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Technical Note:

PRODUCTION OF BLANKING CIRCLES AND DIES - AN APPROPRIATE METHOD

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ABSTRACT

A large important blanking die for production of multiwick stoves oil tanks was damaged beyond repair during normal maintenance. A replacement die could not be made available immediately. Initially an alternative blank production system based upon the adaptation of the inhouse and locally available tools was set up. Subsequently a temporary low cost and a permanent replacement blanking die was designed, developed and manufactured out of pad welding of mild steel plate. Recommendations have been drawn in light of the experiences gained in the deployment of these appropriate methods.

1.0 INTRODUCTION

In the process of industrialization, developing countries are setting up industries to manufacture various products for the Tanzanian market. The bulk of these products are based on pressed sheet metal component employing a large number of imported tools and dies.

By large, the normal maintenance of the same does not present a problem but replacement in the event of a complete breakdown can have serious consequences due to lack of design data, technical capabilities, materials and financial implications.

Such a situation arose in a newly set up large press shop producing multiwick stoves. A large important die for oil reservoir tanks production was found to be damaged during sharpening. See Fig. 1. The same was sent to us for repair.

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In the course of this work a new design and manufacturing approach developed in order to sustain the production targets.

2.0 METHODOLOGY

2.1. Damaged Die

Investigations carried out on the die indicated that it was a blanking die for the production of circular blanks. This Oil Tanks Blanking Tool-T_1 (Fig.4) consisted of a punch and die ring set in a cast iron holder. The die ring set made in tool steel was found to be badly flaked and severe grinding cracks existed. Discolouration of the material indicated that excessive heat generated during sharpening may have caused the damage. The extent of the damage present indicated that the blanking die was irreparable and had to be scraped.

2.2. Remedial Action

A replacement die could not be made available immediately and the production of the multiwick stoves was severely disrupted. It became evident that a need existed to provide the blanking circles immediately from another source and a replacement die as soon as possible.

2.3 Blank Production

2.3.1 Design Background

In order to be dully conversant with the production of the oil tank, it was found that four stages of component manufacture existed and are as shown in Fig.1. The blanking Tool-T_1 produced circles of diameter $332 \pm 0.5mm$ from a strip feed of 26 SWG, SPCC-SD sheet (Ref.1). These blanks were placed in the circular groove in the First Draw Tool-T_2 to produce a drawn component. It was observed that the completely circular shape could be slightly departed from if the blank edges were flat and the tolerance diameter dimensions maintained. Hence a study was conducted in order to set up an alternative blank production system (Fig.2) based upon use of square blanks and the adaptation of the inhouse and locally available tools to cut tangents and profile curves. The power, manual guillotine and a pedestal nibbling machine were identified and selected as the equipment to be used in the production.

2.3.2. Square Blanks

Square blanks, size $332 \pm 0.5mm$ from 26 SWG-SPCC-SD sheet were cut with a powered Guillotine (Ref.2). This is the same production method used when obtaining the feed strip for the blanking Tool-T_1.

2.3.3. Octagonal Blank

The production of the octagonal blanks was achieved by cutting tangents off the square blanks with the help of an attachment fixed to a Hand Guillotine specially designed for the job (as shown in Fig.3) was used. The square blank was held between two horizontal plates which can rotate about their own vertical axis. The top face plate has series of equispaced 2mm location holes at pitch circle diameters rings of 160 and 200mm. The former has 8 and the latter 40 such indexing holes. Two spring loaded balls are held in the body of the clamp which locate in the top face plate, hence an indexing mechanism exists. The position of the clamp can be varied in relation to the Guillotine blade and the distances X and Y set to 165.5mm. The indexing plate with 8 equispaced holes is engaged and monitored. Hence the indexing of the blank square was through 45° and the material cut at this position by hand guillotine. In 4 to 8 cuts the square blank was transformed into an octagonal blank. The lower number of cuts resulted when the square blank was initially dimensionally correct.

2.3.4. Circular Blank

2.3.4.1. Tangent Method

The next step involved the use of the second series of indexing holes. Forty equally spaced holes at a pitch circles diameter of 200mm were located progressively and the hand guillotine used at that instant.

Hence after one revolution of the top face plate a forty sided blank with theoretical diameters between 331.5mm and 332.5mm could be obtained. Practically this was achieved consistently. Care had to be taken in gently operating and maintaining sharp edges on the guillotine in order to minimize drawing of the cut edge. An average production rate of 20 blanks per hour were obtained.

2.3.4.2 Profile Method

A pedestal electrical type of nibbling machine was identified which was available with a subcontractor. After several trials the production method evolved using the octagonal blanks as produced in 2.3.3. Once the latter had been produced, a special 332mm drafting template made from mild steel was used to scribe a circle on the octagonal blank. The skilled worker then used the nibbling tool and cut as close as possible to the scribed circle.

The quality of the circular cut edge of the blank was found to improve with the correct sharpness of the nibbling tool and maintaining the horizontal level of the blank whist being cut. The finished diameter of the circular blank was easily obtained within the specified dimension $332.0 \pm 0.5mm$. An average production rate of 52 blanks per hour were obtained.

2.4. Blanking Die

2.4.1. Design Background

An indepth study of the Oil Tank Blanking Tool-T_1 was done in 2.1 and is illustrated in Fig.4. This revealed that only the die ring needed to be replaced. The die ring could be imported but the time and foreign exchange requirements were prohibitive. The nominal sizes of this die ring were, internal diameter 332mm, outside side diameter 402mm and a thickness of 35mm. Tool steel material was not readily available in Tanzania in this size, but only st. 37 plain carbon mild steel. A further complication arose that the heat treatment furnaces available were unable to accommodate the ring.

In view of the points mentioned above a need existed to design, develop and manufacture a low cost temporary and a long time replacement die out of mild steel plate st. 37. The design details are presented in Fig.5 and 6.

2.4.2. Temporary Blanking Die

In this case a die ring was designed and manufactured out of 50mm thick st. 37 plain carbon mild steel plate. Rings were cut from the same with a profile flame cutter. The ring was completely machined to the final sizes (see Fig.5) the same was carburized using an electric furnace at 920° for six hours. The quenching was done in water. The hardness attained at the cutting edge was 800HV. It was necessary to clean the horizontal surface by using minimal surface grinding.

The blanking die was put into production and the first resharpening done after 1080 blanks. The subsequent resharpening after 600 blanks proved to be fatal. The surface hardness was found to be 480HV. and the case depth had been exhausted.

2.4.3 Replacement Blanking Die

In order to achieve longer service life, surface pad welding of a profile cut in the die ring as per 2.4.2 was used. With the correct design and manufacturing utilising manual consumable - electrode AC arc welding can result in a low cost but functionally satisfactory blanking die. The rectangular profile machine in the case hardened die ring was cut shown in Fig.6. Two different types of 3.2mm diameter electrodes were used and these were Castolin 680 to produce a buffer layers to absorb contraction stress and reduce deposit crack sensitivity. This layering was started with Stringer beads (Ref.4) of Castolin 680 and each bead was peened and three passes to build up the area was done. Subsequently the Tooltectic 6HSS electrodes with material property for hard wearing and ability to maintain sharp cutting edge were used to produce Stringer beads on the built up area. After peening a complete built up of the cutting edge was deposited. Maximum of four passes were used. The ring was left for two days before machining.

The die ring was set on centre lathe and then machined using Tungsten carbide tools and grinding using tool post accessories. Final shapening of the cutting edge was done using surface grinding as per detail A Fig.5. The hardness attained was 58HRC.

The blanking die was put into production and fist resharpening done after 5000 blanks. So far about 8000 blanks have been cut and the cutting edge is performing satisfactorily.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1. Blank Production

The concept of using inhouse and locally available tools has resulted in the setting up of two alternative blank production system. However due to the attainment of lower production rates this methodology should be used only in an emergency. It is recommended that for a large press shop, a circle cutting machine is a must to minimize cost of blank production for medium runs and in case of emergency.

3.2. Blanking Die

An appropriate replacement blanking die was development at the fraction of the cost of a new tool steel die using locally made materials and processes. This technique of surface welding can be used for the development of new tool and die sets.

4.0. REFERENCES

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FIG.1: OIL TANK PRODUCTION SEQUENCE (Scale 1:4, dimensions in mm)

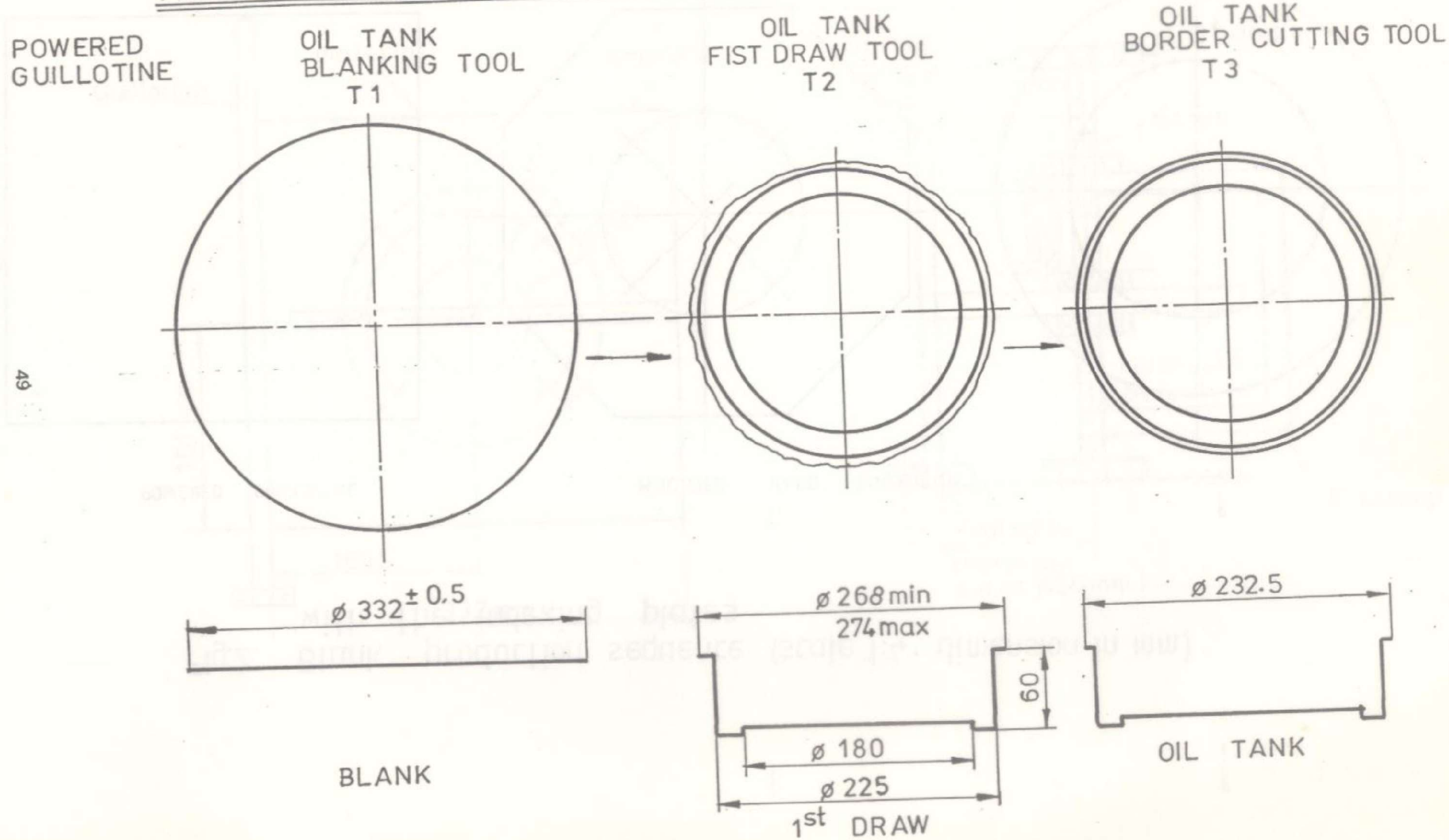

Fig.2. Blank production sequence (scale 1:4 dimension in mm) with the indexing plates

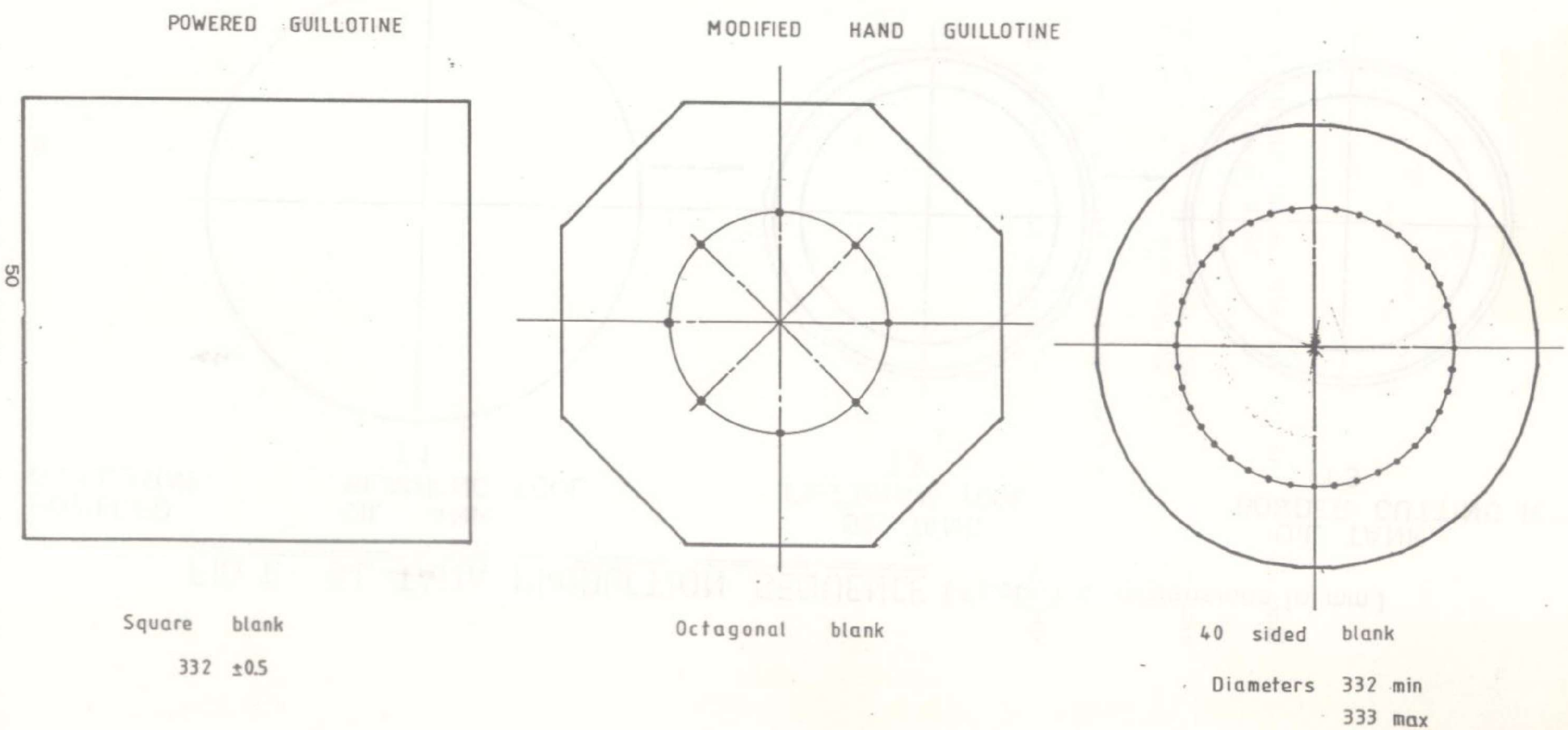

Fig 3—Modified Guillotine