকে তাড়াতাড়ি অপসারিত করে ।



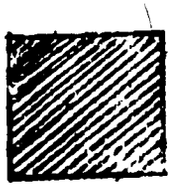
ব্যাসটার্ড ফাইল ।

যেখানে ভাল ফিনিসিং এর প্রয়োজন হয় না সাধারনতঃ সেখানেই ব্যবহৃত হয় ।



সেকেন্ড কাট ফাইল ।

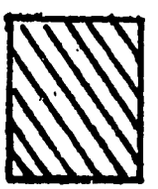
ইহা অধিকাংশ কাজে উপযুক্ত স্মোথ ফিনিস দেয় ।



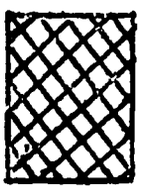
স্মোথ ফাইল ।

ইহা অত্যন্ত স্মুথ পলিস্ড ফিনিস দেয় ।

বিভিন্ন প্রকারের ফাইল কাট ।



সিংগেল কাট

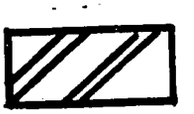


ডাবল কাট

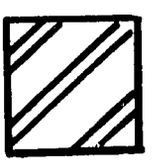
র‍্যাস্প

ফাইল গঠন আকৃতি ।

ফ্লাট বা চেপ্টা



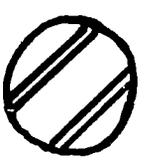
পিলার



স্কোয়ার বা চারকোনা

থ্রি স্কোয়ার

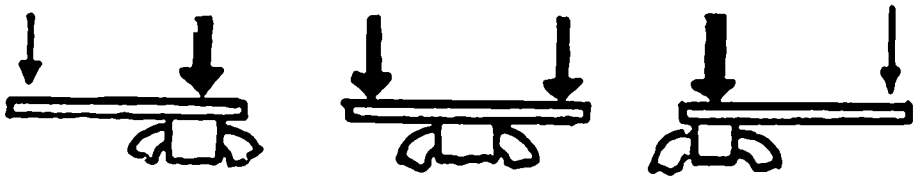
হাফ রাউন্ড



রাউন্ড

FILES AND FILING ফাইলস্ এন্ড ফাইলিং ।

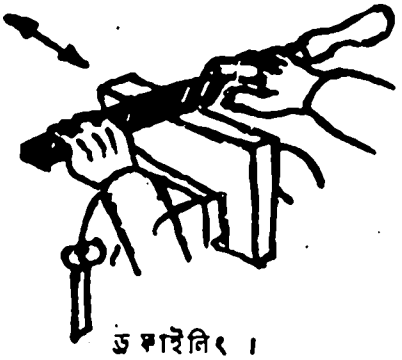
ফাইলিং এ সঠিক প্রেসার বা চাপ ।



প্রারম্ভে	অর্ধ ভাগে	স্ট্রোক এর শেষ
ফাইলের অগ্রভাগে অধিক প্রেসার বা চাপ ।	ফাইলের উভয় প্রান্তে সম চাপ ।	ফাইলে হিল বা গোড়ালিতে অধিক চাপ ।

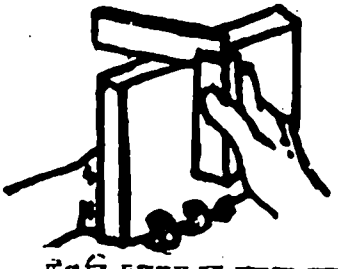
এই ভাবে ফাইল চেপ্টা ভাবে কাটিবে ।

ছাত্রদের আরামের জন্য এবং ভাল কাজের জন্য সঠিক ভাবে দাড়ানো অবস্থায় সব সময় মানিয়া চলিতে হইবে ।



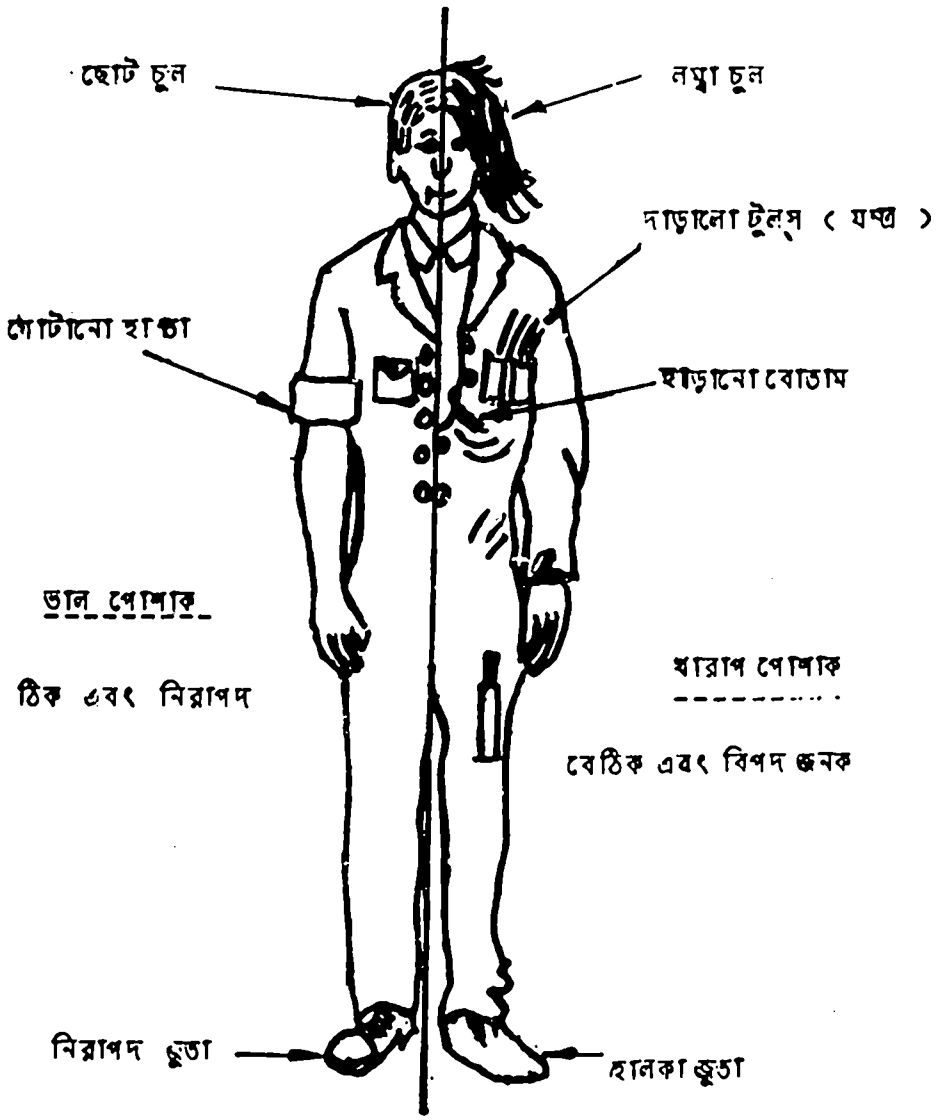
ড ফাইলিং ।

এস ফাইলিং ।



উপরি ভাগের স্ক্রেপার ব্যাস এবং ফ্ল্যাটনেস পরখ করিয়া নেওয়া ।

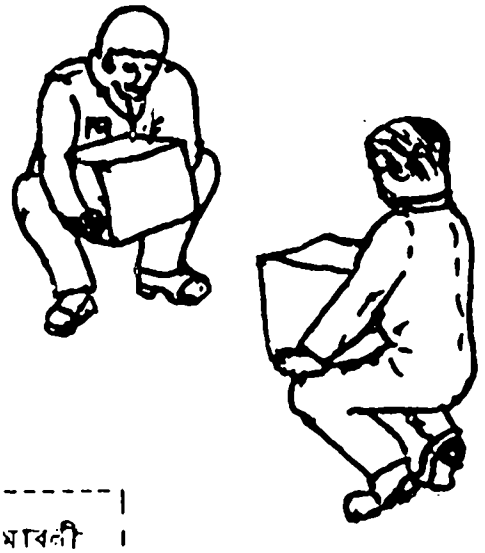
WORKSHOP SAFETY – I ওয়ার্কসপ সেইফটি - ১



সব সময় গগল্স ব্যবহার কর ।

WORKSHOP SAFETY – II ওয়ার্কসপ সেইফটি ।

পিটের উপর ভর না করিয়া
পায়ের উপর ভর করিয়া উঠাও ।



মেশিন সেইফটির জন্য সাধারন নিয়মাবলী

যখন মেশিনে কাজ কর তখন সর্বদা গার্ড ব্যবহার কর ।

যখন মেশিনে কাজ কর না তখন অবশ্যই সুইচ্ বন্ধ রাখিবে ।

মেশিন চালাইবার পূর্বে সব সময় ইহার ব্যবহার সম্বন্ধে নিশ্চিত হইতে হইবে ।

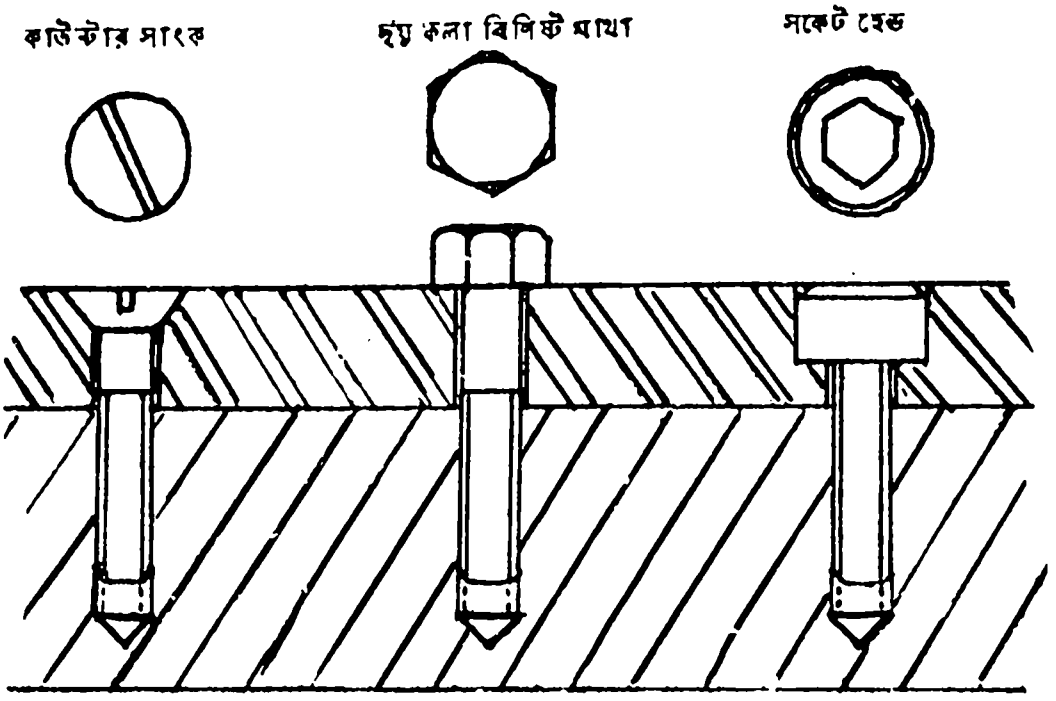
কখনও ওয়ার্কসপের ভিতরে খেলিবে না ।

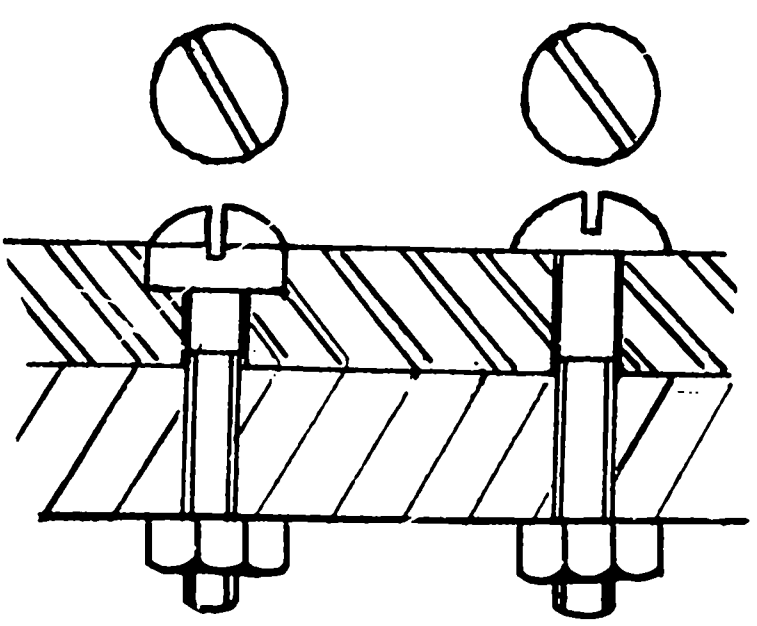
যদি সন্দেহ হয় জিজ্ঞাসা কর ।

NUT AND BOLT FASTENING

নাট এবং বল্টস বাধানো পদ্ধতি ।

বিভিন্ন প্রকারের বল্টস্ ।

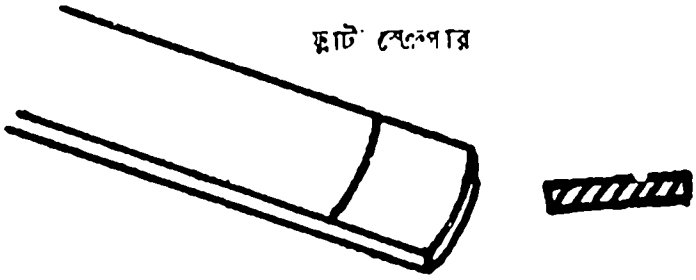




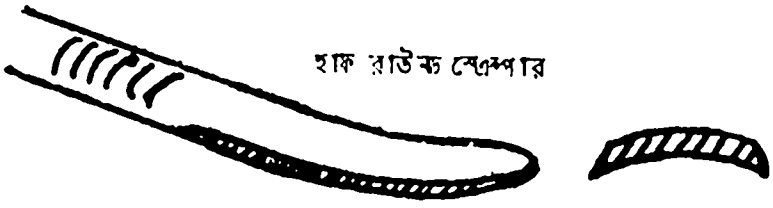
এই পাঁচ প্রকারের বল্টস গুলি সব চেয়ে বেশী প্রচলিত । ইহাদের প্রত্যেকটিই বিভিন্ন আকারের বিভিন্ন দৈর্ঘ্যের ও বিভিন্ন প্যাচের হইয়া থাকে । বল্টের সাহায্যে দুইটি ধাতব প্লেটকে সংযোজন করার পদ্ধতি উপরের চিত্রে দেখানো হইয়াছে । এই গুলি উপরের প্লেটের ক্লিয়্যার্ড হোলে (ছিদ্র) এর ভিতর দিয়ে ফিট করিয়া নিচের প্লেটের থ্রাইন্ড হোলে বল্টের স্ক্রুর প্যাচ ঘুরাইয়া লাগান হয় । দ্বিতীয় চিত্রে অতিরিক্ত জোর দেওয়ার জন্য নাটস্ ব্যবহৃত হইতেছে ।

SCRAPERS AND SCRAPING স্ক্রেপারস্ এবং স্ক্রেপিং ।

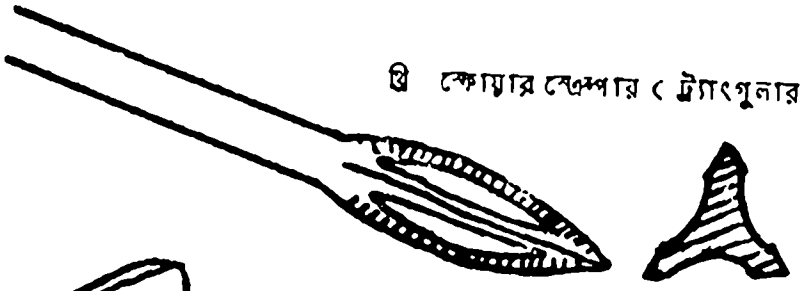
ফ্লাট স্ক্রেপার

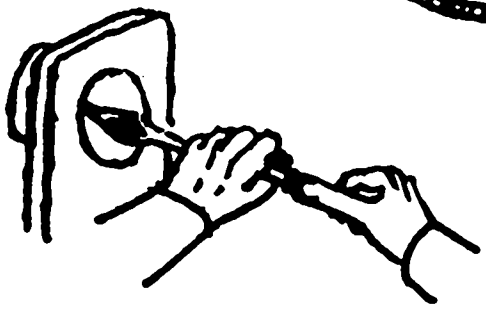


হাফ রাউন্ড স্ক্রেপার

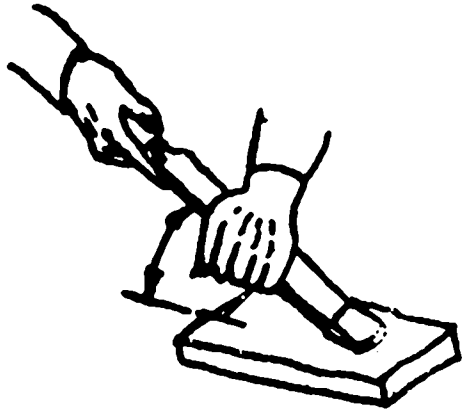


থ্রি স্কোয়ার স্ক্রেপার (ট্র্যাংগুলার স্ক্রেপার) ।

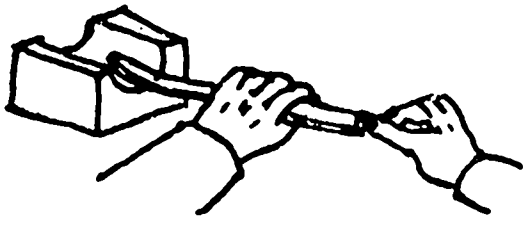




ভিতরের সারফেস এ (যেমন বিম্বারিং) ব্যবহৃত হয় ।

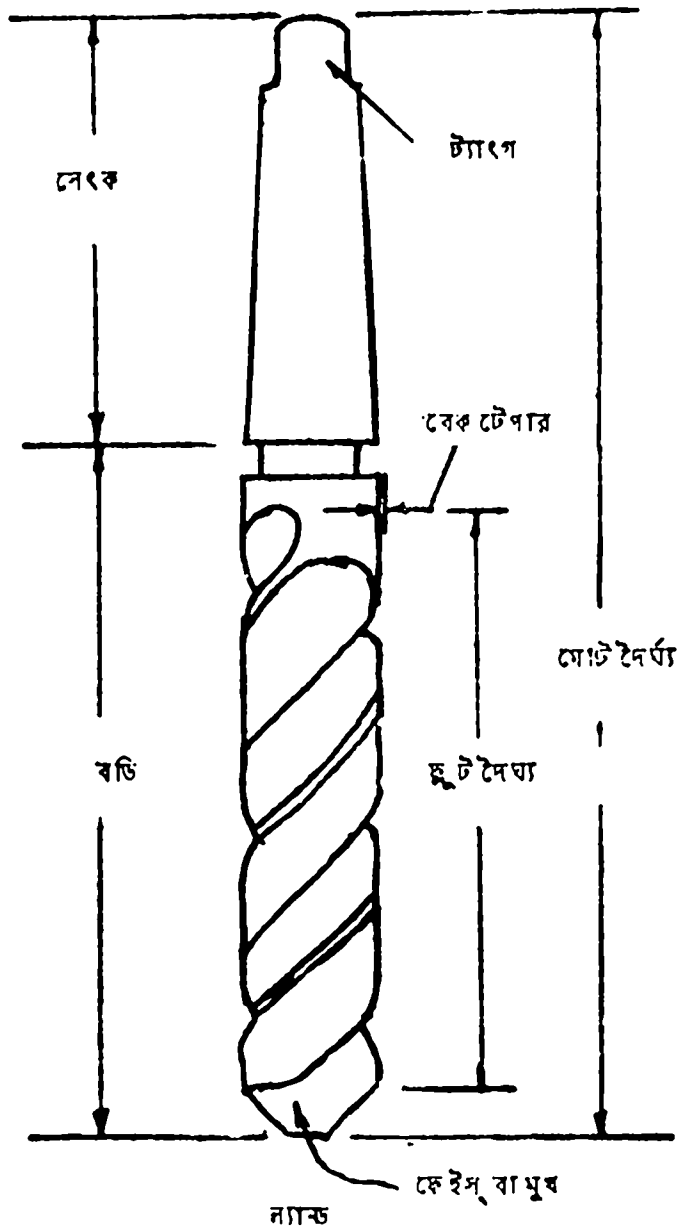


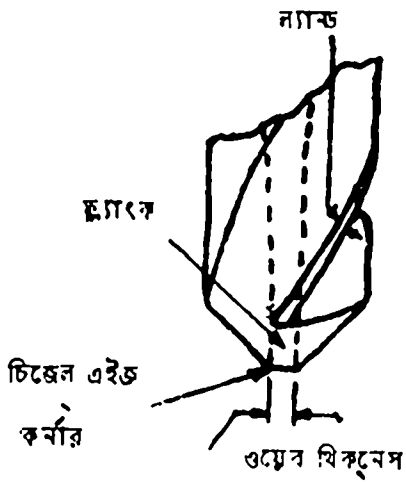
ফ্লাট স্ক্রেপারস্ ফ্লাট সারফেস এ ব্যবহৃত হয় ।

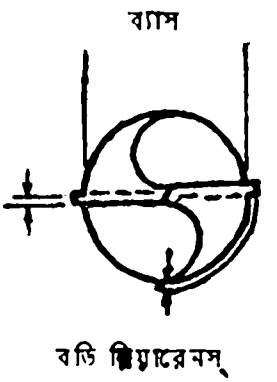


হাফ রাউন্ড স্ক্রেপারস্ আভ্যন্তরিন সিলিন্ড্রারিকেল সারফেস্ এর ব্যবহৃত হয় ।

DRILLING AND REAMING - I ড্রিলিং এন্ড রিমিং ।



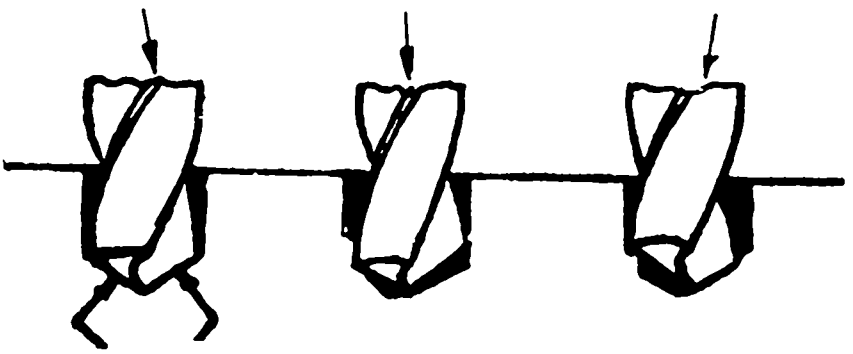




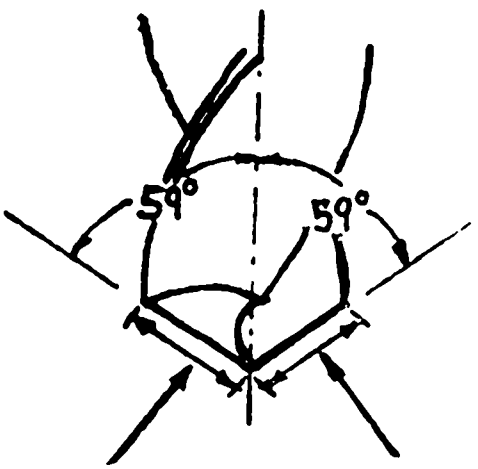
DRILLING AND REAMING - II ড্রিলিং এন্ড রিমিং - II

ড্রিলকে অবশ্যই সঠিক ভাবে গ্রাউন্ড করিতে হইবে । তাহা না হইলে ইহা সঠিক ভাবে কাটিবে না ।

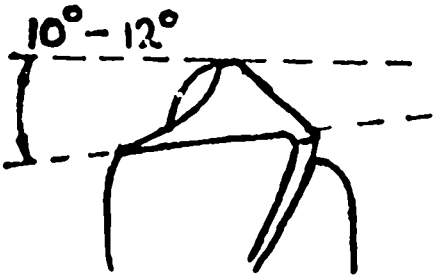
সঠিক লিপস বিভিন্ন কোনে লিপস বিভিন্ন দৈর্ঘ্যে লিপস



লিপস্



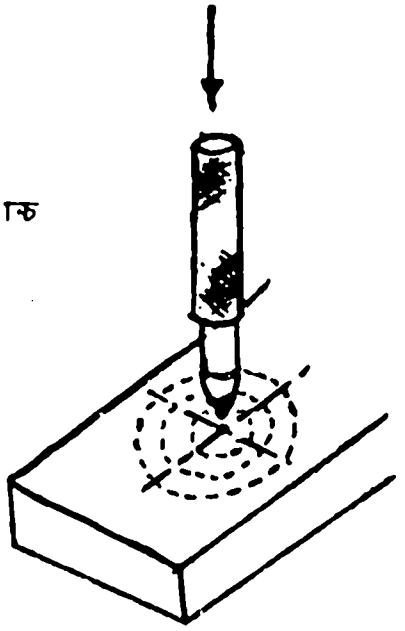
এই দুইটি দৈর্ঘ্যে অবশ্য সমান হইতে হইবে ।



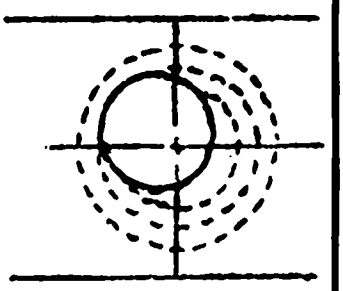
ক্লিয়ারেন্স কোন

DRILLING AND REAMING – III ড্রিলিং এন্ড রিমিং – III

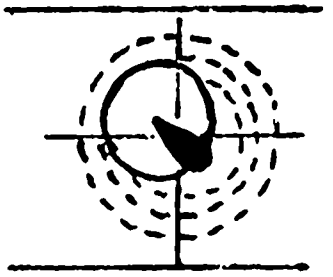
ড্রিলিং এর জন্য হোল দাগাংকন ।



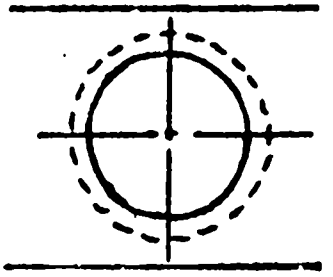
ড্রিলকে কেন্দ্রে ফেরৎ আনয়ন ।



ড্রিল কেন্দ্রের বাহিরে



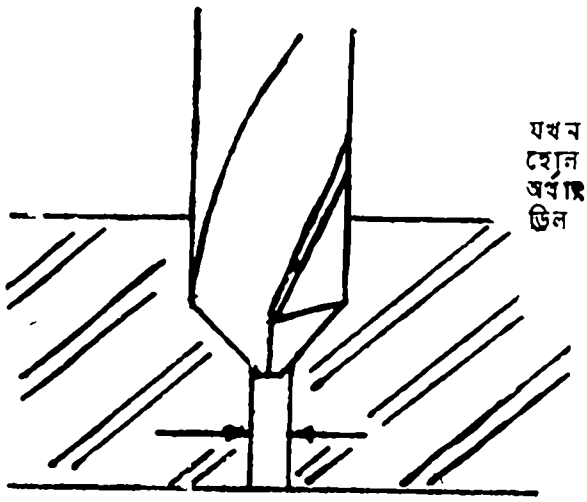
ইহাকে কেন্দ্রে ফেরৎ আনিবার জন্য ছেনির সাহায্যে গ্রোব কাটন



ড্রিল এখন কেন্দ্রে ফেরৎ আসিয়াছে ।

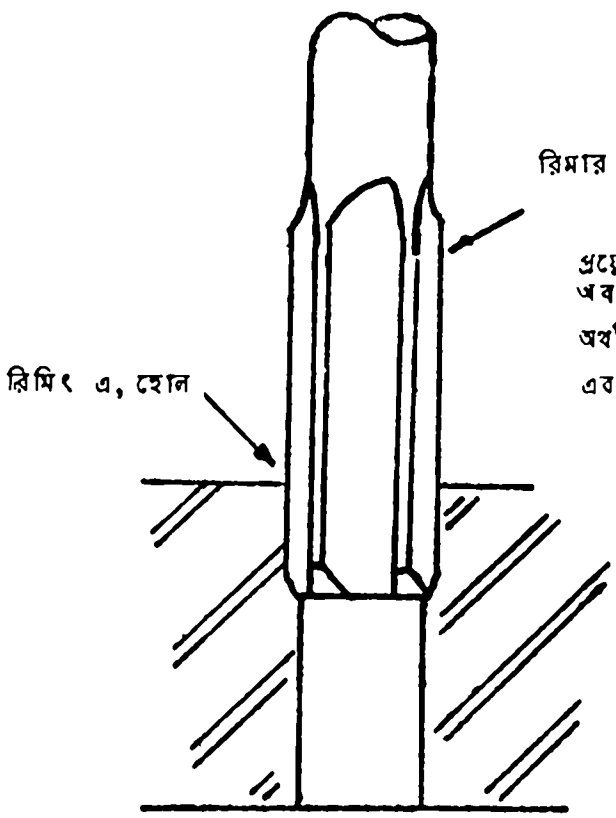
DRILLING AND REAMING - IV ড্রিলিং এন্ড রিমিনিং - IIII

বড় হোলের জন্য ড্রিলিং



যখন বড় ড্রিলের প্রয়োজন হয় তখন পাইলট হোল ব্যবহৃত হয় ।
অর্থাৎ $1\frac{1}{2}$ ড্রিলড্ হোলের জন্য $\frac{1}{8}$ পাইলট ড্রিল ।

রিমিং



প্রয়োজনীয় রিমারের সাইজ হইতে $\frac{1}{64}$ কমে হোল অবশ্যই ড্রিল করিতে হইবে ।
অর্থাৎ $\frac{3}{4}$ রিমার ড্রিল $\frac{31}{64}$ তারপর রিমার কাটিবে এবং ভাল ফিনিসিং পাওয়া যাইবে ।

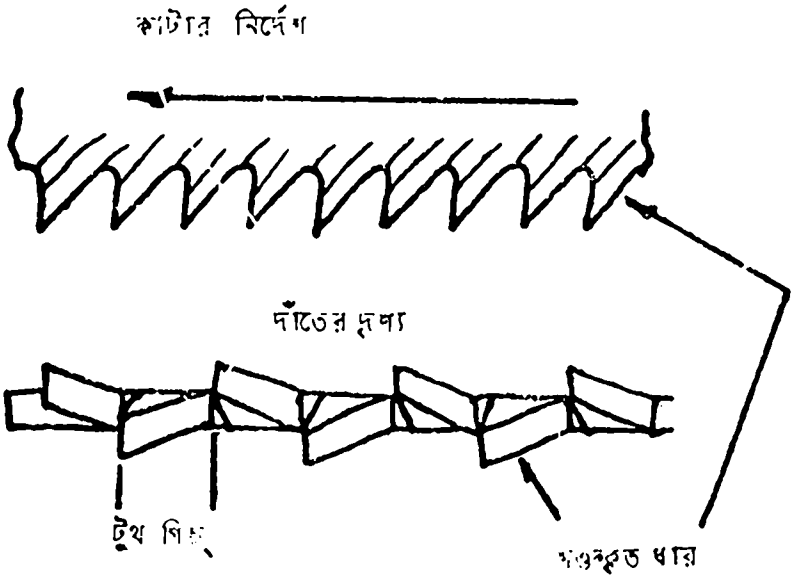
DRILLING & TAPPING

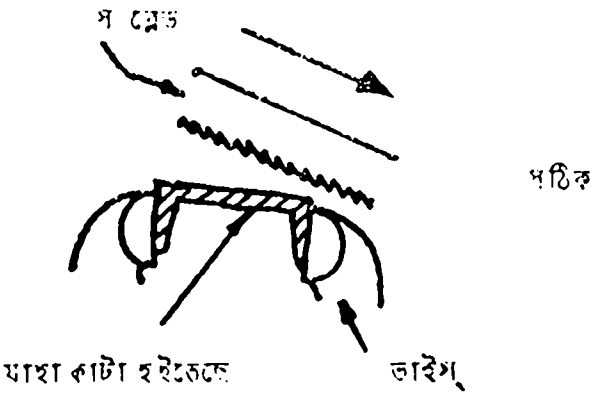
DRILL SIZES FOR TAPPED AND CLEARANCE HOLES

Tap Size	Threads per inch of tap	Tapping Drill		Clearance Drill	
	British Standard Whitworth (B.S.W.)				
1/8"	40	3/32"	2.55mm	1/8"	3.30mm
3/16"	24	9/64"	3.70mm	3/16"	4.90mm
1/4"	20	13/64"	5.10mm	1/4"	6.50mm
5/16"	18	1/4"	6.50mm	5/16"	8.10mm
3/8"	16	5/16"	7.90mm	25/64"	9.70mm
7/16"	14	23/64"	9.30mm	29/64"	11.30mm
1/2"	12	13/32"	10.50mm	33/64"	13.00mm
	British Standard Fine (B.S.F.)				
3/16"	32	5/32"	4.00mm	3/16"	4.90mm
1/4"	26	13/64"	5.30mm	1/4"	6.50mm
3/8"	20	21/64"	8.30mm	25/64"	9.70mm
7/16"	18	3/8"	9.70mm	39/64"	11.30mm
1/2"	16	7/16"	11.10mm	33/64"	13.00mm
3/4"	12	21/32"	16.75mm	49/64"	19.25mm

From the table above you can establish the correct drill to use before tapping a hole, and the drill sizes for clearance holes.

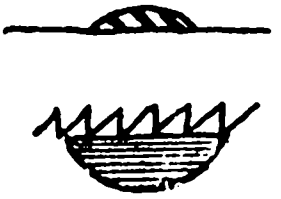
HACKSAWING - I হ্যাকসইং-।





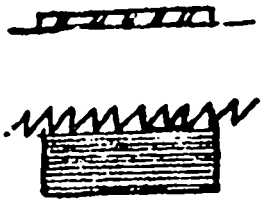
30° কোনে সব সময় কাটা আরম্ভ কর।

HACKSAWING - II হ্যাকসইং - II



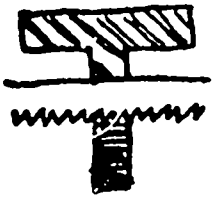
যথেষ্ট চিপ ক্লিয়ারেন্স

ব্রাস, ব্রাস নরম স্টিল কাস্ট আইরন এর মত নরম পদার্থের জন্য প্রতি ইঞ্চিতে ১৪ দাঁত ।



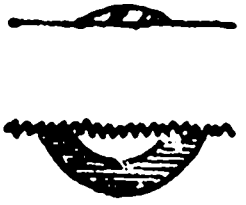
যথেষ্ট চিপ ক্লিয়ারেন্স

টুল স্টিল, হাই কারবন, হাই স্পিড স্টিল, ড্রিল রড, এই গুলির জন্য প্রতি ইঞ্চিতে ১৮ দাঁত ।



সেকশনে দুই ও তার অধিক দাঁত

এ্যাংগেল আয়রন, ব্রাস টিউব, কপার, এবং আয়রন পাইপ এই গুলির জন্য প্রতি ইঞ্চিতে ২৪ দাঁত ।



সেকশনে দুই ও তার অধিক দাঁত

কনডুইট এবং অন্যান্য পাতলা টিউব ও সিট মেটাল কাজের জন্য প্রতি ইঞ্চিতে ৩২ দাঁত ।

4. DEVELOPING WORKSHOP EXERCISES

It is the responsibility of the working instructor to develop his own educational material. It should form an integrated system of theory and skills based on the production of useful workpieces which will benefit the workshop and training centre..

At the beginning of this section, marking out procedure was outlined briefly. But marking out should not be taught in isolation from production.

In practice, that marking out exercise should be a step in the production of a job which is seen to be useful.

It should be based on a drawing (blueprint) as shown here. It also should have an accompanying Operation Sheet for the guidance of the student. (Also shown here).

STEPS IN DEVELOPING EXERCISES

1. The instructor should establish a list of items which are needed by the workshop, (e.g. calipers, hinges, drill stands, machine parts, etc.)

2. Prepare drawings showing dimensions and form.

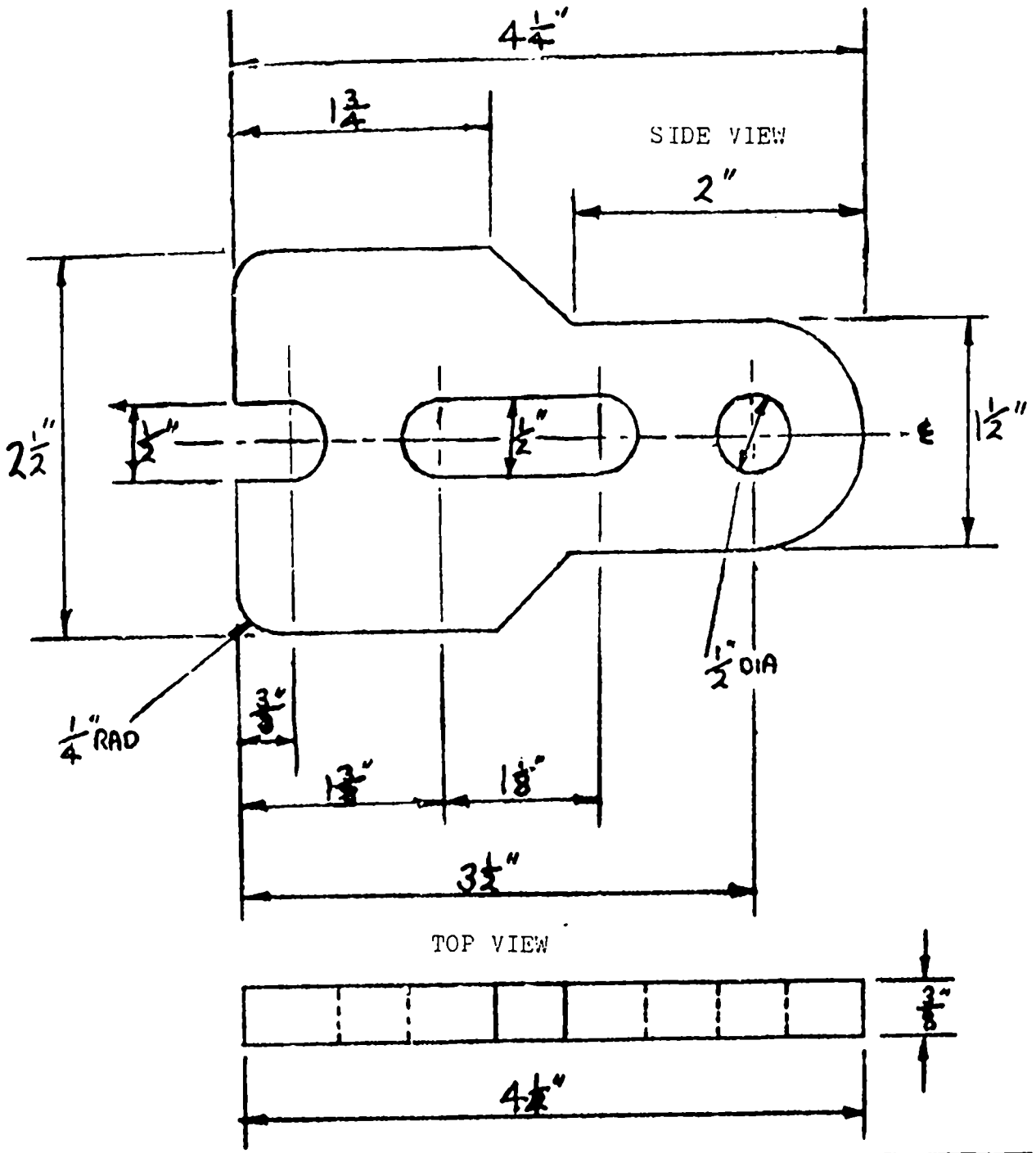
3. From the drawings, prepare Operation Sheets.

4. Assess the skills involved in producing the job. From this information lesson plans will be drawn up. (Theory must always be related to the practical requirements of the students.)

FILING AND DRILLING EXERCISE

M.S. BRACKET

NOT TO SCALE



ANY TRAINING CENTRE. ANYWHERE, BANGLADESH.	
	DRAWN BY:
	DATE:

FILING AND DRILLING OPERATION SHEET

TOOLS REQUIRED FOR THIS JOB

Files

Marking out Tools

Drills

Centre Punch

Hacksaw

Hammer

You must now work out the size and type of tool you require

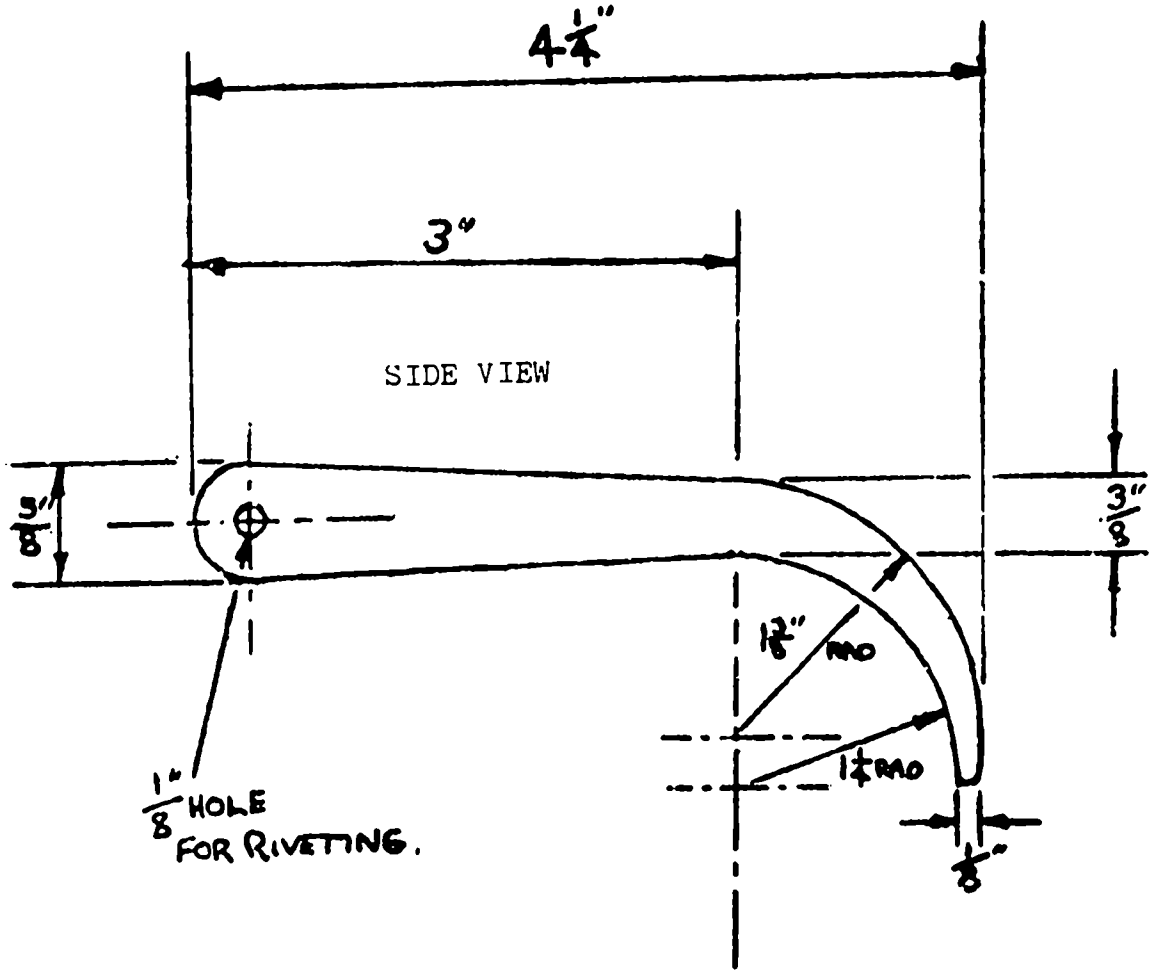
Operations:

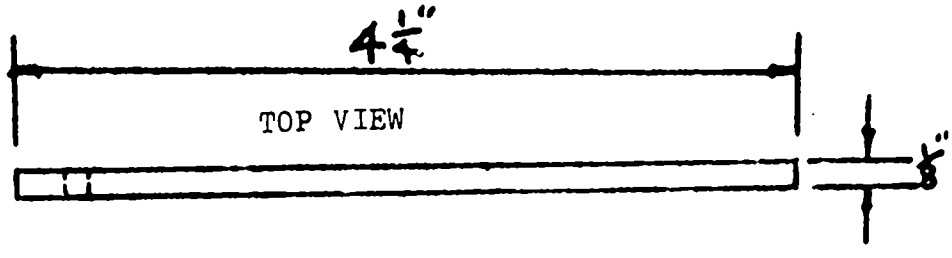
1. Check metal for size 4 3/8" X 2 5/8" X 3/8".
2. File two datum faces square and flat to each other.
3. Mark on centre line then mark out job as drawing ± 1/64th. Mark out hole slots.
4. Hacksaw almost to size and then file to correct size.
5. Centre punch, centre drill and drill holes. File out holes to size.
6. Check all sizes with rule (scale), and remove all sharp edges.
7. Hand in for Inspection.
8. This job will be marked and all marks recorded.

OUTSIDE CALIPERS

NOT TO SCALE

NB: 2 off to be produced





ANY TRAINING CENTRE, ANYWHERE, BANGLADESH.	DRAWN BY:
	DATE:

OUTSIDE CALIPERS OPERATION SHEET

TOOLS REQUIRED FOR JOB

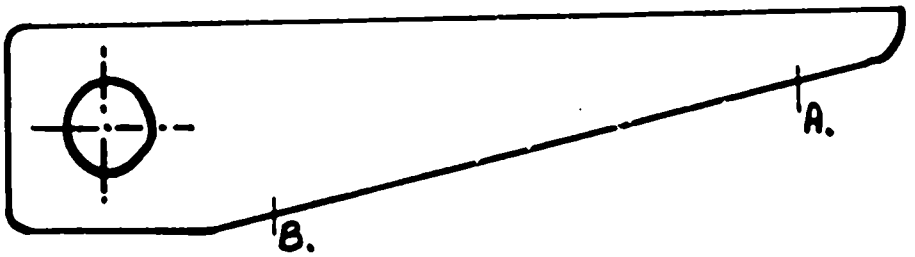
Files, Hacksaw, Centre Punch, Hammer
1/8" Drill, Dividers, Ruler (Scale)
Scriber, Try Square, Marking Out Blue.

Operations:

1. Check metal for size 4½" X 2 " X 1/8".
2. Mark on centre line.
3. Dot punch hole. Using dividers, scribe out the 5/8" hole.
4. Mark off the 3" length. Mark off 3/16" both sides of the centre line. Draw a line at a tangent to the 5/8" diameter.
5. Mark on the 1¼" and the 1 3/8" centre lines for the radius.
6. Mark on the radius 1¼" and 1 3/8" with dividers. Round off the 1/8" radius at the point.
7. Centre punch and drill 1/8" hole for rivetting.
8. Using hacksaw, cut out. File to size. Remove all sharp edges.
9. Two of these must be made.
10. When the two pieces have been filed to size and shape, and the holes drilled : They must be rivetted together with a 1/8" countersunk rivet.
11. Hand in for Inspection.
12. You are being marked. The marks are recorded.

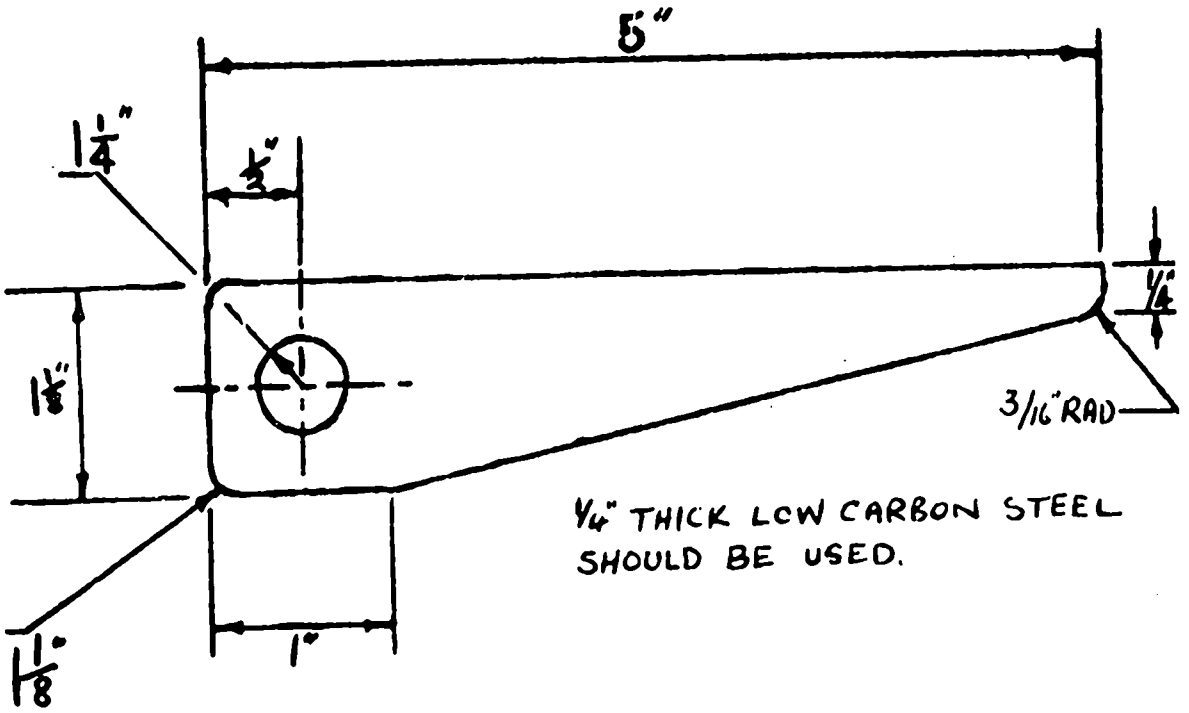
PREPARING A DRAWING & OPERATION SHEET

Suppose a drill drift is to be made by the student for use in the workshop. The form of drill drifts should be well known to the instructor. The size is clearly the next most important consideration.



The instructor should measure the slot in the tapered adaptor for which the drift is being made. He should ensure that the job is so designed that it will begin to engage near point A. It must be able to complete its job of ejecting the drill before it reaches point B. This function determines the length and angle of the taper.

Assume his calculations are complete. He must then prepare a simple drawing showing the form and dimensions of the drift.



<u>From this drawing he can begin to prepare his Operation Sheet.</u>

THE OPERATION SHEET

The first requirement is to specify tools for the job. Obviously, since the job must be marked out, a scriber and a try-square will be needed.

What about marking blue ? Files ?

For the hole: a centre punch, hammer and a ½" drill.

How will the form be cut ? With a chisel ? Or a hacksaw ?

How will the measurements be checked ? With calipers or a rule ? Write them down.

Tools Required for Job
Files, centre punch, hacksaw, ½" drill, try-square, marking blue, ruler, scriber and hammer..

That's a beginning.

What about operations ?

What is the first step ? Check the last operation sheet - it may contain a clue.

The first step in most operation sheets involves either cutting metal to size or checking pre-cut metal for size. So write it down.

The second step is very often filing two datum faces flat and square to each other.

From these datum faces, the marking out can be done.

Marking out of any detail on the form follows marking out of the form. Similarly, the production of detail on the form follows the hacksawing and filing to size of the form.

The final operation or operations normally include removing sharp edges and burrs, scraping holes, etc., and checking measurements against the drawing.

Now rearrange these items to produce a logical Operation Sheet and check it against the sample shown hereafter.

***

SAMPLE OPERATION SHEET (Drill Drift)

Tools Required

Three files (rough, second cut and smooth). centre punch, ½" drill, marking out blue, try-square, scriber, ruler (with 1/64th" graduations), hammer and hacksaw.

Operations

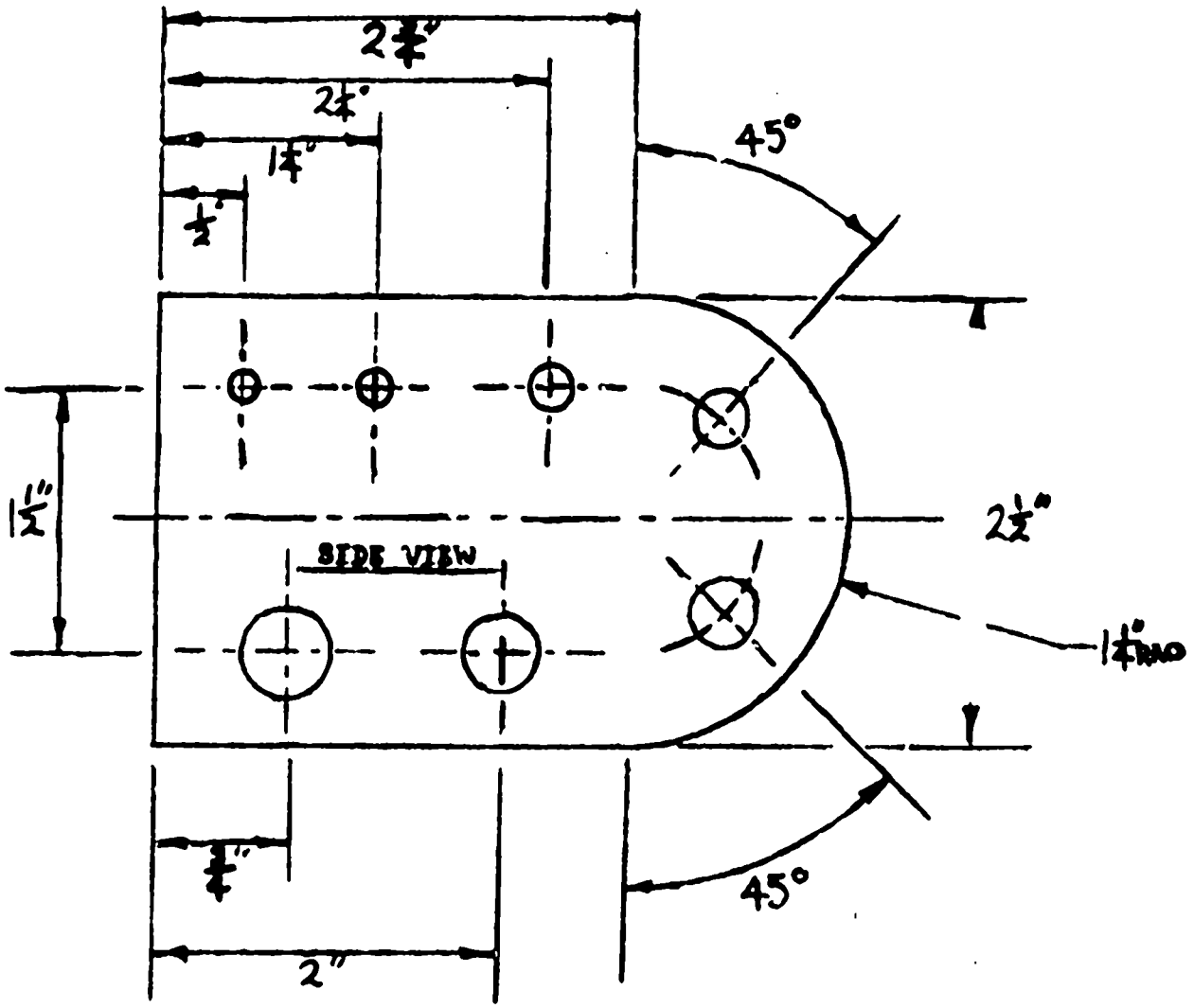
1. Check metal for size: 5 1/8" X 1¼" X ¼".
2. File two sides flat and square for datum faces.
3. Mark out drift using drawing. (All sizes ± 1/64").
4. Mark out hole in drift, (½").
5. File drift to size, (the angle, flats and radii.) A good finish must be obtained.
6. Centre punch and drill ½" hole.
7. Check all sizes and remove all sharp edges and burrs.
8. Hand in for inspection.
9. You are being assessed and the marks being recorded.
10. This job must be hardened in the furnace.

****

Exercise

Now try to produce an Operation Sheet,without any assistance, from the drawing of a Drill Stand shown here:

INSTRUCTORS' EXERCISE



Remember, if you are designing a drill stand, it should be useful for your workshop. Measure the drills you have to stand in it. This will determine the size of the holes. You may have to change the dimensions given above to suit your requirements.

Use cheap metal. (Wood might also do).

When your drawing is complete, prepare the Operation Sheet.

This approach can be applied to any area of the workshop. If there is a shortage of bench vices, a fabricated plate metal vice can be designed and made in the workshop using this system. Broken joints on coolant pumps, (a common problem), can be removed, measured, drawn, production operations detailed on the operation sheet, and given to the students for manufacture.

If there is anything more disheartening than the concentration on theory in this country, it has to be the sight of students, surrounded by broken equipment, making "doofers" - useless bits of metal garbage.

5. DEVELOPING MACHINESHOP MATERIAL

What was said in the section on Bench Fitting Material development holds true for machineshop materials also. (Again, the visual aid material shown here constitutes about 25% of that prepared for a 6 month training course.)

One additional point needs to be added.

The skills involved in bench fitting are not nearly so complex as those which must be developed in the machineshop. Compare, for example, the skills involved in filing and in parting off a job on a lathe. The number of steps in parting off is considerably greater than the steps involved in filing. This creates two problems:

(a) It is not possible to name the steps in parting off, and other machining processes, and expect the student to remember, not alone the names of the steps, but also their sequence; and

(b) it is neither practical nor economical for training centre staff to produce visual aid information sheets which cover a large number of steps within one skill.

For this reason we developed basic skill operation sheets, which are issued to the student with a visual aid information sheet covering the more important steps to be simplified. This reduces both the volume of paper to be issued to the student and the number of drawings which the instructor has to prepare. Three examples are shown at the beginning of this section.

(In other cases which appear later in this section, a slightly different approach was adopted. Where the layout of the visual aid sheet permitted, and if the basic skill operation sheet was fairly short, they were combined. But this is purely a question of economics, and does not detract from the need, in most cases, for machineshop visual aid information sheets to be accompanied by basic skill operation sheets.)

Apart from the three examples shown, the basic skill operation sheets for this section have been omitted, partly for reasons of space, but also to facilitate the involvement of instructors in developing this material.

At present, instructors have neither visual aid material nor basic skill operation sheets. Additionally, whereas an instructor could verbalise the steps to be taken in parting off, he can only perform more complex operations. He has very little conscious recollection of the steps involved. The skill has become intuitive. He can not, therefore, teach that skill. To learn a skill, the student must absorb every step in the process.

Look at the third example of a basic skill operation sheet at the beginning of this section - ("Screwcutting Vee Form Threads".) No instructor could easily verbalise the 36 steps involved from memory. At best, each student would require a full time personal tutor to take him through the steps. Such skills are not being taught at the moment. Until such time as instructors are obliged to prepare basic skill operation sheets from available textbooks, the level of skill transfer will remain abysmally low. They can start right here by preparing sheets for each of the visual aid sheets shown.

(NB: If system 'C' - large education charts - is being used, then instead of issuing basic skill operation sheets, the instructor will present the information in the form of trade notes on the chalkboard for the students to copy in their notebooks.)

BASIC SKILLS OPERATION SHEET

PARTING OFF

1. Set workpiece in the chuck allowing width of parting tool tip plus 1/8" clearance from chuck jaws.

2. Set parting tool in tool box, (tool post), at correct centre height.

3. Select and set speed.

4. Hold rule to side of tool and wind saddle along until required length on scale is aligned to workpiece face.

5. Saddle must be clamped to the lathe bed.

6. Start machine and supply plenty of coolant to the tool tip.

7. Maintain an even feed rate as parting tool is fed into workpiece.

8. Using a file, carefully remove the burrs from the corner of the parting slot BEFORE completing the parting off operation.

NB: Should swarf build up in the slot whilst cutting, then:

a. wind the tool clear of slot.

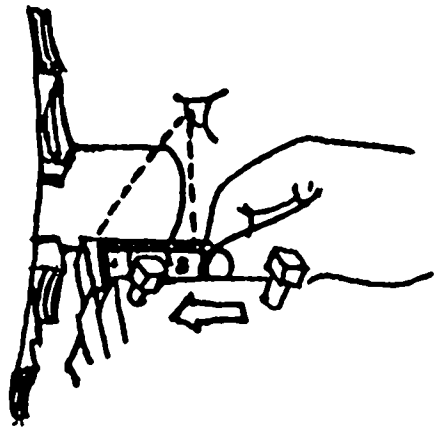
b. Using compound slide, move the tool approximately half its width towards the chuck.

c. Feed the parting tool into the workpiece again, this time about 1/8" more than the previous cut.

d. Withdraw the tool and return it to its original position using the compound slide.

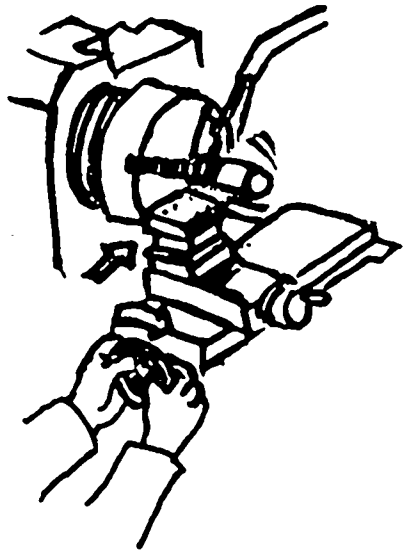
e. Hand feed the tool in to workpiece to part off.

PARTING OFF



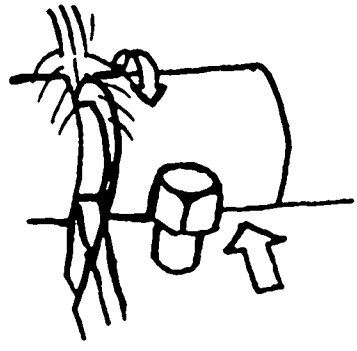
PREPARATION FOR PARTING OFF

Set the workpiece in the chuck allowing for the width of the tool plus ¼" clearance from the tool to the chuck jaws. With the ruler set the length holding the ruler along the side of the tool and the job to be cut. Mark off the length



PARTING OFF

Part off the job, winding in the cross-slide by hand. Use coolant. If the tool is on the centre height of the job it will cut to the centre of the job, which will fall off.



SWARF BUILD UP WHEN PARTING OFF

If swarf builds up when parting off, wind the tool clear of the slot. Never move the tool half the width of its cutting edge towards the chuck. Hand feed the tool into the workpiece. Cutting approximately ¼" deeper than the previous cut, withdraw the tool. Return it to its original position. Feed in the tool. Part off the work.

BASIC SKILLS OPERATION SHEET

KNURLING

1. Set the workpiece with minimum length projecting from chuck.

2. Long workpieces should be supported by a tailstock centre.

3. Turn diameter to be knurled about 0.010" below required finishing size.

4. Check knurling tool is clean, (no swarf, etc.). Clean with a wire brush if necessary.

5. Set pivot pin to centre height.

6. Set the knurling tool at a slight angle to give a lead-in.

7. Set slow speed and fast feed, and tighten tool securely.

8. Start the machine and supply coolant.

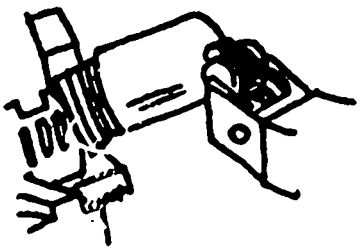
9. Wind knurling tool into workpiece applying pressure until the full pattern is formed.

10. Engage automatic traverse and feed along until required length of knurling is achieved.

11. Knurling tool is then wound out rapidly from workpiece.

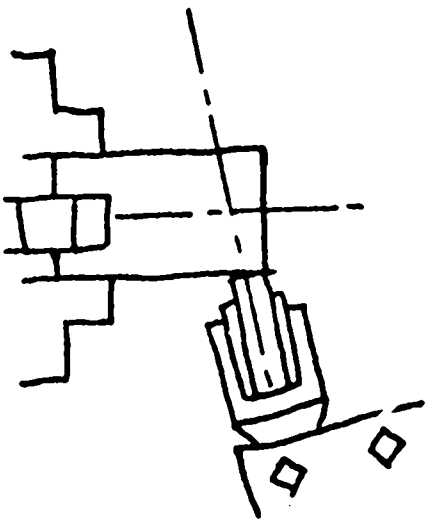
12. Use 45 degree chamfer to remove burrs.

KNURLING



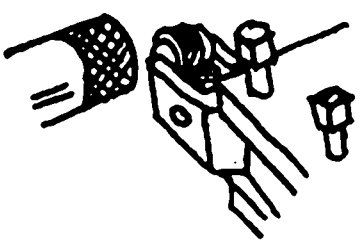
SETTING UP TO KNURL

Set workpiece in chuck and support with a centre.



Visually set the knurling tool at a slight angle to give a good lead in. Check that the tool is clean of swarf. Set the pivot pin to the centre height of work.

KNURLING WORKPIECE.



Set a slow speed and a fast feed on the lathe. Start the machine spindle. A good flow of coolant is required.

Wind the knurling tool into workpiece, applying pressure until full pattern is formed. Feed tool along to required length of knurl. Remove all burrs.

(An example of a fairly complex multi-step skill progression which quite obviously must be given to the student in written form if he is ever to master this skill.)

BASIC SKILL OPERATION SHEET

SCREWCUTTING VEE FORM THREADS

1. Mount the workpiece in the chuck and turn diameter to be screwcut.

2. Undercut to provide a runout recess of thread depth, approximately two pitches wide.

3. Set machine to cut the required pitch of thread. (Set levers in position as indicated on machine).

4. Establish which position of the screwcutting dial the screwcutting lever can be engaged at.

5. Screwcutting tool shape must be checked with the aid of a screw-cutting gauge, (i.e. 60 degrees for metric and unified threads, 55 degrees for B.S.W. and B.S.F. threads.)

6. Clamp compound slide parallel to machine bed.

7. Clamp tool on the centre height of workpiece.

8. Tool point must be set square to the workpiece centre line. Position the tool into an appropriate cut-out of the screwcutting gauge while holding the gauge in contact with the work diameter or face. Gently tap the tool to align tool form with setting gauge.

9. Position tool. Take up backlash in topslide by turning handwheel clockwise.

10. Set compound slide to zero.

11. Run machine at low RPM.

12. Feed tool slowly in until contact is made with the workpiece. This will be obvious from a fine ring being cut around the diameter.

13. Clamp cross-slide and set index to zero.

14. Withdraw tool from work surface.

15. Make trial cut. Position the saddle to bring the tool approximately 1/4" clear of the end of workpiece.

16. Re-index the cross-slide to zero. Apply a cut of 0.024" and mark setting. (Write down if necessary).

17. Switch coolant pump on.

18. Apply a light engaging pressure to the screwcutting lever just before an engagement position is indicated on the screwcutting dial.

19. Disengage the screwcutting lever with a sharp single movement before commencing the work.

20. Withdraw tool from work.

21. Stop machine.

22. Select correct pitch gauge and offer it in to the lightly screwed work surface. Pitch of thread must correspond to the gauge.

23. Cut the thread. Reposition the tool beyond end of workpiece.

24. Re-index cross-slide to apply a 0.023" cut.

25. Index compound slide forward 0.006"

26. Engage screwcutting lever at appropriate screwcutting dial indication.

27. Disengage as tool enters the run-out recess.

28. Withdraw tool from work.

29. Reposition for next cut.

30. Operations to be repeated until within 0.024" of full depth.

31. Stop the machine. Check thread size using a screw ring gauge or a mating component.

32. Take fine cuts and check for fit after each pass until full depth is reached.

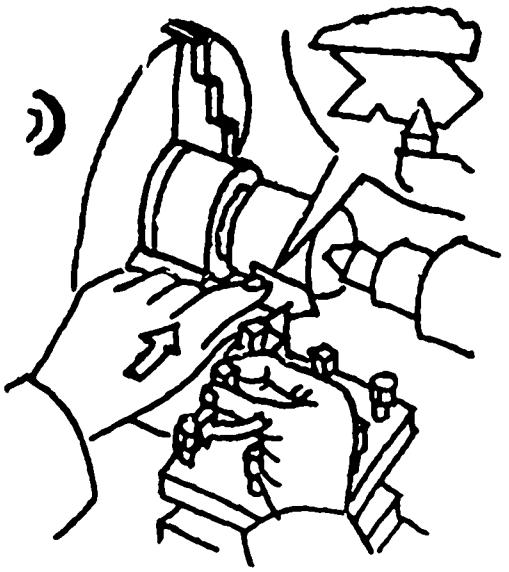
33. At full depth, index the compound slide back with the tool running along thread until a very light cut is taken off opposite side of thread.

34. Run this cut over the full length of thread.

35. Check thread size.

36. If necessary, continue to take very fine cuts until correct fit is obtained with the gauge.

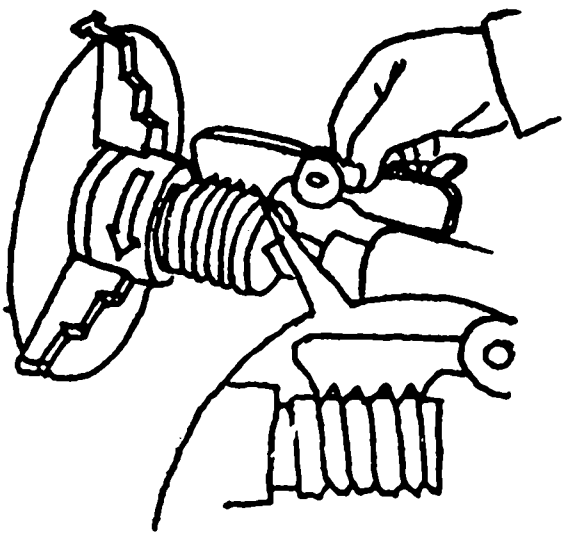
SCREW CUTTING



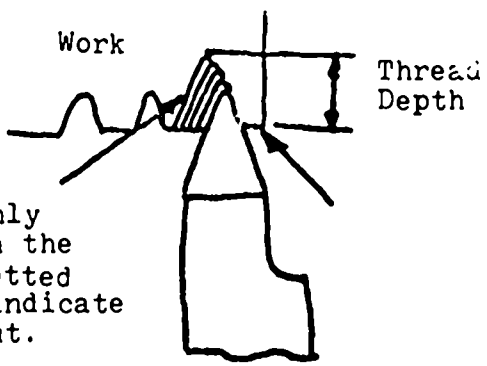
SETTING SCREWCUTTING TOOL

Set the machine to cut required recess of thread. Set the tool with the aid of a screwcutting gauge. Tool mustbe on centre height of work.

Make a trial cut only a light pass and then check the pitch of the thread with the correct pitch gauge. T.P.I.



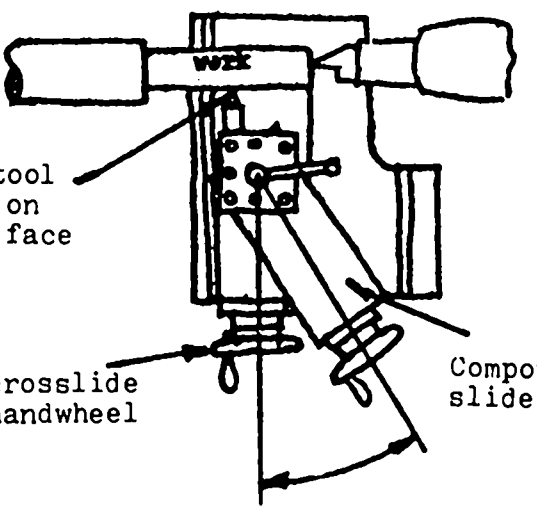
SCREWCUTTING SETUP



Tool only cuts on the face. Dotted lines indicate each cut.

Depth of each cut applied at half thread angle.

THE SCREWING OPERATION



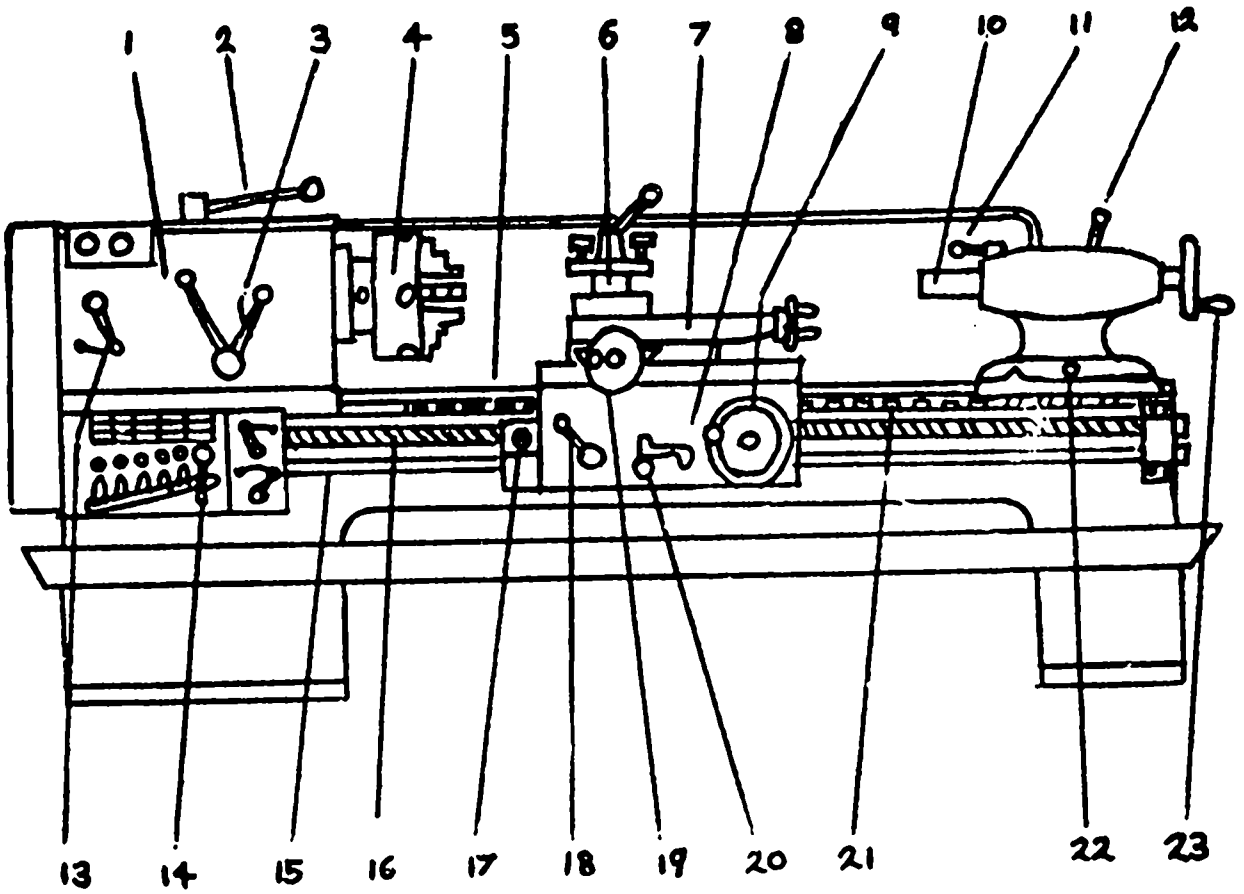
The tool cuts on this face

crosslide handwheel

Compound slide.

Half thread angle.

THE CENTRE LATHE AND IT'S PARTS

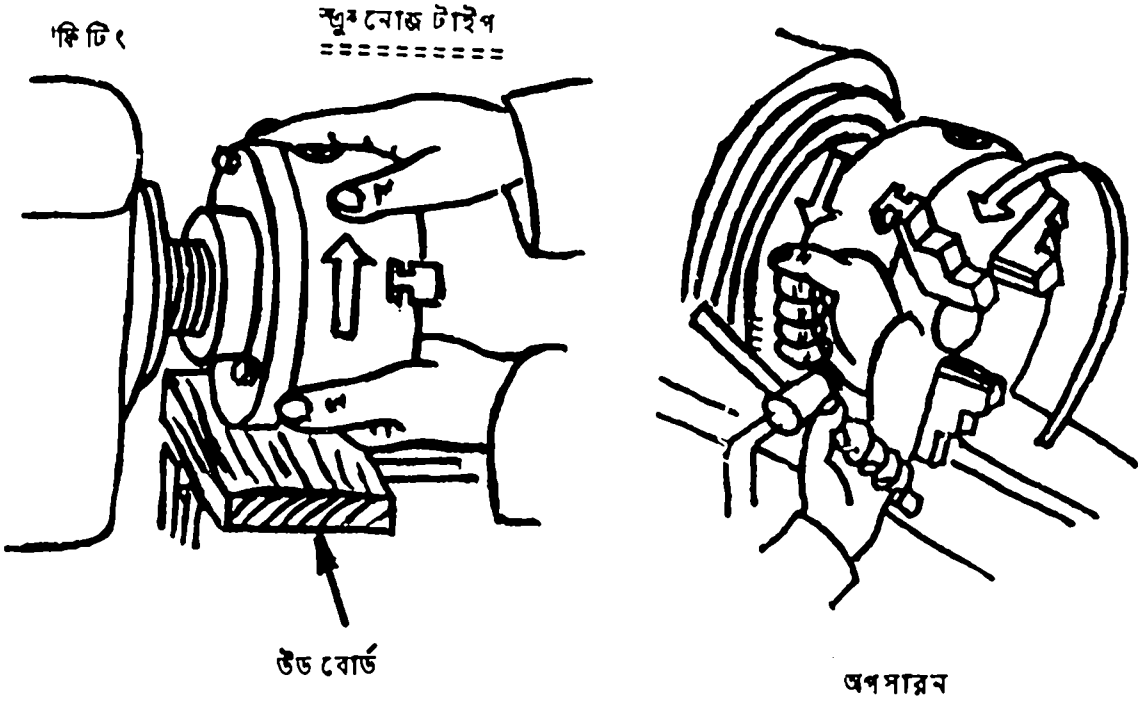


PARTS OF THE CENTRE LATHE.

1. All-geared headstock
2. Clutch lever
3. Speed change levers
4. Chuck
5. Bed slideways
6. Four-way turret
7. Compound slide
8. Apron
9. Sliding handwheel
10. Tailstock sleeve
11. Sleeve locking lever
12. Tailstock clamping lever
13. Feed reverse lever
14. Quick change gearbox
15. Feedshaft
16. Leadscrew
17. Screwcutting lever
18. Screwcutting dial
19. Cross-slide handwheel
20. Feed engage lever
21. Rack
22. Tailstock offset screw
23. Tailstock handwheel

MOUNTING A CHUCK ON A LATHE - I

নেদে চাক বাঁধা পদ্ধতি - ১



স্ক্রুড নোজ চাকে বাঁধন পদ্ধতি

১।(ক) ফিটিং - স্পিন্ডল স্ক্রু থ্রেড, লোকেশন ডায়মেটার । এবং ফেইস কে পরিস্কার করিয়া লও ।

(খ) চাক স্ক্রু থ্রেড, লোকেশন ডায়মেটার এবং ফেইস কে পরিস্কার করিয়া লও ।

(গ) ষ্টেশনারী মেশিনে লো গিয়ার এ্যাংগেইজ কর ।

(ঘ) চাককে স্পিন্ডেল নোজে স্ক্রু কর । চাককে যথাস্থানে স্থাপন করিতে, যতটুকু বলের প্রয়োজন শুধু মাত্র ততটুকু বলই প্রয়োগ কর ।

২।(ক) অপসারন :- ষ্টেশনারী মেশিনে লো গিয়ারকে আলাদা করিয়া ফেল ।

(খ) চাকের ভিতর চাকের চাবি লাগাও ।

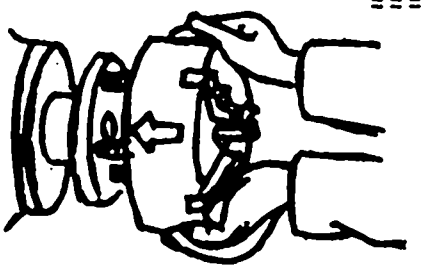
(গ) চাকের ভিতর চাবি ধর এবং হাতের গোড়ালি বা নরম হাতুড়ী দিয়া চাবিকে আঘাত কর ।

(ঘ) চাককে সরাইয়া গুদামে রাখ ।

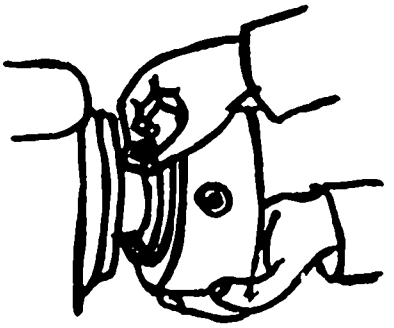
MOUNTING A CHUCK ON A LATHE - II

লেদে চাক বাঁধার পদ্ধতি - ।।

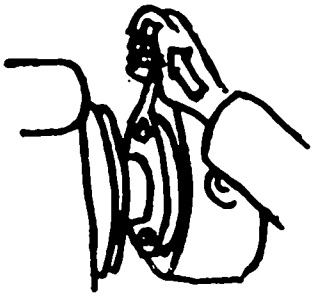
ফ্ল্যাঞ্জ টাইপ চাক বাঁধার পদ্ধতি



ফ্ল্যাঞ্জ টাইপ ।



ফিটিং



১। (ক) ফিটিং :- স্পিন্ডল ফ্ল্যাঞ্জ, লোকেটিং ফেইস এবং স্পিগট পরিস্কার কর ।

(খ) নাট এবং ওয়াসার গুলি এ্যাটাচমেন্ট স্টাড্স হইতে অপসারন কর ।

(গ) চাক লুকেটিং ফেইস এবং রেইসেস্ পরিস্কার কর ।

(ঘ) ফ্ল্যাঞ্জে চাক ফিট কর ।

(ঙ) ওয়াসার এবং নাট স্টাডে এ ফিট কর যখন হোলডিং চাক ঠিক অবস্থা থাকে ।

(চ) নাট গুলি স্পেনার দিয়া টাইট কর ।

২। (ক) অপসারন :- স্পেনার দিয়া নাট ঢিলা কর ।

(খ) নাট এবং ওয়াসার যদি আটকানো থাকে, তবে অপসারন কর ।

(গ) চাক অপসারন কর ।

(ঘ) পূর্বের জাগায় নাট এবং ওয়াসার লাগাও ।

(ঙ) চাক গোদামে রাখ ।

CUTTING SPEEDS AND FEEDS

Here speed refers to the speed at which the job in the chuck of the lathe revolves, and the feed refers to the rate at which the lathe tool is fed in to the chuck. Use of the correct feed and speed is very important for the maintenance of the tools life, and the achievement of good sizes and finishes. What follows is a chart of cutting speeds, given in FEET PER MINUTE and METRE PER MINUTE, on which the lathe you will find a chart showing how to set the speed, but in REVOLUTIONS PER MINUTE. You therefore require a method of converting F.P.M. into R.P.M., and this is given below the speed charts.

Recommended cutting speed in feet per minute (FPM).

Material	Roughing Finishing SPEED (ft./min)	Roughing Finishing SPEED (m./min)
Aluminium	300-400	90-150
Brass	150-400	45-120
Mild steel	70-150	20-45
Cast iron	60-100	20-30

To find the correct Revolutions per minute (RPM) to set your machine to; Simply take the middle of the cutting speed range for the metalyou are going to work on. Multiply it by 4 and divide your answer by the approximate diameter of the metal you are going to cut. eg if you are going to machine steel with a 2" Dia, then the calculation will be =

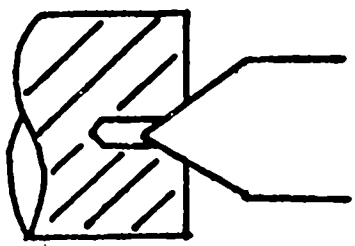
$$\frac{\text{FPM X 4}}{\text{Dia. of Metal}} + \frac{200 \text{ X } 4}{\text{Dia. of Metal}} = \frac{200 \text{ X } 4}{2''} = \frac{800}{2''} = 400 \text{ RPM.}$$

You can now work out the R.P.M. needed to cut any metal with any cutter. When you have your answer in R.P.M. select the nearest available R.P.M. setting on your machine.

CENTRE DRILLING — I সেন্টার ড্রিলিং - ।

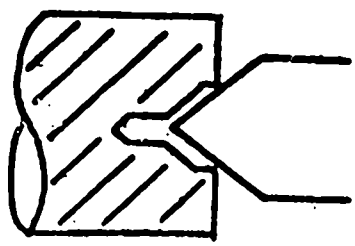
সেনটার ড্রিলিং

A



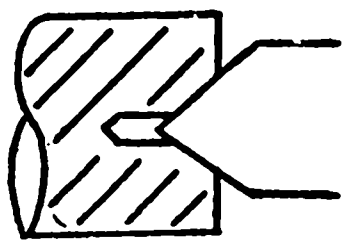
ভালভাবে আটকাইয়া ধরিবার জন্য সেন্টার যথেষ্ট গভীর নয় ।

B



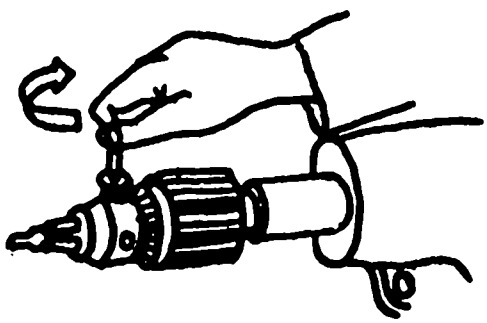
সেন্টার হোল অত্যন্ত গভীর । সেন্টার হোলের পার্শ্ব স্পর্শ করে না ।

সঠিক



C

ভাল গ্রিপ এবং দৃঢ় ধারণ কেন্দ্র ।

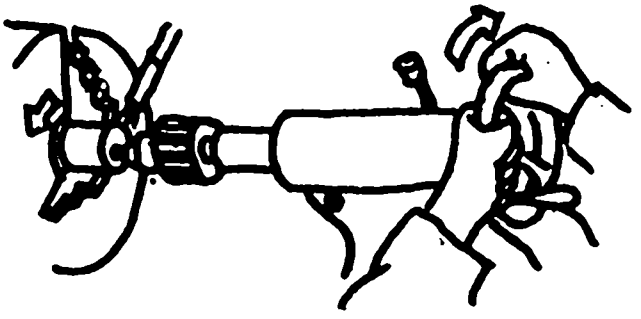


যতটুকু সম্ভব কম বাড়তি রাখিয়া সেন্টার ড্রিলকে টেইল স্টকের চাকে লাগাও ।

চাবির সাহায্যে চাককে নিরাপদ ভাবে শক্ত করিয়া লাগাও ।

সেন্টার ড্রিলিং - ।।

ওয়ার্ক পিসে সেন্টার ড্রিলকে সতর্কতার সহিত অগ্রসর করাও । কুলেন্ট এর উত্তম প্রবাহ প্রয়োগ কর । মাঝে মাঝে ফ্লুটসকে পরিষ্কার করার জন্য ড্রিলকে অবশ্যই বাহির করিয়া আনা উচিৎ ।



বিভিন্ন প্রকারের সেন্টার ড্রিল আছে এখানে কতগুলি দেওয়া হইল যাহা তুমি ব্যবহার করিবে । নম্বর-১, নম্বর-২, নম্বর-৩ নম্বর-৪, নম্বর-৫ ।

:- প্রস্তুতি -:

১ (ক) বারের প্রান্ত সুজা কাটিয়া লও ।

(খ) টেইল স্টকের ভিতর ড্রিল চাককে লাগাও ।

(গ) সঠিক মাপের সেন্টার ড্রিল নির্ধারন করিয়া লইয়া চাকের ভিতরে লাগাও ।

(ঘ) কমপক্ষে যতটুকু বাহিরে রাখার প্রয়োজন ঠিক ততটুকু বাহিরে রাখিয়া সেন্টার ড্রিলকে চাকে লাগাও

(ঙ) সঠিক চাকের চাবির সাহায্যে চাককে ভালভাবে শক্ত করিয়া লাগাও ।

সেন্টার ড্রিল ওয়ার্ক পিস ফেইস ।

২।(ক) টেইল স্টককে কাজের কাছাকাছি নিয়া সেন্টার ড্রিলের অবস্থান পয়েন্ট নির্নয় কর ।

(খ) টেইল স্টককে অবস্থানে ক্ল্যাম্প বা আটকাইয়া দাও ।

(গ) স্পিড সেট করিয়া মেশিন স্পিন্ডল স্টার্ট কর ।

(ঘ) টেইল স্টক হিতকে অগ্রসর করাও যতক্ষন পর্যান্ত না সেন্টার ড্রিলের পয়েন্ট ওয়ার্ক পিসকে স্পর্শ করে ।

(ঙ) ভাল কোলেন্ট প্রবাহ প্রয়োগ কর ।

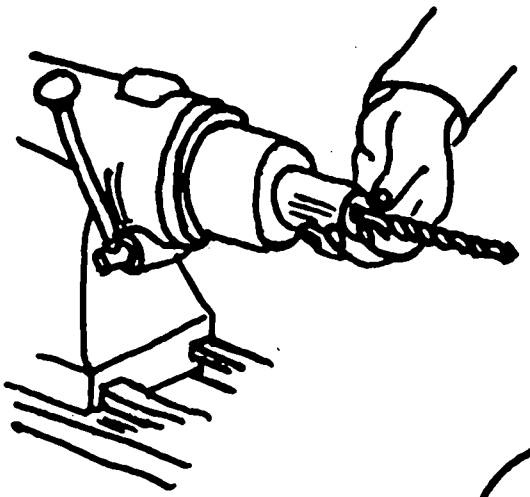
(চ) সাবধানতার সহিত সেন্টার ড্রিলকে ওয়ার্ক পিস ফেইসের ভিতর চেমফারের পূর্ন গভীরতায় চালাও ।

(ছ) পৌছার পর সেন্টার ড্রিল এবং টেইল স্টককে সরাইয়া লও ।

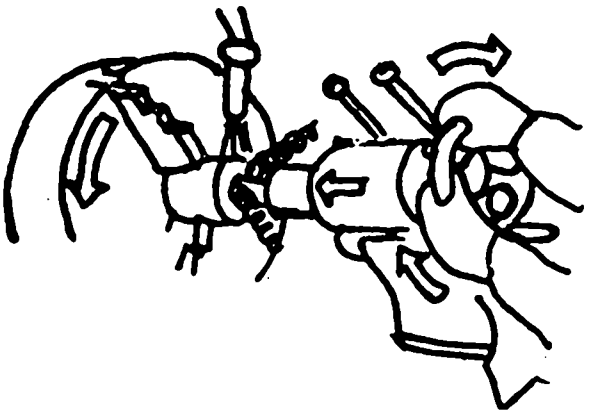
-: নোট :-

ছোট সেন্টার ড্রিলের ফ্লুটের ভিতর কাটা টুকরা জমা হওয়ার আশংকা থাকে । সেই জন্য উহাকে মাঝে মাঝে বাহির করিয়া আনিয়া ফ্লুটগুলি ব্রাসের সাহায্যে পরিষ্কার করিয়া নিতে হইবে ।

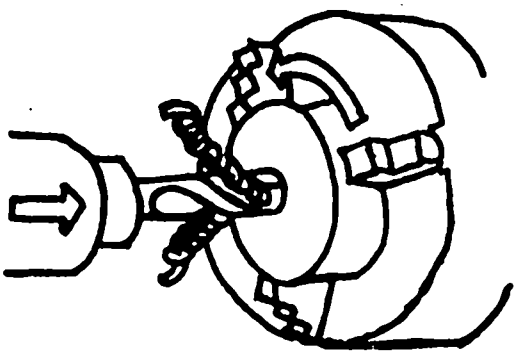
DRILLING ON A LATHE - I লেদের সাহায্যে ড্রিলিং ।



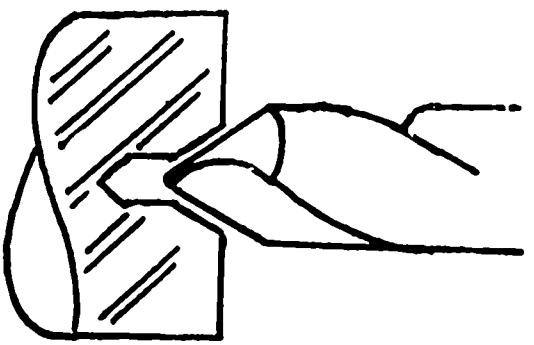
টেইল স্টকে ড্রিল লাগানো পদ্ধতি ।



ড্রিলিং এর সময় যখন সর্বদা কাটিং কোলেন্ট ব্যবহৃত হয় ।



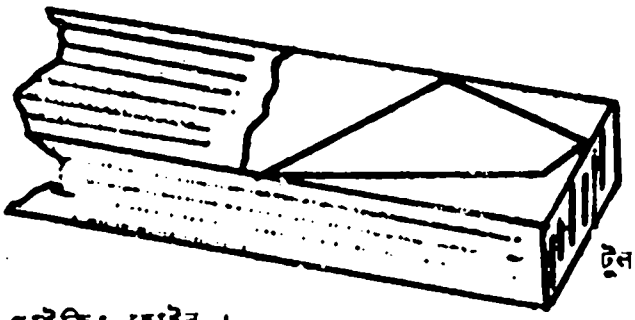
হোল ড্রিলিং করুন ।



ড্রিল করার পূর্বে সেন্টার ড্রিল ।

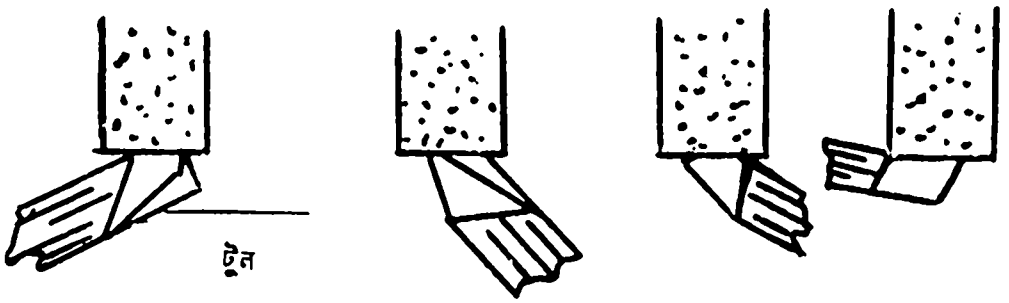
LATHE TOOL GRINDING লেথ টুল গ্রাইন্ডিং ।

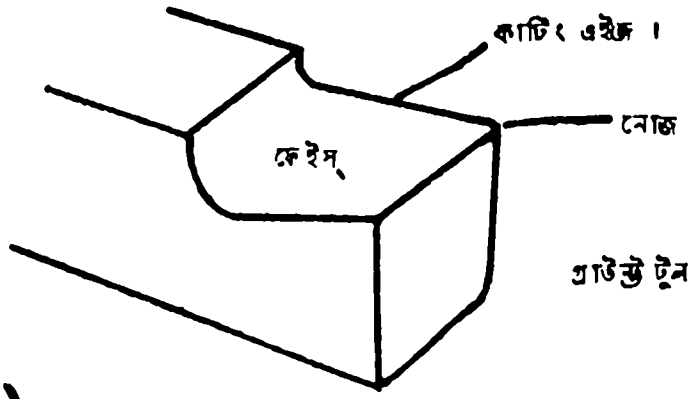
কাটার বিট গ্রাইন্ডিং সিকুয়েন্স ।



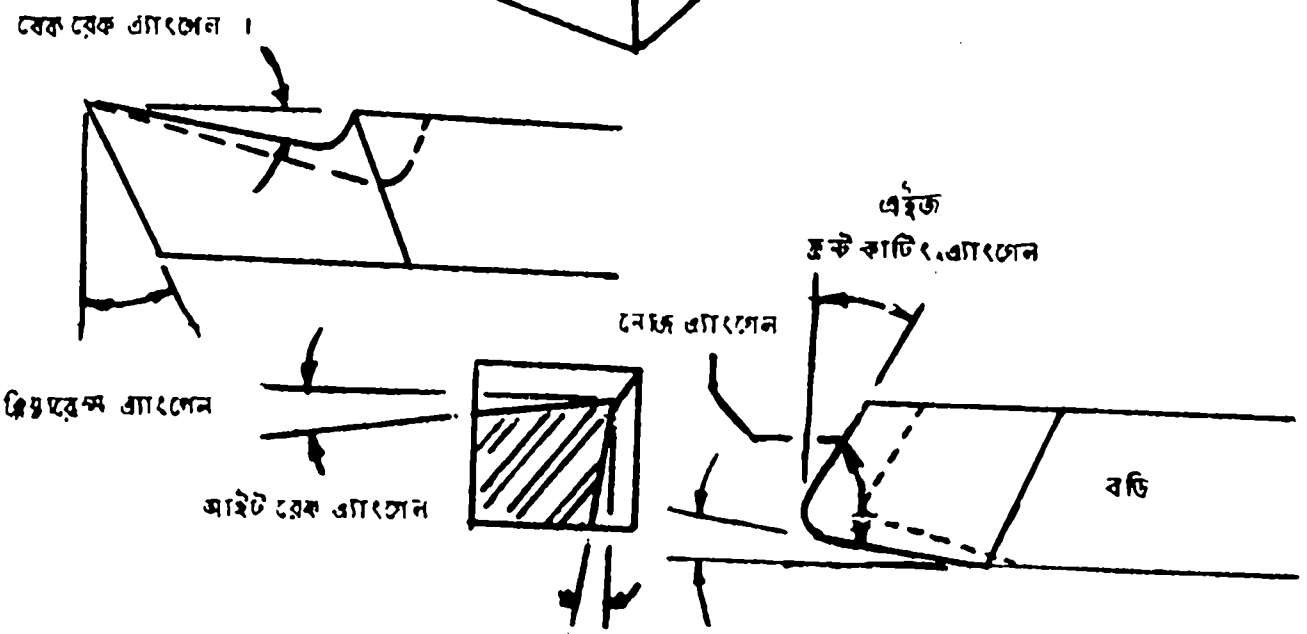
টুল বিট যাহা গ্রাইন্ড করিতে হইবে।

গ্রাইন্ডিং হোইল ।



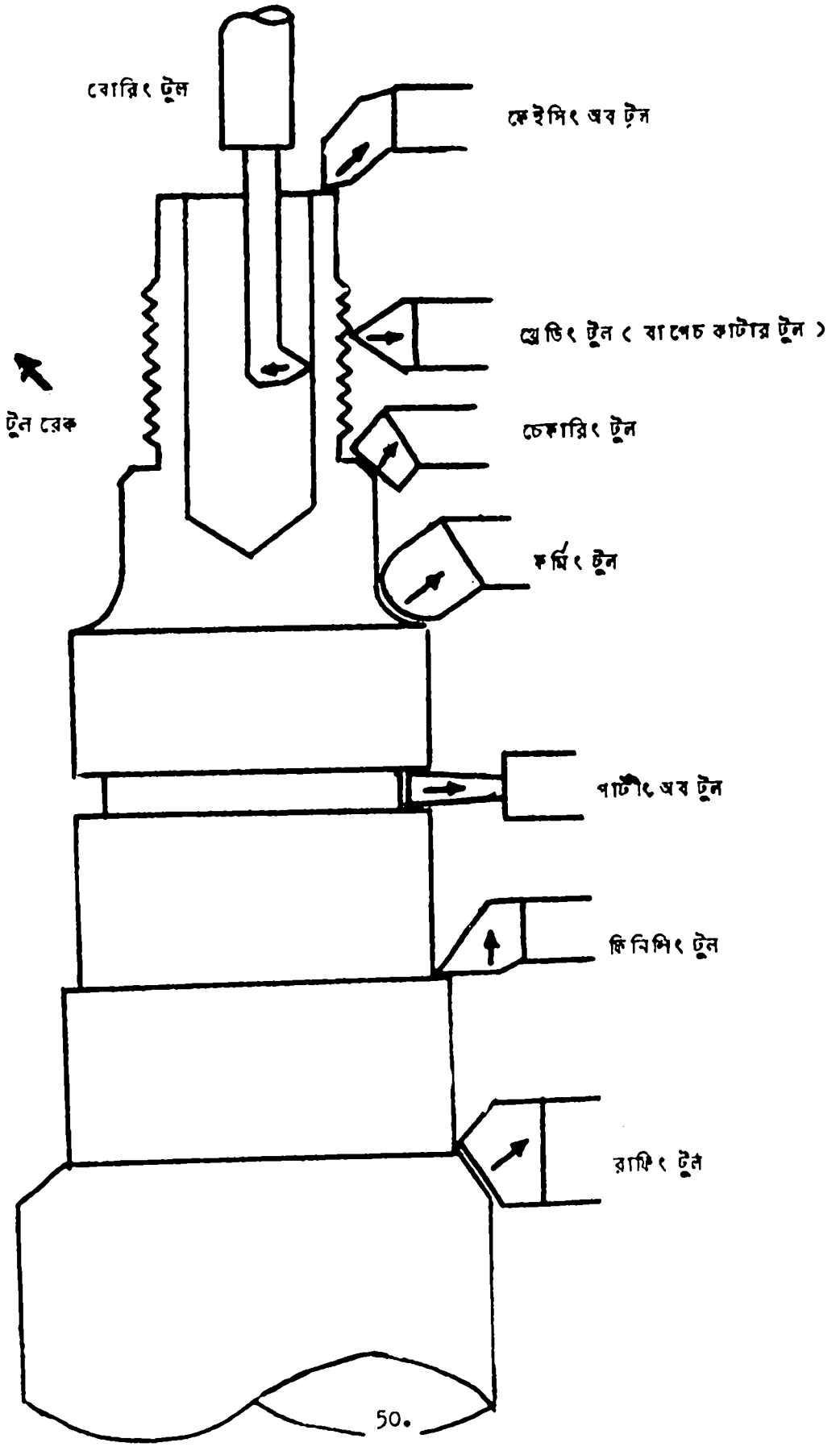


গ্রাউন্ড টুল বিট ।



সাইড কাটিং এইজ এ্যাংগেল ।

LATHE CUTTING TOOLS লেদ কাটিং টুলস এবং তাহাদের কাজ।



LATHE SAFETY লেদ সেইফটি।

১। মেশিন ব্যবহার করিবার পূর্বে জিজ্ঞাসা কর ।

২। চাক ফিট করিবার অথবা সরাইয়া নেওয়ার পূর্বে মেশিনকে পৃথক করিয়া লও ।

৩। যখন টুল গ্রাইন্ডিং করিবে অথবা লেদে কাজ করিবে তখন সব সময় নিরাপদ গগল অবশ্যই ব্যবহার করিবে ।

৪। চাক এবং টুল পোষ্টের টুল হইতে হাত এবং বাহুকে বেশ দূরে রাখিবে ।

৫। যখন লেদে ফাইল ব্যবহার করিবে তখন হইতে যেন হেন্ডেল যাকে সেট সম্বন্ধে নিশ্চিত থাকিতে হইবে ।

৬। যখন লেদে চাক বাঁধিবে তখন নিশ্চিত হইবে যেন উহা সঠিক ভাবে লাগানো হইয়াছে ।

৭। যখন ড্রিল লাগাও তখন ইহাকে সমতল বেসে ধর ।

৮। কর্তিত লৌহার টুকরায় হইতে তোমার হাত দূরে রাখিবে ।

৯। গিয়ারিং দেখিবার জন্য গার্ড খুলিবার পূর্বে মেশিনকে আলাদা করিয়া লও ।

১০। কাজ চেক করিবার পূর্বে নিশ্চিত হও যেন ইহা স্থীতিশীল অবস্থা আছে ।

১১। কি ভাবে কাজ করে যদি তাহা না বুঝ তবে সবসময় জিজ্ঞাসা কর ।

১২। ওয়ার্কশপে অথবা মেশিনে কোন সময় বোকার মত রিবেনা ।

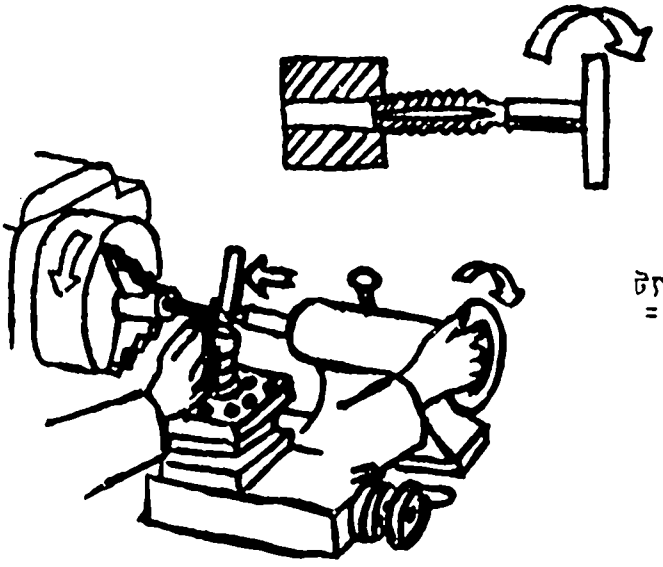
১৩। সব সময় টুল এবং মেশিনকে পরিষ্কার পরিচ্ছন্ন রাখিবে ।

১৪। যদি কোন ইনস্ট্রাকটার ওয়ার্কশপে না থাকে তবে কখনও মেশিন ব্যবহার করিবে না ।

১৫। তোমার সব পোশাক পরিচ্ছন্ন টাইট রাখিবে যেন ঐগুলি মেশিন অথবা চাকের সংগে না লাগিতে পারে ।

TAPPING & DIE CUTTING THREADS

ট্যাপিং এন্ড ডাই কাটিং থ্রেড

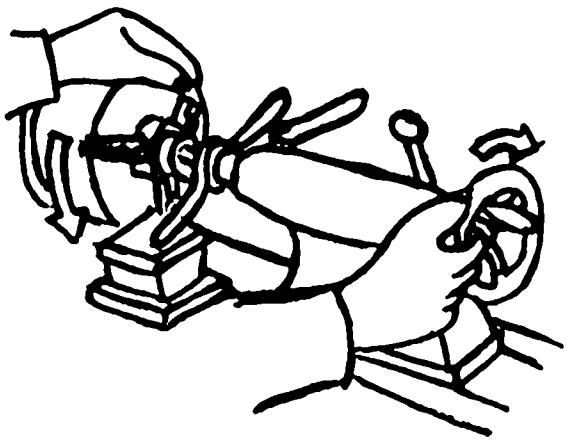


ট্যাপিং এর জন্য সেট করার পদ্ধতি ।

ট্যাপের জন্য সঠিক মাপের হোল ড্রিল কর । ট্যাপকে ট্যাপ রেঞ্চ এর ভিতর ফিট কর । টেইল স্টকের ভিতর সেন্টারকে স্থাপন কর । লুব্রিকেন্ট প্রয়োগ কর । ড্রিল হোলের ভিতর ট্যাপের ট্যাপার্ড বা সরু প্রান্ত প্রবেশ করাও । টেইল স্টককে অগ্রসর করাও । ট্যাপের পশ্চাৎ ভাগে হোলের সেন্টার নির্ণয় কর । টেইল স্টককে বেডের সংগে আটকাইয়া লও । ট্যাপ রেঞ্চকে ক্লক ওয়াইজ ডিরেকশনে পুরা দুই চক্র ঘুরাও ।

ট্যাপকে উলটাদিকে অর্ধ চক্র ঘুরাও । ইহা চিপকেভাংগিবে এবং ট্যাপকে ক্লগিং অথবা আটকাইয়া দেওয়া হইতে মুক্ত রাখিবে ।

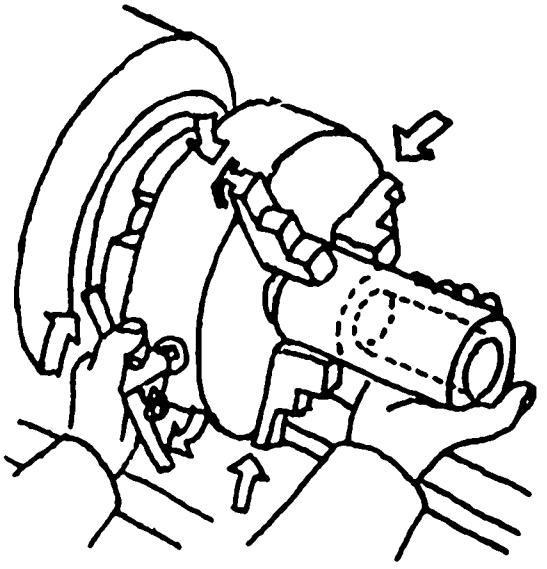
পদ্ধতিটিকে বার বার প্রয়োগ কর যে পর্যন্ত না হোল বরাবর ট্যাপ হয় ।

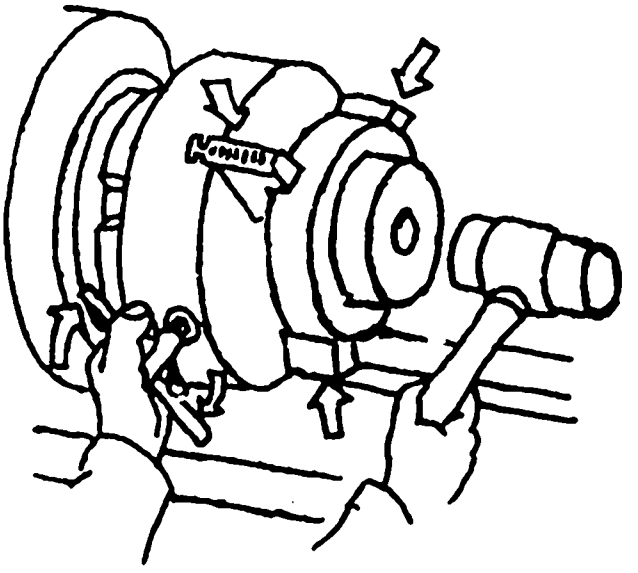


লেদে ডাইয়ের সাহায্যে পেচ কাটন পদ্ধতি ।

যে ব্যাসের পেচ কাটিতে হইবে উহাকে টার্ন করিয়া ·০০৩" ইঞ্চি কমাইতে হইবে । কাটিং অয়েল ব্যবহার কর । ডাই স্টকে ডাই সেট কর । ডাই স্টকে ধারন করিবার জন্য টেইল স্টককে পজিসন কর । ওয়ার্ক পিসের প্রান্তে ডাইকে ধারন কর । ডাই স্টককে পজিসনে ধারন করিবার জন্য টেইল স্টককে সম্মুখের দিকে অগ্রসর কর । এবং বেড এর সংগে আটকাইয়া দাও । টেইল স্টকের সংগে ডাই স্টকের উপর সমান চাপ প্রয়োগ করিয়া চাককে হাতের সাহায্যে ঘুরাও । সব সময় টেইল স্টক ব্যারেলকে ডাই এর সহিত সংযোজন করিয়া রাখ । ডাইকে স্প্রিং ডাস্টন রাখিয়া মিনিং কাটের জন্য বার বার চালাও ।

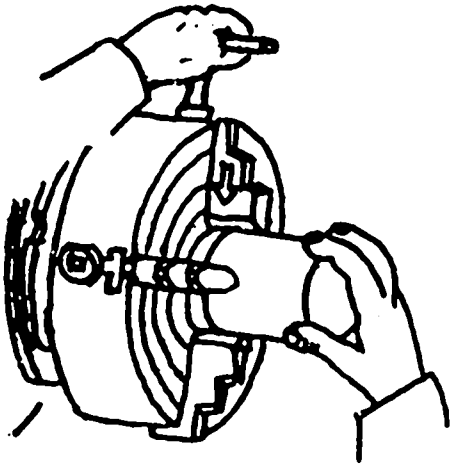
MOUNTING WORK IN A CHUCK

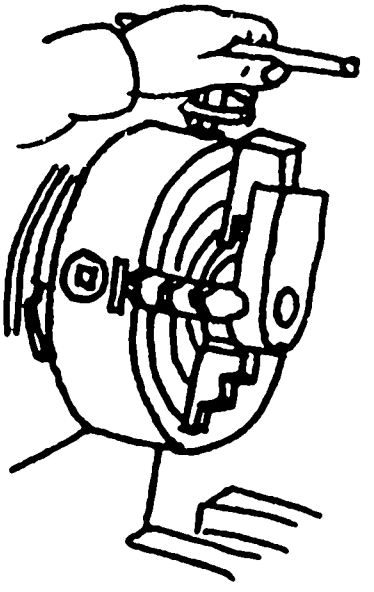




সেন্টর স্থাপন এবং ক্ল্যাম্পিং করুন ।

চাকের জ-গুলি খুল । ওয়ার্ক পিসকে চাকের মধ্যে স্থাপন কর । ওয়ার্ক পিসকে কেন্দ্র বরাবর এবং জ-এর সমানুপাত করিয়া ঢুকিবার জন্য জ-এর সংগে হালকা ভাবে ক্ল্যাম্প কর এবং তার পর চাকের জ-গুলিকে ভাল ভাবে আটকাও ।

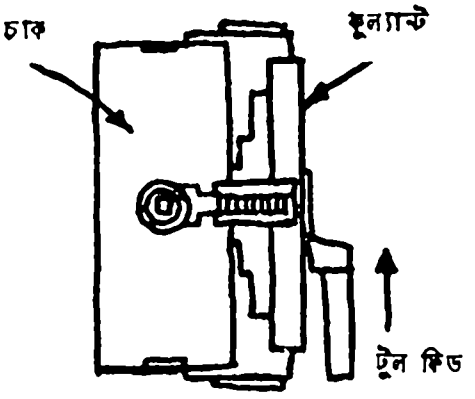




৪ জ- বিশিষ্ট চাকে কাজ বাধন প্রনালী ।

আনুমানিক ভাবে ওয়ার্ক পিসের মাপের কাছাকাছি চাকের জ-গুলিকে অবস্থান কর । চাকের ফেইস জ-গুলিকে একই ইনডেক্স লইন বরাবর বসাও । যে পর্যন্ত না ওয়ার্ক পিস হালকা ভাবে ক্ল্যাম্প হইয়া না বসে সেই পর্যন্ত বিপরীত জ-গুলিকে সমান ভাবে অপসারন করিয়া কাজকে চাকের সঠিক অবস্থায় আন এবং হালকা ভাবে ক্ল্যাম্প কর । অপূর্ণাকৃত কাজের ক্ষেত্রে জ-গুলি চাক ফেইসের বিভিন্ন ইনডেক্স লইনের উপর থাকিবে । এক বা তার বেশী জ- পরিবর্তন করার প্রয়োজন হইতে পারে ।

FACING OF WORKPIECES ...ফেসিং...



ফেসিং অফ
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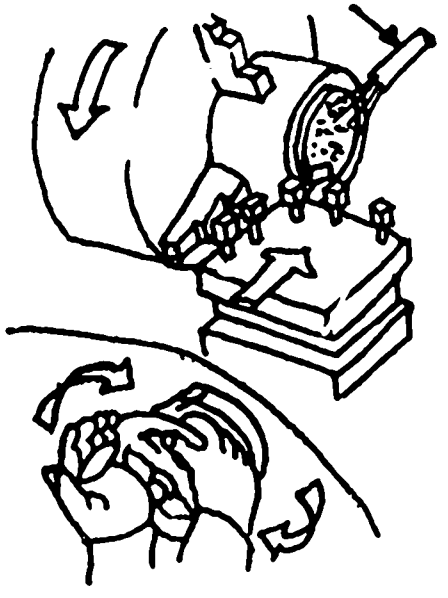
ইহা ফেস কাটিবার জন্য টুল ফিড দেখায় যখন ফেইসিং করা হয় তখন নেদ ক্যারেইজকে আটকাইয়া রাখা ভাল অভ্যাস ।



ফেইসিং
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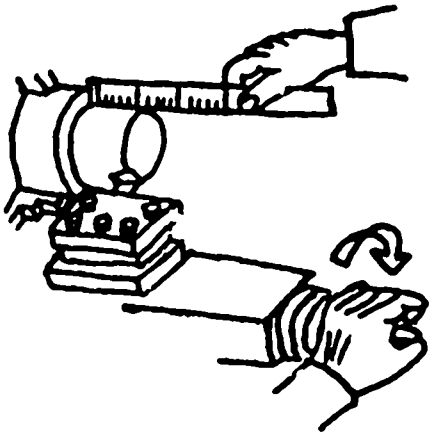
এস্ স্লাইড এর সাহায্যে টুলকে ওয়ার্ক পিসের ফেইসে আনিয়া হাতে ফিড দেও । সব সময় ফিড রাখ । টুল অবশ্যই সেন্টার লাইনে থাকিতে হইবে । কুলেন্ট ব্যবহার কর ।



ফেইসিং টু - এ লেংথ অথবা দৈর্ঘ্য বরাবর ফেইসিং করা ।
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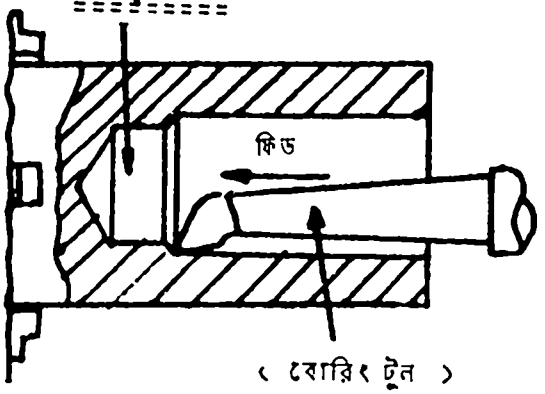
লেংথ এর উপর প্রায় "½" রাখিয়া ফেইসকে রাফ টার্ন কর । মেশিন বন্ধ কর এবং রোলারের সাহায্যে দৈর্ঘ্য মাপিয়া দেখ । মেশিন সেট করিয়া কম্পাউন্ড স্লাইডের সাহায্যে ফিনিসিং দেও । দৈর্ঘ্য বরাবর ফেইস কর ।

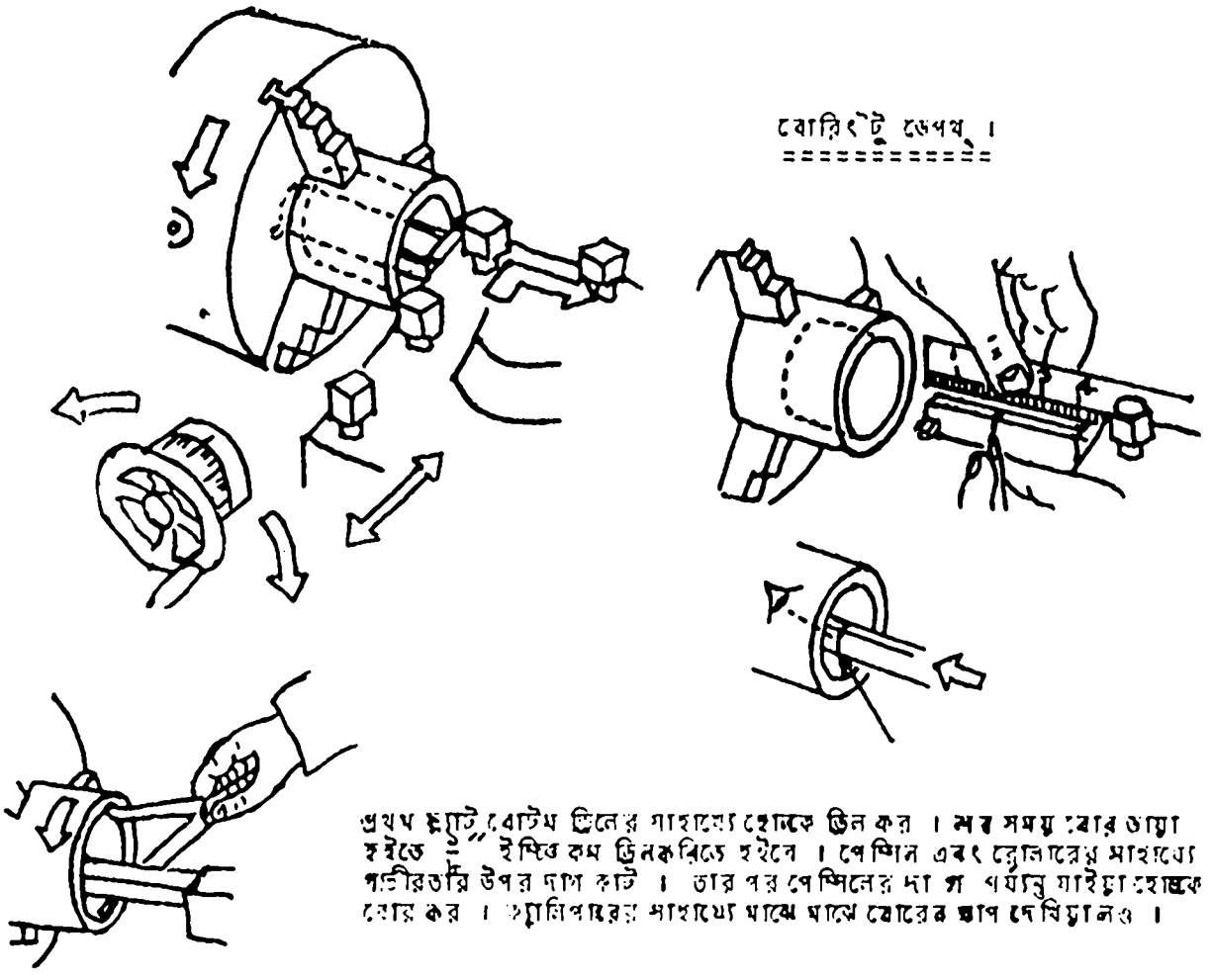
BORING HOLES ---হোল বোরিং পদ্ধতি ।---

যখন ড্রিল হোলকে বাড়ানোর প্রয়োজন হয় তখন বোরিং টুল ব্যাবহৃত হয় ইহা যতদূর সম্ভব লম্ব হইতে হইবে ।



বোরিং এ - হোল ।

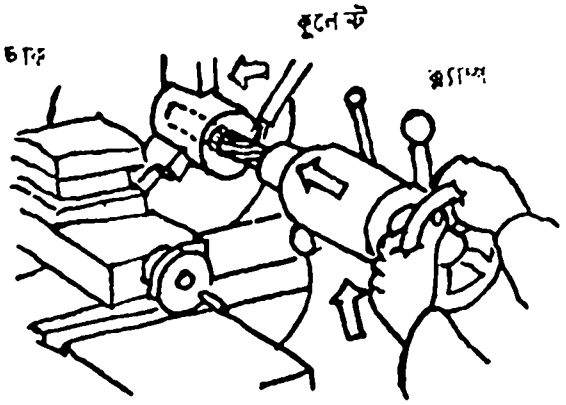
বুঝেয় নিশ্চিত হইতেহইবে যেন বোরিং টুলটা কাজের জন্য যথেষ্ট লম্বা হয় । হোলকে বড় করিবার জন্য এন্স ইডের সাহায্যে দাগ কাটিয়া লও । টুল একবার অতিক্রম করার পর ইহাকে সাধারণ সড়াইয়া হোল হইতে বাহির করিয়া আন । যখন বোরিং সামান্য ভাবে কাটে তখন একবারে $\frac{1}{32}$" এর বেশী যেন না হয় ।



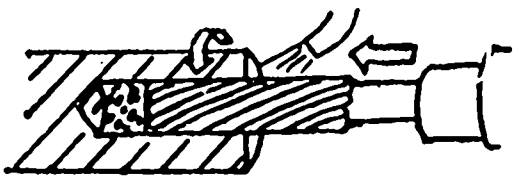
বোরিং টু ডেপথ ।

প্রথম ছোট বোটম ড্রিলের সাহায্যে হোলকে ড্রিল কর । সব সময় বোর আরম্ভ হইতে $\frac{1}{8}$" ইঞ্চির কম ড্রিলকরিতে হইবে । পেন্সিল এবং রুলারের সাহায্যে গভীরতার উপর দাগ কাট । তার পর পেন্সিলের দাগ পর্যন্ত যাইয়া হোলকে বোর কর । ক্যালিপারের সাহায্যে মাঝে মাঝে বোরের মাপ দেখিয়া লও ।

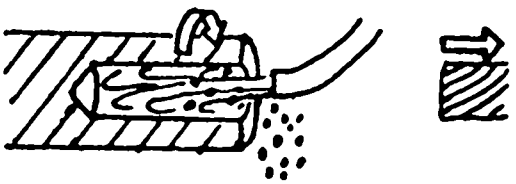
REAMING রিমিং ।



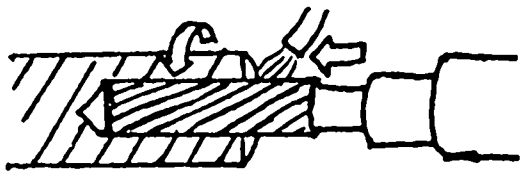
রিমিং প্রায় ড্রিলিং এর মতই কিন্তু এখানে তোমার অপেক্ষাকৃত দ্রুত শিড এবং দ্রুত ফিট প্রয়োজন । ভাল ফিনিস এবং সঠিক মাপের জন্য রিমার দিয়া কাটিতে অবশ্যই অন্ততঃ পক্ষে ·০১৬″ ইন্চি রাখিতে হইবে ভাল ফিনিস পাইতে এবং লৌহার গুড়া সরাইতে কুলেন্ট সাহায্য করে ।



যখন রিমিং করা হয় তখন রিমারের অগ্রভাগে লৌহার গুড়া জমা হয় এবং ইহা ছাড়া বেশী কাটা হইতে পারে তখন আটকাইয়া যাইতে পারে ।



ইহাকে বন্ধ করিবার জন্য রিমারকে অপসারন কর এবং কুলেন্ট এর প্রবাহ হোলের দিকে চালিত কর । মেশিনকে উল্টা দিকে ঘুরাও । তার পর গুড়াগুলি কুলেন্ট এর সংগে বাহির হইয়া যাইবে



এখন তুমি রিমারকে পুনরায় স্থাপন করিতে পার এবং প্রয়োজনীয় গভীরতায় হোলকে ফিনিস কর । সব সময় কুলেন্ট ব্যবহার করিবে ।

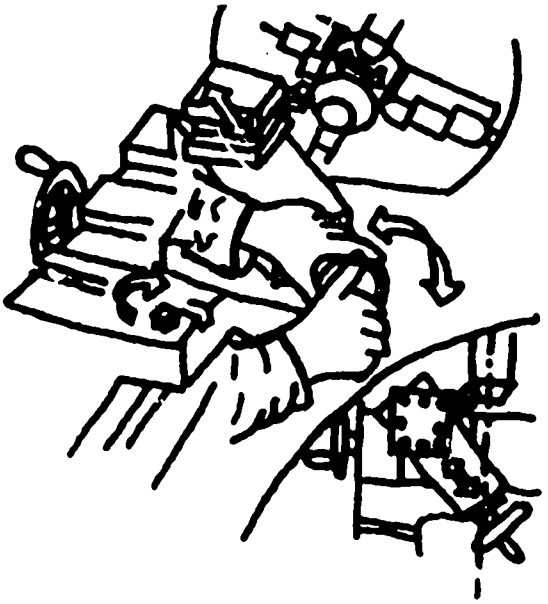
নোট:-
রিমড্ হোলের ফিনিশড্ ডেপথ হইতে ড্রিলিং এর গভীরতা অন্ততঃ পক্ষে ·১২৫″ ইন্চির বেশী হইতে হইবে ।

TAPER TURNING - I

ট্যাপার টার্নিং - ১

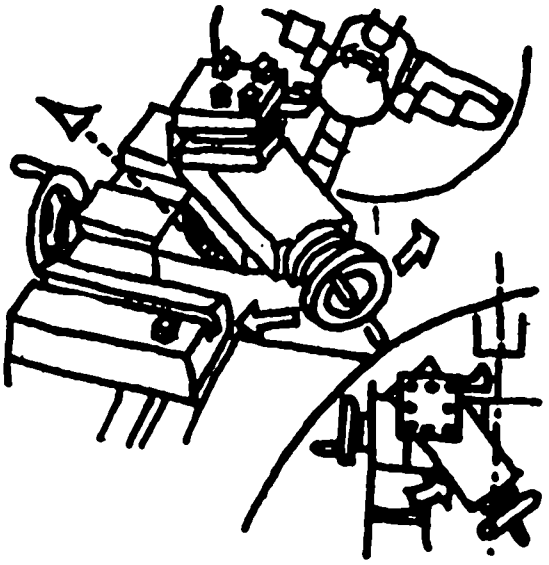
টার্নিং দি ট্যাপার :-

কম্পাউন্ড স্লাইডকে ইহার সর্বশেষ অবস্থা সেট কর। তার পর কাজকে ঘুরাও। ফুলক্রাম প্রয়োগ কর এবং ট্যাপার কাটা আরম্ভ কর। কম্পাউন্ড স্লাইডকে কাজের দিকে অগ্রসর করিয়া সুক্ষ্মভাবে কাট দাও। যতক্ষন না ফিনিস সাইজে আসে ততক্ষন বার বার এই ভাবে কাট।



ট্যাপার কাটিবার জন্য কাজের দিকে কি ভাবে টুলকে ওক্ত করা হয়।

কম্পাউন্ড স্লাইডের সাহায্যে ট্যাপার টার্ন করার পদ্ধতি :-



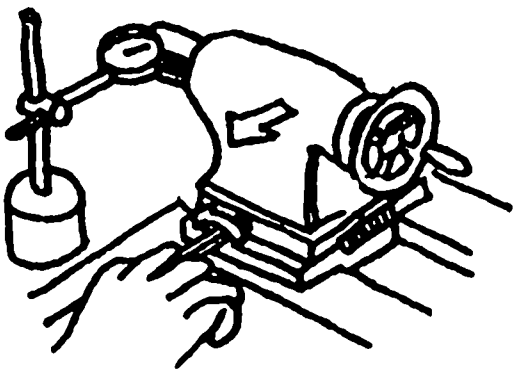
অনুভূত কোনের অর্ধেকে কম্পাউন্ড স্লাইড কে স্থাপন কর। টুলকে সঠিক সেন্টার সাইটে স্থাপন কর। ট্যাপার কাটিবার জন্য টুলকে সেট কর। নিশ্চিত হও যেন ট্যাপারের পূর্ন দৈর্ঘ্য কাটা হয়।

মেশিনের উপরি ভাগ হইতে তাকাইয়া কি ভাবে টুল এবং কম্পাউন্ড স্লাইড সেট করিতে হয়।

TAPER TURNING - II

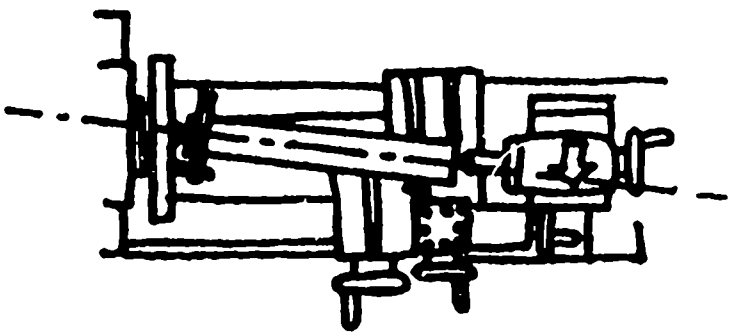
ট্যাপার টার্নিং অফসেট টেইল স্টকের ব্যবহার :-

কাজকে লেদের কেন্দ্রের মধ্যে স্থাপন কর । তার পর টেইল স্টককে ঘুরাইতে হইবে হিসাব কর । এখন টেইল স্টকের পিছনে ডায়েল গজ ব্যবহার করিয়া টেইল স্টক সেট কর । টেইল স্টক বেইজের সাইড ফেইস বরাবর ২ টা বিপরিত স্ক্রু এডজাষ্ট কর । স্ক্রুকে ডাইয়েল গজ এবং টেইল স্টক এর সেন্টার এর সংগে সেট কর । তার পর সকল স্ক্রুকে টাইট কর ।



লেদের উপরি ভাগ হইতে কাজকে কেমন দেখায় :-

ইহা টেইল স্টককে সঠিক অবস্থান হইতে বাহিরে এবং ট্যাপার গঠন করিতে ইহা কি ভাবে কাজের উপর চলাচল করে । তাহা দেখা ।



6. PREPARING MACHINESHOP EXERCISES

As explained in Section 4, on "Developing Workshop Exercises", the starting point is always: "What jobs could the student perform to maintain or develop this workshop ?" Once the job has been identified, the drawing is prepared. From the drawing and the instructor's knowledge of the skill breakdown, the job operation sheet is produced.

However, as was pointed out in Section 5, on "Developing Machineshop Material", machineshop skills are more complex than bench fitting in terms of the number of steps in the skill sequence. This largely affects the area of educational material, but it also complicates the job operation sheet somewhat. For this reason, we would recommend that the instructor follow the procedure shown here:

(a) Examine the drawing and job operation sheet shown on the next two pages.

(b) Prepare operation sheets for the two drawings which follow.

(c) Attempt to produce the jobs from his own operation sheets, and correct any weaknesses, omissions, etc.

(d) Prepare drawings and operation sheets for simple jobs required in the machineshop.

(e) Record all difficulties experienced by the student in using the operation sheets.

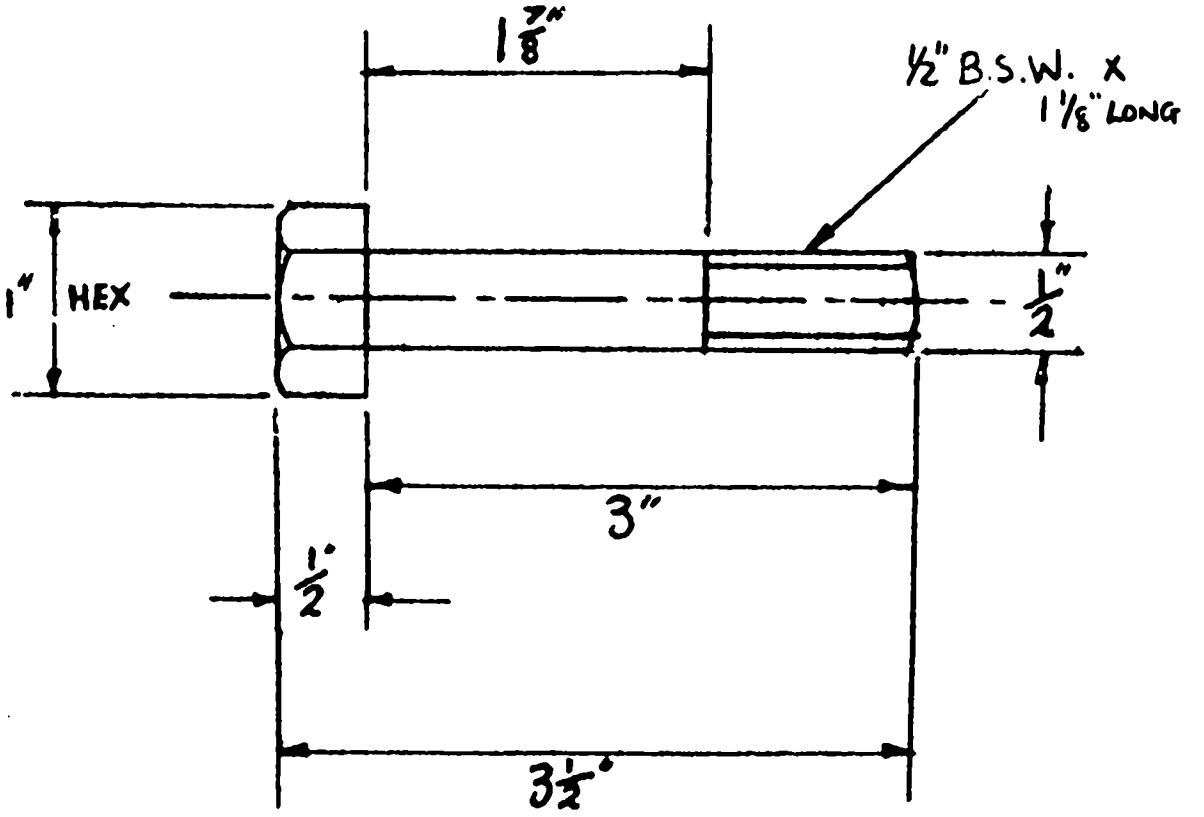
(f) Amend the operation sheet accordingly.

The instructor is now ready to proceed with the production of a range of drawings and job operation sheets for use on his course.

***

HALF INCH B.S.W. BOLT

NOT TO SCALE



ANY TRAINING CENTRE, ANYWHERE, BANGLADESH.	DRAWN BY:
	DATE:
	MATERIAL: 1" A/F M.S. HEX. BAR
	AMENDMENTS:

Operation Sheet

Half Inch B.S.W. Bolt

1. Hold in a 3-jaw chuck and face off one end.

2. Turn on the ½" diameter by 3" long, and face out at 3" length.

3. Die on the ½" B.S.W. thread 1 1/8" long with die stock and die, leaving 1 7/8" plain shoulder.

4. Reverse job in chuck and face off to length, 1/2" by 1" (± 0.032").

5. Chamfer head, 1/8" by 45 degrees.

6. Remove all sharp edges and burrs.

7. Hand in for inspection.

This is a very simple operation sheet, because the job is very straightforward.

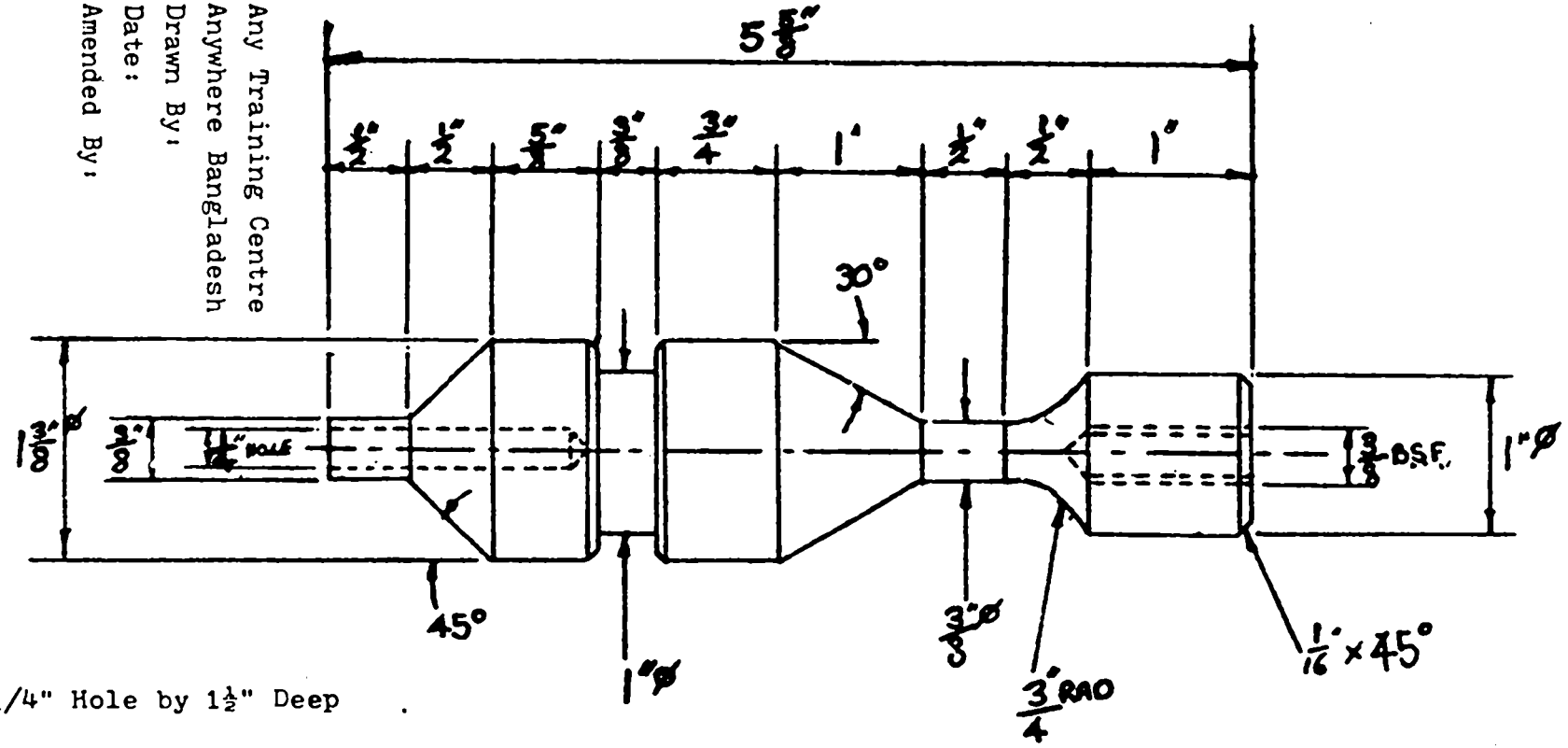
Now try preparing job operation sheets for the next two drawings.

Remember to try them out yourself and amend as necessary.

***

STEPPED SHAFT WITH TAPERS
(not to scale)

Any Training Centre
Anywhere Bangladesh
Drawn By:
Date:
Amended By:



1/4" Hole by 1½" Deep

3/8" BSF Tapped hole
by 1" Deep

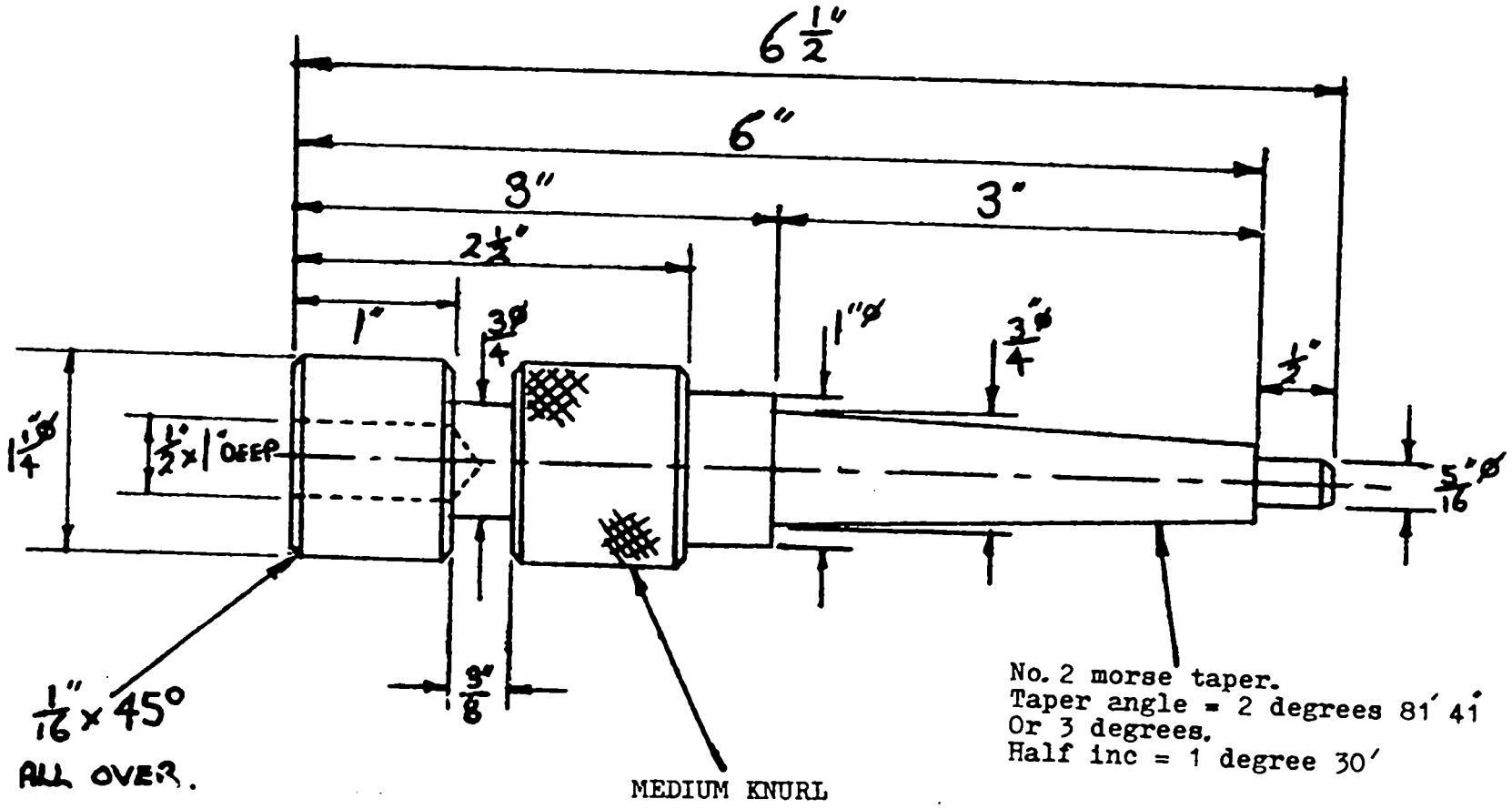
TOLERANCE

ALL DIAMETERS ± 1/64"

ALL LENGTHS ± 1/32"

Blank Bar Size = 1½"

No 2 MORSE TAPER TOOL HOLDER
(not to scale)



TOLERANCE -

ALL DIAMETERS ± 1/64"

ALL LENGTHS ± 1/32"

BLANK SIZE - 1½"

7. PREPARING LESSON PLANS

If the system outlined so far in this pamphlet is implemented, i.e. the work is done, then the preparation of lesson plans will be relatively easy, if not effortless. The lesson plan is the very last step in the process.

The System

The system outlined so far will be re-stated briefly and the connection with lesson planning made:

1. From the crude teaching/learning standard established in the introduction, the curriculum is designed or modified.

2. The curriculum contains an outline of the course and a more detailed course of study.

3. The course of study begins at the simplest and works towards the more complex skills, operations and theory.

4. The instructor selects modern technical texts with good visual aid content and marks the section or sections which he will teach.

5. Within that section, or those sections, he selects the material he is going to present visually.

6. He prepares visual aid information sheets.

7. He prepares accompanying basic skill operation sheets where necessary, i.e. where the skill is too complex in terms of number of steps to be undertaken for an average student to be able to retain it in his memory..

8. He examines the workshop environment to establish which production exercises he will design.

9. He prepares a drawing.

10. From this he develops a job operation sheet.

11. Now he must prepare his lesson plans.

12. First he must distinguish between theory lessons and skill lessons (or "demonstrations"). These should be taught separately for ease of learning.

    (a) Skill lessons should be performed on or with the equipment, tools, machines, etc., which are the subject of the lesson. They should be basically visual and experiential. The verbal part should be purely descriptive. (No complex theories or calculations should be included.)

    (b) Theory lessons should be taught in a classroom, but should always be related, in the instructor's verbal presentation, to practical applications.

13. No theory lessons should last more than 30/40 minutes, as the students' concentration will wane. Skill lessons should be considerably shorter.

14. The instructor now has in his presence all the material he requires for his lesson plans - information sheets, basic skill operation sheets, drawings, operation sheets and the course of study specified in the curriculum.

15. The curriculum determines both the order and pace of instruction. The order runs from simple to complex, whereas the pace of instruction

is determined by the length of the course and the amount of material to be taught. There will never be time in any training course to teach "everything".

16. The instructor begins the preparation of lesson plans by setting learning objectives - e.g. "The student will be able to set the speed gears of the lathe". This is obviously part of a skill lesson.

17. A number of compatible objectives may be combined in one lesson: e.g. "The student will be able to hold a file correctly"; "Will be able to file a flat surface"; "Will be able to file two faces square to each other"; "Will be able to file to a scribed line", etc.

18. A single objective will probably produce a boring lesson. On the other hand, more than 5 or 6 objectives will probably produce an over-long, or cramped, lesson and some of the objectives will not be achieved. Where more than 5 or 6 compatible objectives are identified, they should be grouped into two or more lessons. Incompatible objectives should never be combined.

19. The instructor begins by writing <u>all</u> his objectives for a specified period. He then combines them into workable lessons. If he has more lessons than lesson periods, he must eliminate the more complex material and teach the more basic lessons.

20. Then he divides the lessons into skill(demonstration) and theory lessons.

21. He then divides each theory lesson into four parts: 1. Introduction, (which links the lesson to previous lessons and provides the context for the new lesson). 2. Presentation, (wherein the content of the lesson, as defined by the objectives, is outlined). 3. Recapitulation, (which involves a brief, concise, summary of the presentation); and 4. Testing. (By asking specially designed questions, the instructor checks to ensure that he has achieved the objectives set for the lesson). Section 2 should be no more than 15 minutes long; the other three about 5 minutes each. (The lesson should be timed by the instructor).

22. Skill lessons should be divided into four parts: 1. Introduction, (e.g. application of skills to be taught, etc); 2. Demonstration, (in which the instructor demonstrates each step of the skill slowly and carefully). 3. Student Practice, (in which one or two of the students attempt to repeat the steps of the skill); and 4. Correction, (in which the instructor comments on the mistakes made by the practicing students and recapitulates the steps of the skill). The demonstration should not exceed 5 minutes. Student practice should not be less than 10 minutes. Parts one and four should be less than 5 minutes each.

23. Information sheets and basic skill operation sheets will normally be issued at the end of a skill lesson, or during Recapitulation in the case of a theory lesson.

23a. If education charts are used, (i.e. system 'C' in Section 2 on Preparing Visual Aids), then they are used from the beginning of the theory lesson, and the students are given time to copy the drawings into their notebooks. The information which would appear on the basic skill operation sheet, should, in the case of system 'C', be written on the chalkboard by the instructor and copied by the students into notebooks. (In the case of skill lessons, the notes are taken <u>after</u> the lesson is completed.)

24. A typical lesson plan might look like this:

Lesson No. Date:

Objectives: The student will:

1. Be able to hold a file correctly.
2. Be able to file flat surfaces
3. Be able to file two faces square to each other
4. Be able to remove all sharp edges and burrs.

Lesson title: Introduction to filing

SKILL LESSON/~~THEORY LESSON~~

1. Introduction: Explain the applications of filing.(2 to 3 minutes).
2. Demonstration: The instructor scribes two lines at 90 degrees near the edges of a piece of roughly square metal. He demonstrates the method of holding the file; files two sides flat and square to each other. He removes all sharp edges and burrs. (5 minutes).
3. The students practice these skills. (10 minutes).
4. The instructor corrects their errors and recapitulates the lesson.

NB: Issue all relevant information sheets and or basic skill operation sheets at the end of the lesson.

Objectives must be capable of being tested in a practical manner. Therefore they must consist of observable behaviour changes.

It would be useful at this stage if the instructor were to put some of the above procedures into practice:

a. Decide on a very simple job which you want a future intake of students to make for the workshop, (e.g. a washer, a parallel pin, a plain stud, etc.)

b. Prepare a drawing.

c. Prepare a job operation sheet.

d. Prepare a visual aid information sheet and a basic skill operation sheet to cover all skills necessary for the job.

e. From this information, prepare a lesson plan.

DO NOT READ ANY FURTHER UNTIL THESE EXERCISES HAVE BEEN COMPLETED.

Once you have completed these exercises, it becomes obvious that it really is not a very difficult job.

- You are now in a position to give a lesson from your lesson plan.
- At the end of the lesson you would issue the information and operation sheets.
- You could then give the student the drawing and job operation sheet and tell him to make the job.
- He would still need some supervision.

It really is that easy.

Finally, here are some questions to be answered:

1. What is the first item to be written <u>before</u> lesson plans are prepared ?

2. Is it wise to use one objective per lesson ?

3. How many types of lesson plan are there ?

4.a. How many parts are there to a theory lesson plan ?

4.b. Name them.

5. What factor determines whether certain objectives may be combined ?

6. Where does the instructor get the information for his lesson plans ?

Now check your answers carefully against the text above. If they are all correct, you have absorbed the substance of the system. If not, then go back to the beginning of this section and re-read it. When you get all the answers correct, you are ready to start the real thing; preparing all necessary educational material for your course.

Happy teaching.....

ABOUT THE AUTHORS

Jim Byrne and Malcolm Willis are both mechanical engineers by trade, engineering instructors by experience, and appropriate technologists by inclination. They both came to Bangladesh as organisation and training consultants seconded by the British Volunteer Movement to an International Labour Organisation/Norwegian Agency for International Development organisation and training programme at the Marine Diesel Training Centre, Narayanganj.

Jim Byrne has a varied background in many aspects of engineering - (chemical, electrical, mechanical, etc.,) - and in administration and training. He is a graduate of Ruskin College, Oxford, where he specialised in industrial relations and economics. He also holds a certificate in advanced machineshop practice from GTC Enfield Training Centre, Enfield, Middlesex, England.

Malcolm Willis, who was educated at Burford Grammar School, Oxfordshire, England, has a solid background in mechanical engineering. His apprenticeship was in all aspects of mechanical engineering, with emphasis on fitting/turning, tool making and machine maintenance. He holds a full certificate in mechanical engineering from the Engineering Industry Training Board (UK), and is a graduate (with credit) from Oxford Polytechnic.

They have both worked as Appropriate Technology consultants to the Education and Urban Services Section of UNICEF Bangladesh, and are currently working as Workshop & Village Technology consultants to the Village Education Resource Centre, (SCF/CDF), Savar.

WORKSHOP PRACTICE is designed to assist instructors in the step-by-step process of training the technicians who must design, make and maintain mechanical implements. This Manual explains in simple detailed steps both how to create a functioning workshop and how to use simple tools for the production of equipment in a classroom/workshop environment. It stresses safety precautions and the proper care of machinery.

ADAB takes pride in publishing this pioneer work.

The authors and ADAB welcome suggestions for its improvement and reports on experience in its use.

Winburn T. Thomas, PhD.
Nancy M. Straughan

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Winburn T. Thomas, an Educator who came first to Asia forty five years ago is Director and Co-Founder of ADAB. He also is Editor of the ADAB NEWS which by January 1,1978 reached a monthly circulation of 3,000 copies. This international publication has pioneered in stressing appropriate technologies for Bangladesh as well as providing current and relevant agricultural and rural development information. ADAB NEWS is practical in scope, undertaking to present complicated information in lay language.

Nancy M. Straughan is a teacher and independant international consultant currently working as Co-Editor of the ADAB NEWS. Additionally she is editing a manual on appropriate technology for Bangladesh, for which she has been research advisor. This forthcoming publication is by the authors of WORKSHOP PRACTICE.

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An Abridged List of Appropriate Technology Publications Available in the ADAB Library:

* CHINESE CHAIN AND WASHER PUMPS, by Watt, Simon. Publisher: ITDG, 1976.

* TECHNOLOGICAL SELF-SUFFICIENCY, by Clarke, Robin. Publisher: Faber& Faber, London.

* TOOLS FOR AGRICULTURE, A Buyers Guide to Low Cost Agricultural Implements, by Boyd, John. Publisher ITDG 1976.

* LIKLIK BUK, A Rural Development Handbook for Papua New Guinea. Publisher:Liklik Buk Information Centre Papua New Guinea.

* APPROPRIATE TECHNOLOGY, A Handbook. Publisher: Brace Research Institute, Canada.

* APPROPRIATE TECHNOLOGY SOURCEBOOK by Darrow,Ken & Pam, Rick. Publishers: Volunteers In Asia USA.

* FIRST STEPS IN VILLAGE MECHANIZATION by MacPherson, G.A. Publisher: Tanzania Publishing House Dar Es Salaam

* ENERGY AND AGRICULTURE IN THE THIRD WORLD (report) by Makhijani, Arjun & Poole, Alan. Publisher: Ballinger Publishing Company, USA

* RADICAL TECHNOLOGY, edited by Bovle, Godfrey & Harper, Peter. Publisher: Pantheon Books.

* EXPERIENCE IN FARM MECHANIZATION IN SOUTH EAST ASIA by Southworth, Herman. Publisher: A/D/C New York, USA

* SMALL IS BEAUTIFUL by Schumacher, E.F. Publisher: Spher Books, Ltd. 1977

* ENERGY FOR RURAL DEVELOPMENT, National Academy of Science.

* SIMPLIFIED WIND POWER SYSTEMS FOR EXPERIMENTERS by Park, Jack. Publisher: Helion, California, USA

* WATER LIFTERS AND PUMPS FOR THE DEVELOPING WORLD, by Wood, A.D. Publisher: AID, Washington, USA

* ECONOMICALLY APPROPRIATE TECHNOLOGIES FOR DEVELOPING COUNTRIES, An Annotated Bibliography, by Carr Marilyn. Publisher: ITDG, 1976

* HAND PUMP MAINTENANCE. Publisher: ITDG

* AGRICULTURAL MACHINERY DEVELOPMENT PROGRAM by IRRI, Philippines. Publisher: AID, Washington

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