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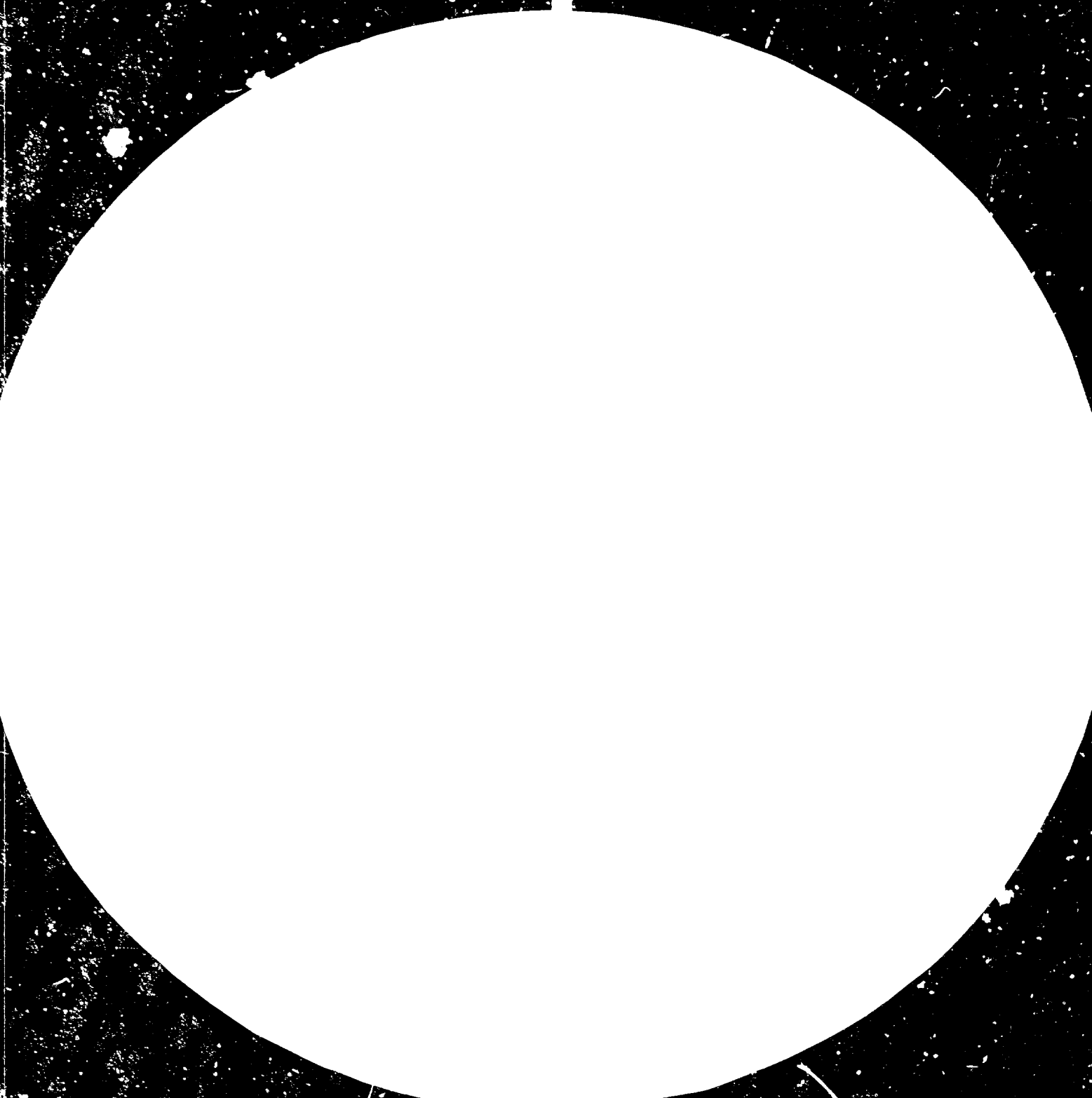
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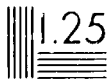
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MANUFACTURING TECHNOLOGY OF COMPAX DIAMOND BLANKS

DP/CPR/80/053

CHINA

Technical report: The production of diamond tools made of  
polycrystalline diamond blanks and  
diamond grit

Prepared for the Government of China  
by the United Nations Industrial Development Organization,  
acting as executing agency for the United Nations Development Programme

Based on the work of Jürgen Lang,  
adviser in diamond tools

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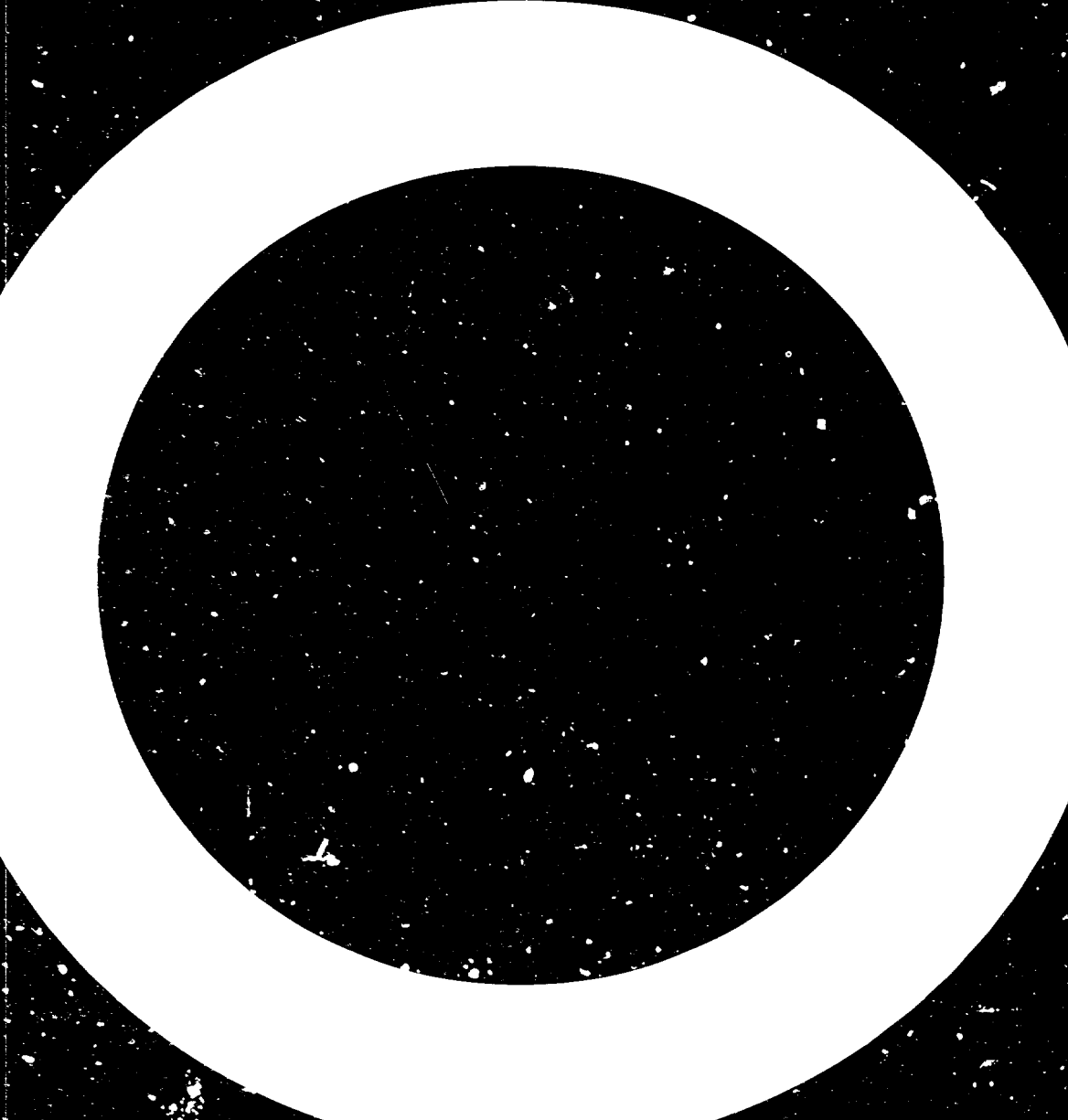


ABSTRACT

As a part of the United Nations Development Programme project "Manufacturing technology of compax diamond blanks" (DP/CPR/80/053) an expert was sent by the United Nations Industrial Development Organization to Beijing, China for one month to advise on the technical requirements for the production of diamond tools.

The mission was carried out from 5 October to 3 November 1982.

Many of the processes involved in the manufacture of compax diamond (CD) tools from diamond grit are trade secrets or protected by patents. Therefore the work assumed the use of other raw materials which are available in China, the development of indigenous production technology and the use of diamond grit now held in stock for other purposes.



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## INTRODUCTION

As a part of the United Nations Development Programme project "Manufacturing technology of compax diamond blanks" (DP/CPR/80,053) an expert was sent by the United Nations Industrial Development Organization (UNIDO) to Beijing, China for one month to advise on the technical requirements for the production of diamond tools.

The mission was carried out from 5 October to 3 November 1982.

The purpose of the mission was to investigate production methods, equipment and raw materials for CD blanks to be used for drill bits and other tools and to investigate further production possibilities. There is a growing demand in China for a larger variety of large-size tools for oil and rock drilling, implying CD rather than natural-diamond tools. As the Beijing Drilling Tool Factory produces diamond grit and as at least 1 million carats of the production capacity of 1.6 million are unused, it was initially thought that such excess grit could serve as a raw-material input for the production of CD. However, tests indicated that the grit does not meet the requirements for CD manufacture, and that further satisfactory test results cannot be foreseen. Nonetheless, as other CD precursors are available in China the production of some turning and milling tools may be envisaged. Thus production could begin before locally made CD precursors are available. The need of the users of these tools for high quality would then be satisfied.

## I. FINDINGS

### Tool production

For the purpose of tool production the Beijing Drilling Tool Factory received, within the terms of the UNIDO project, a diamond grinding machine. Tool production will also require both a brazing machine and a profile projector for quality checks.

The factory can envisage production of several new tools. Electroplated tools can be made. The excess diamond grit could be used for these tools, made using plating equipment. Diamond saws may also be made. The existing presses may be used for the production of diamond saws. Production should begin quickly as the processing is similar to the one of drill bits.

The Beijing Drilling Tool Factory should also try to produce CD raw material. However, it is not necessary to wait for such production as CD raw material is available in China and the diamond grit produced in the firm can be used for other tools.

However, all the above production techniques are kept secret by tool producers. Therefore this knowledge cannot be transferred within this project. The only possibility to produce high-standard tools meeting the needs of the Chinese industry during the short term, is to take licences or to co-operate otherwise with foreign partners.

For the production of diamond grit the Beijing Drilling Tool Factory has 16 hydraulic presses built in China and 3 presses built in Sweden. The capacity is at least 1.6 million carats (according to the information of the Beijing Drilling Tool Factory). Eighty per cent of the current production is unused.

The diamond grit seems to be of good quality and quantity and its use for other tools was tested. Production equipment for tools includes middle frequency presses and equipment for drill bits, and galvanic baths for electroplated tools.

### Raw material

An optical test indicated the quality of the diamond grit to be adequate, however, CD precursor materials produced up to now do not meet the quality requirements. Whether or not they can be used for drill bits is left to further tests.

### Equipment

The existing equipment for producing drill bits is not used to full capacity and therefore could be used for processing the unused grit for diamond saws. A high frequency brazing machine, costing approximately DM 72,000, and an equipped profile projector, costing approximately DM 20,000, are necessary to carry out production of CD turning and milling tools.

The electroplating baths meet the latest technical developments and can also be used for the production of electroplated tools.

#### Process techniques

The production methods for drill bits and those for electroplated diamond tools are a very good basis for expansion of the production to diamond saws and other electroplated diamond tools.

#### Techniques for new tool production

##### CD turning and milling tools

The production methods for CD turning and milling tools are new. The raw materials have to be brazed onto a shank and then ground and lapped. These techniques determine the quality of the tools. Poor technique may cause the destruction of the raw material (during the brazing process). Thus additional knowledge and experience is required.

##### Diamond saws

The production techniques parallel those of production conditions for drill bits. However, detailed knowledge and experience is necessary for bonding.

##### Electroplated tools

There is sufficient knowledge of the technique.

#### Informational needs and know-how required to use tools

##### CD tools

Knowledge of the use and the equipment (as well as knowledge of the production technique) affects the quality of the tools and tool life. There is not enough knowledge of equipment use.

##### Diamond saws

Knowledge of development of the bonds is important.

##### Electroplated tools

The special knowledge required is minimal.

#### Market possibilities

For the sales of all new tools knowledge of the market is required. Knowledge of the market is also necessary for the decision which tool geometries should be produced and where there is a need for the tools. The three groups of new tools are greatly needed on the Chinese market. Afterward new markets could be developed. Some possibilities for use on the Chinese market are:

CD tools for turning and milling:

- Al-Si alloys (pistons, tubes etc.)
- Cu and Cu-alloys
- Graphite
- Tungsten carbide and green tungsten carbide

Diamond saws for sawing of:

- Marble
- Granite
- Artificial stone
- Concrete

Electroplated tools:

- Saw wire
- Profile wheels
- Dental tools
- Small wheels for sawing marble and granite

## II. INTRODUCTION OF NEW TOOLS

Based on the three new groups of tools a modification of the existing production techniques and an addition to the machine equipment is required.

### New production techniques

#### CD turning and milling tools

The process technique is only in a phase of experimenting. Therefore comparisons must be made between the Chinese raw material and the raw material of other countries using tests with finished tools as a basis. The finished tools should be fitted with different kinds of material to find out whether the material obtained in China meets the requirements in the tool. For this there must be adequate knowledge of brazing, grinding and lapping.

It is also necessary to know the different tool geometries depending on the materials to be processed and on the machines for which the materials will be used. At this place the knowledge of application technique and production technique has to be co-ordinated.

#### Diamond saws

Some modification has to be made for the production of diamond saws.

#### Electroplated tools

Current production methods can be continued. In some cases an improvement of the production method should take place.

### New equipment

#### CD turning and milling tools

In addition to the diamond grinding machine a brazing machine and a profile projector are needed.

#### Diamond saws

Segment-forming tools are required. Auxiliary equipment can be made by the factory. In a later extension phase the acquisition of a brazing machine for saw segments can be taken into consideration.

#### Electroplated tools

Some minor auxiliary equipment is necessary.

