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AOD-TR-78-001

FINE BLANKING SMALL CALIBER WEAPON PARTS

JOHN JUGENHEIMER
ROCK ISLAND ARSENAL

NOVEMBER 1978

FINAL REPORT

U.S. ARMY ARMAMENT COMMAND

ROCK ISLAND ARSENAL

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objective of this project was to investigate the feasibility of fine blanking small weapon components to close tolerances. Of particular concern was the applicability of the process to higher alloy materials. Eight parts which represented a variety of size, shape, thickness and material were selected. Fine blanking dies and a sample lot of blankings were produced for each part. Five of the test parts were blanked satisfactorily. Two parts

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) could be produced satisfactorily by changing material thickness or blanked configuration. One part was unacceptable due to extensive tears. Fine blanking presses and dies are high cost items. Average tooling cost was $7,922 per die set and equipment costs may be as high as $490,000. The average cost reduction was $5.19 per part. Fine blanking is an effective and cost reducing process when properly utilized. High carbon alloy steels can be successfully fine blanked. Material must be properly annealed as hardness is critical. The fine blanking process is applicable to the production of ordnance parts. However, large production quantities are required to realize an economic advantage.

1. INTRODUCTION

Fine blanking is a metal stamping process which produces parts with edges and holes fully shaved through the entire part thickness while holding very close part tolerances. It also can produce holes and webs less than part thickness.

In conventional metal stamping, a punch pushes the part out of the feed stock through a hole in the die. This process produces a part with much of the edge surface broken away and bends the part (see Figure 1).

When utilizing the fine blanking process, the feed stock is held between the top and bottom dies by a V-Groove. This keeps the stock flat and prevents the material from pulling in toward the punch. As the punch pushes the part out of the feed stock, a lower "punch" applies a counter pressure. This aids in keeping the part flat while the punch extrudes the part through the die (see Figure 2).

2. OBJECTIVES

The objective of this project was to investigate the feasibility of fine blanking small caliber weapon components to close tolerances and at a reduced cost when compared to conventional manufacturing processes. Of particular concern was the applicability of the fine blanking process to the higher alloy materials required in small arms fabrication.

3. PROCEDURE

A large number of small arms components were studied and a group of suitable candidate parts identitifed. From this group, eight parts were selected which represented a variety of part size, shape, thickness, and material (see Table 1).

A contract was let to Forming & Fabricating Equipment Company to manufacture the necessary die sets to produce a fine blanking for each of the eight parts. The contract also called for the production of a sample lot of fine blanked parts from each die.

4. RESULTS

The die sets and sample parts were produced and sent to Rock Island Arsenal for evaluation.

4.1. TRIGGER GUARD - PART NO. 7790618

The trigger guard (Figure 3) was blanked from 1065 steel, 5/64 inch thick. This component was blanked to finished outside contour and with all required holes. Only bending and finishing remained to be done on the fine blanked preform. This component was an excellent application of fine blanking with an estimated cost savings of $3.10 per unit. The sample parts produced are held for a future order.

4.2. PAWL, CARTRIDGE GUIDE - PART NO. 7793244

This part (Figure 4) was blanked from 3/8 inch thick 4140 steel annealed to Rb90 maximum. The fine blanked pawls had a high percentage of corner tears on all four corners. These tears made the blanks unusable. A redesign of the dies to allow additional stock on the corners would probably allow the successful blanking of this part at the cost of a small amount of additional machining. Estimated cost savings of the redesigned blanked component is $1.47 .

4.3. HAMMER - PART NO. 7792878

Blanked from 1/4 inch thick 4150 steel annealed to Rb90 maximum, the hammer was successfully produced with only an occasional small corner tear on the front corner (see Figure 5). Finish machining will remove the occasional tear and allow use of this component as presently blanked. Cost savings for this part are calculated at $6.91 . The sample parts are held for future use.

4.4. RETAINER, CARTRIDGE CASE - PART NO. 7791378

The retainer was blanked from 4340 steel annealed to Rb90 maximum, 1/4 inch thick (see Figure 6). The test lot of this component showed frequent corner tears on all corners and frequent side tears on the long sides (see Figure 7). The maximum depth of the tears observed was 0.025 inches. A metallurgical examination of the parts showed a spheriodized annealed microstructure with no apparent defects in grain structure or stress risers at the tear sites. Material hardness tests were run on transverse sections of parts with no tears, slight tears, and severe tears. The results indicate that while tears increase as hardness increases there are other factors that influence part tearing. It is felt that the small radius configuration of this component also contributed to the tearing problem.

4.5. STRIPPER, CARTRIDGE LINK - PART NO. 7793234

The stripper (Figure 8) blanked from 8620 steel annealed to Rb90 maximum, 1/4 inch thick. This part experienced a small amount of corner tearing when blanked. The finish machining operation would remove most of these corner tears. Other corner areas would require additional stock to allow for machining cleanup. This component should also be blanked from slightly thicker stock. The finish thickness is .248 - .003 inch. Blanked from 1/4 inch stock, there is insufficient thickness to allow removal of the die roll on the blanked part. Cost reduction on this part is estimated at $5.57 per unit.

4.6. SPACER - PART NO. 5140444

This component was blanked from 1018 or 1022 steel, 3/16 inch thick. The spacer was a very good fine blanking. The sample parts were used in production. The fine blanked parts were produced at a savings of $0.96 per piece. This represents a savings of 31 percent.

4.7. WASHER, KEY, BEARING RETAINER - PART NO. 10908460

This part was successfully blanked from 1018 or 1022 steel, 1/8 inch thick. These parts were used in a production order. A cost comparison is not available for this component. Figure 9 shows a section of the stock this part was blanked from. Note the impression left in the material by the V ring.

4.8. WASHER, FLAT - PART NO. 10892151

The washer, at an 11-3/4 inch diameter, was the largest part produced as a fine blanking (Figure 10). It was blanked from 1008 or 1010 steel, 1/8 inch thick. This component was very successful, and the sample parts were utilized on a production order. A $1.05 cost savings was realized per part.

4.9. ECONOMICS

In addition to the eight components actually produced, an engineering estimate of the cost savings for ten additional parts suitable for fine blanking was prepared. These results are summarized in Table 2. The average tooling cost is $7,922 per die set. The average cost savings per part produced is $5.19 .

Using an equipment cost of $490,000 for a 440 ton Feintool fineblanking press and the average part savings of $5.19, a break-even point of 94,412 parts is calculated. A five-year payback of equipment costs would, therefore, require an annual production of 18,883 components. In addition to the equipment costs, it would also require the production of over 1,500 units of each part to pay back the tooling cost.

5. CONCLUSIONS

Fine blanking is an effective and cost reducing process when properly utilized. Accuracy is very good, and the process can produce blanked forms which eliminates a large amount of finish machining.

High carbon alloy steels can be successfully fine blanked; provided the material is spheriodized annealed and of the proper hardness. The harder the material, the more likely that tears will occur in the blanked edge. Part configuration is also more critical with the high carbon alloy steels than with softer materials. A part with a sharp radius is much more likely to develop corner tears than one with a more gentle contour. Blanking higher alloy materials may also reduce die life by up to 50 percent.

The fine blanking process is applicable to the production of certain ordnance components. However, for the process to be economical, large production quantities are required to justify the cost of equipment and tooling.

TABLE 1

TEST PART SUMMARY

COMPONENT	PART NUMBER	MATERIAL	THICKNESS	PRESS SIZE	TOOLING COST
Trigger Guard	7790618	1065 or 1075	5/64"	--	$ 4,660
Pawl, Cartridge Guide	7793244	4140	3/8"	250 Ton	5,960
Hammer	7792878	4150	1/4"	250 Ton	4,490
Retainer, Cartridge Case	7791378	4340	1/4"	250 Ton	4,120
Stripper, Cartridge Link	7793234	8620	1/4"	350 Ton	10,450
Spacer	5140444	1018 or 1022	3/16"	250 Ton	4,950
Washer, Key, Bearing Retaining	10908460	1018 or 1022	1/8"	350 Ton	12,000
Washer, Flat	10892151	1008 or 1010	1/8"	440 Ton	17,250
			AVERAGE TOOLING COST -		$ 7,922

TABLE 2

CALCULATED COST SAVINGS

COMPONENT	PART NUMBER	STD HRS/ PART SAVED	PERCENT OF SAVINGS	DOLLAR SAVINGS
Trigger Guard	7790618	.1033	--	$3.10
Pawl, Cartridge, Guide	7793244	.079	25.0	1.47
Hammer	7792878	.2304	42.1	6.91
Stripper, Cartridge Link	7793234	.1857	44.8	5.57
Spacer	5140444	.032	31.0	0.96
Washer, Key, Bearing Retaining	10908460	--	--	--
Washer, Flat	10892151	.0350	12.0	1.05
Cam Feed	7793600	.3072	22.4	9.22
Retainer	8433380	.4656	37.8	13.97
Ring, Lock	10936118	.0930	76.9	2.79
Lever, Feed Actuator	7791449	.5383	52.1	16.15
Rack	8433665	.5176	76.6	4.73
Pawl	8429555	.0507	52.6	1.52
Disc	12000536 & 538	.1219	74.5	3.66
Disc	12000535 & 539	.0525	60.6	1.58
AVERAGE		.2009	46.8	$5.19

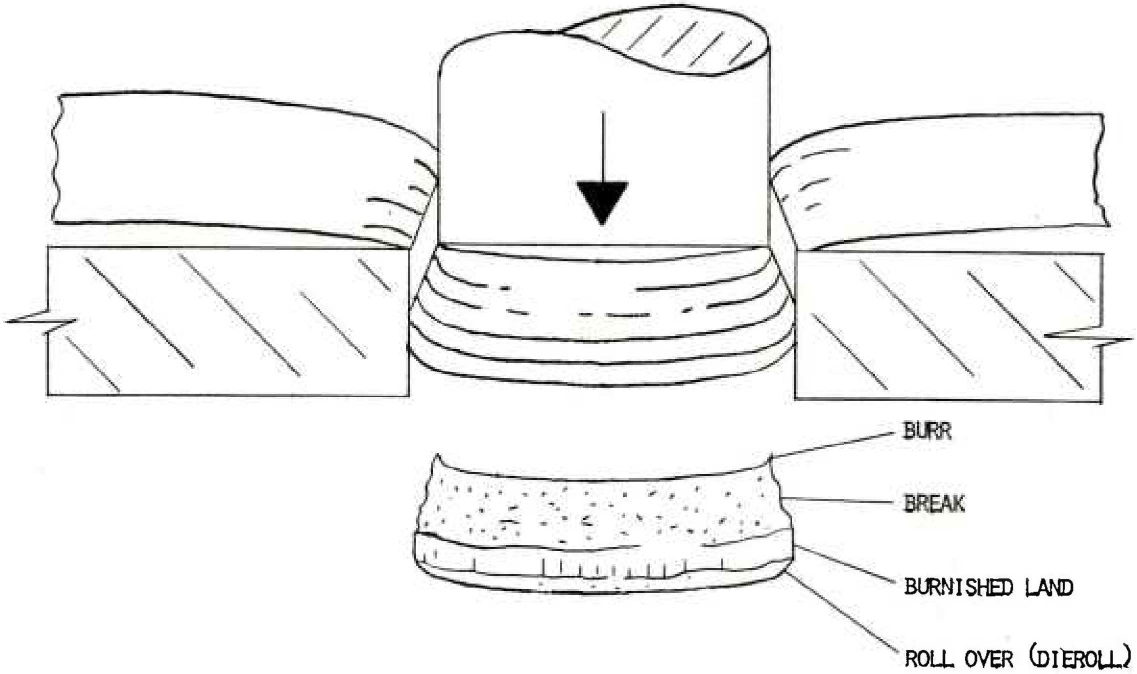

FIGURE 1 GRAPHIC REPRESENTATION OF CONVENTIONAL SHEARING

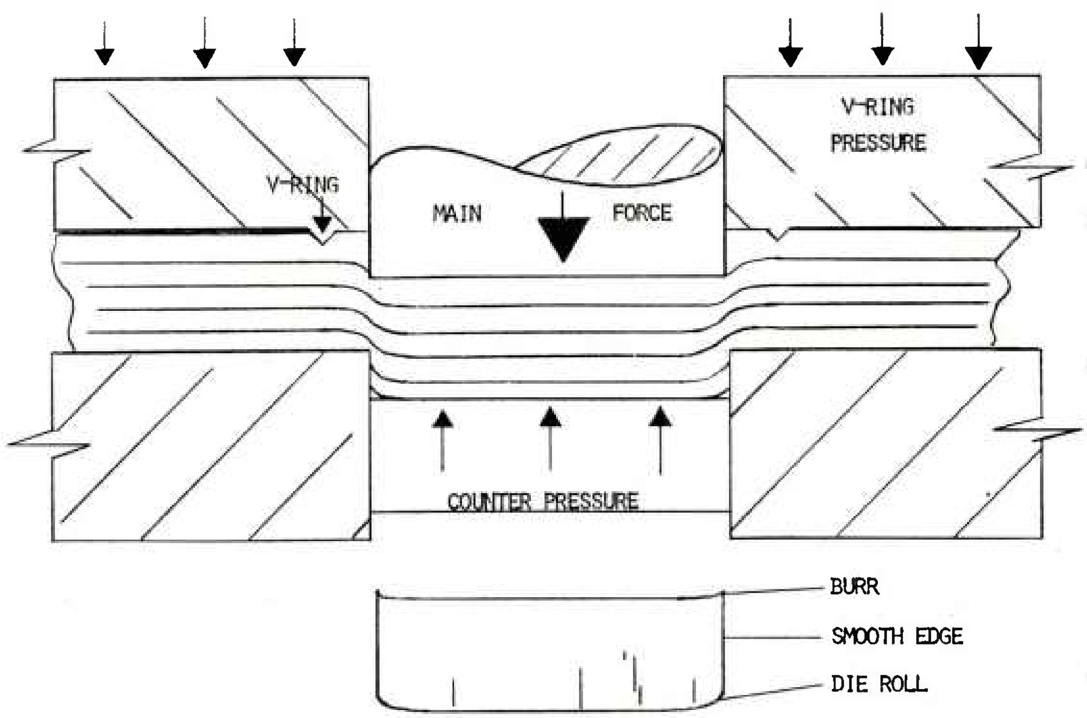

FIGURE 2 GRAPHIC REPRESENTATION OF FINE BLANKING

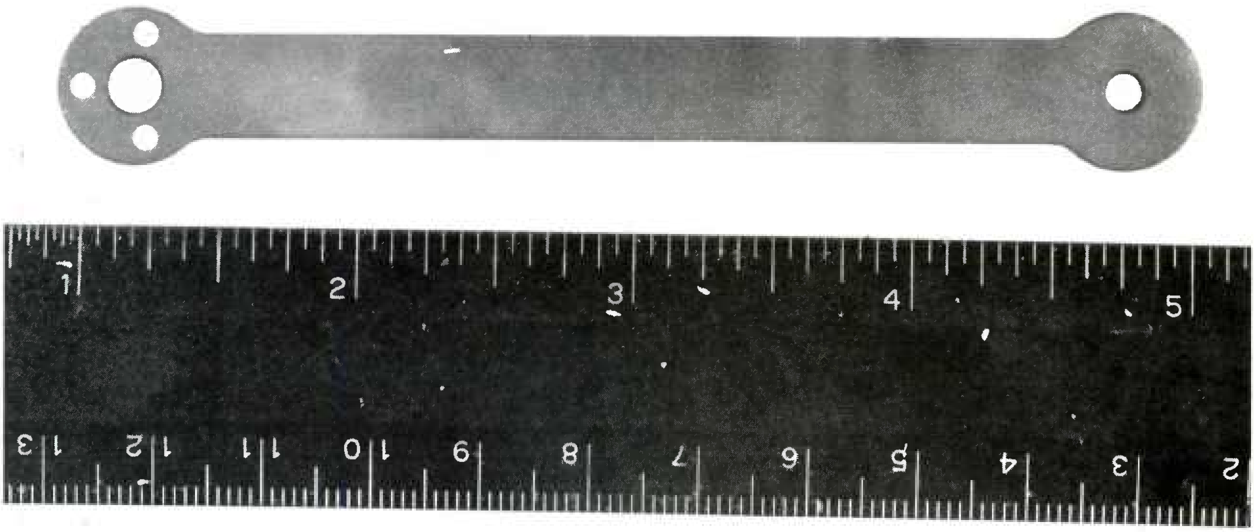

FIGURE 3 Fine blanking - Trigger Guard, PN 7790618

FIGURE 4 Fine blanking - Pawl, Cartridge Guide, PN 7793244

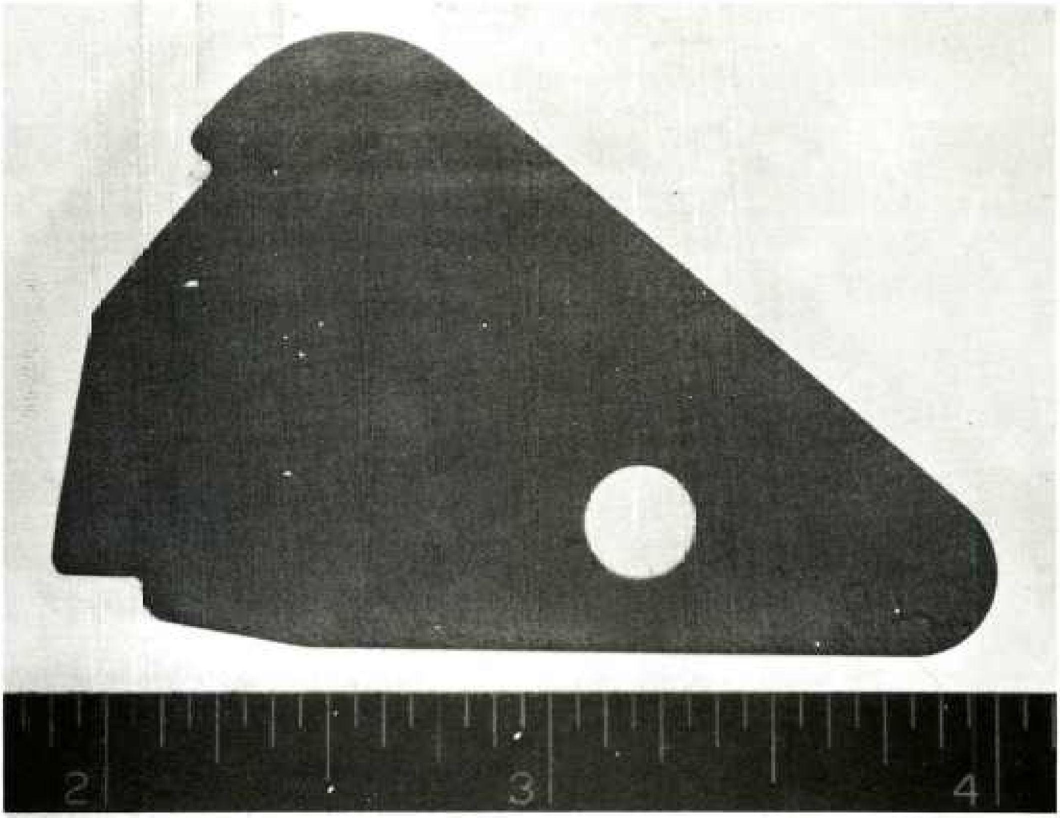

FIGURE 5 Fine blanking - Hammer, PN 7792878

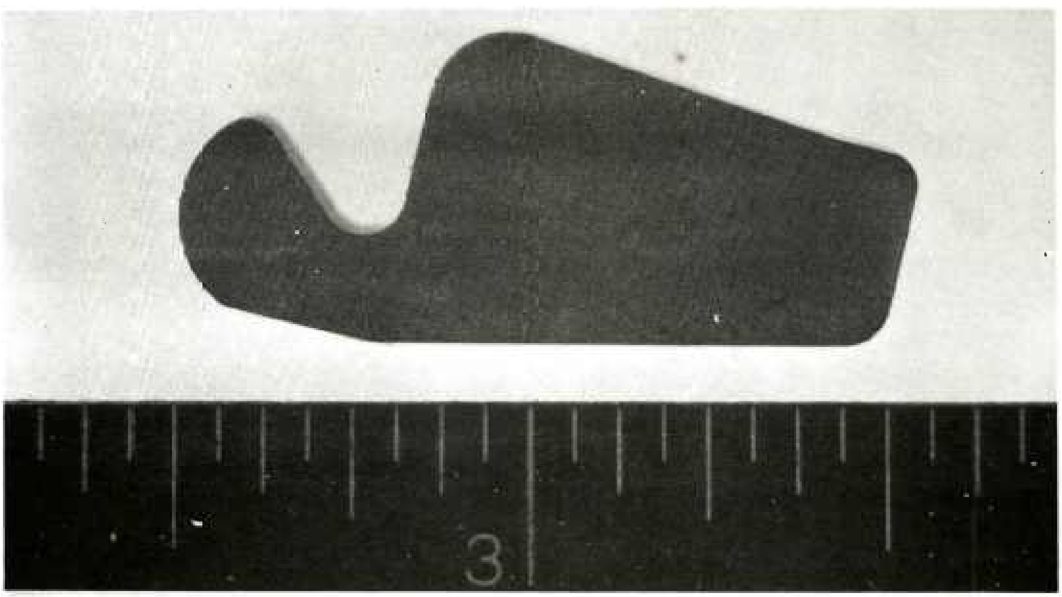

FIGURE 6 Fine blanking - Retainer, Cartridge Case, PN 7791378

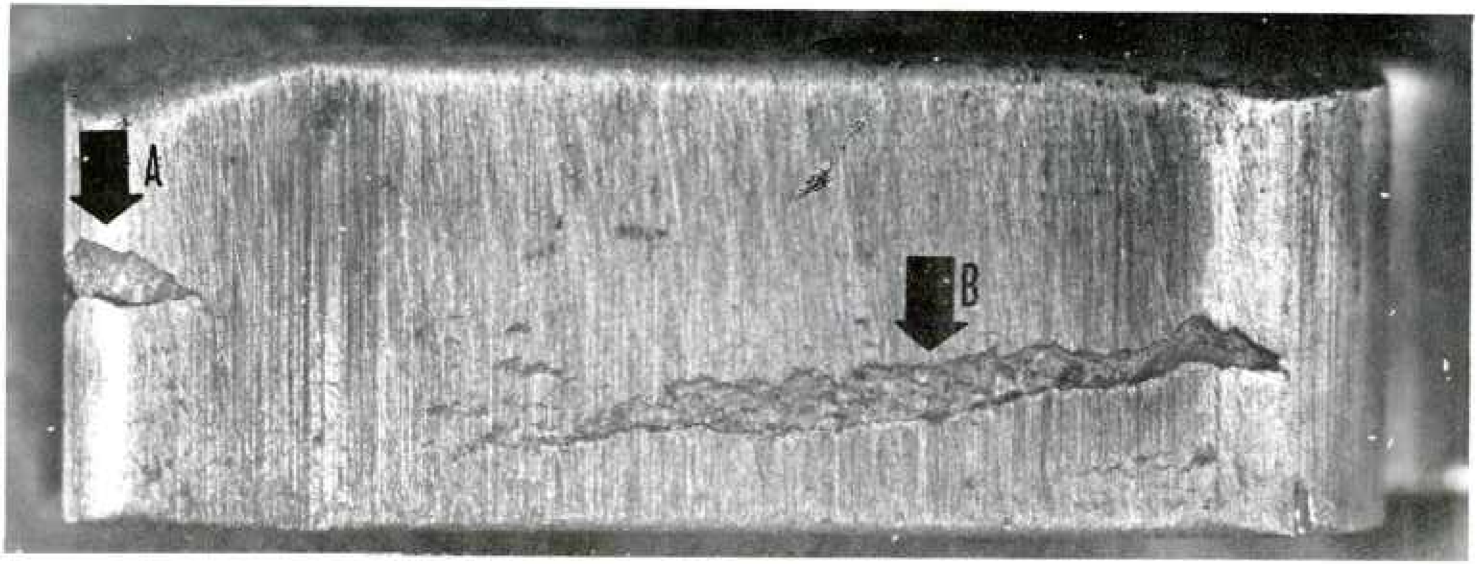

FIGURE 7 Edge View Fine blanking - Retainer, Cartridge Case, PN 7791378 Showing Corner Tears (A) and Edge Tears (B) 10X

FIGURE 8 Fine blanking - Stripper, Cartridge Link, PN 7793234

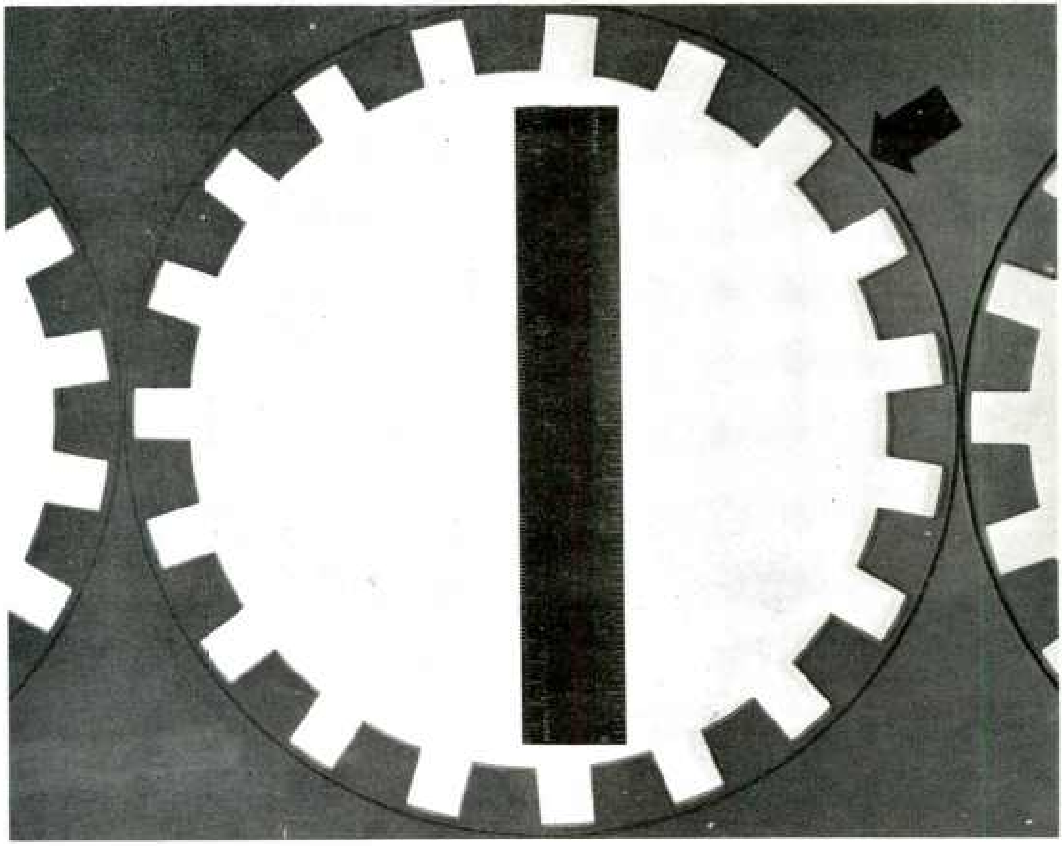

FIGURE 9 Feed Stock, Fine blanking, For Washer, Key, Bearing Retainer, PN 10908460. Note the impression left in the material by the V ring.

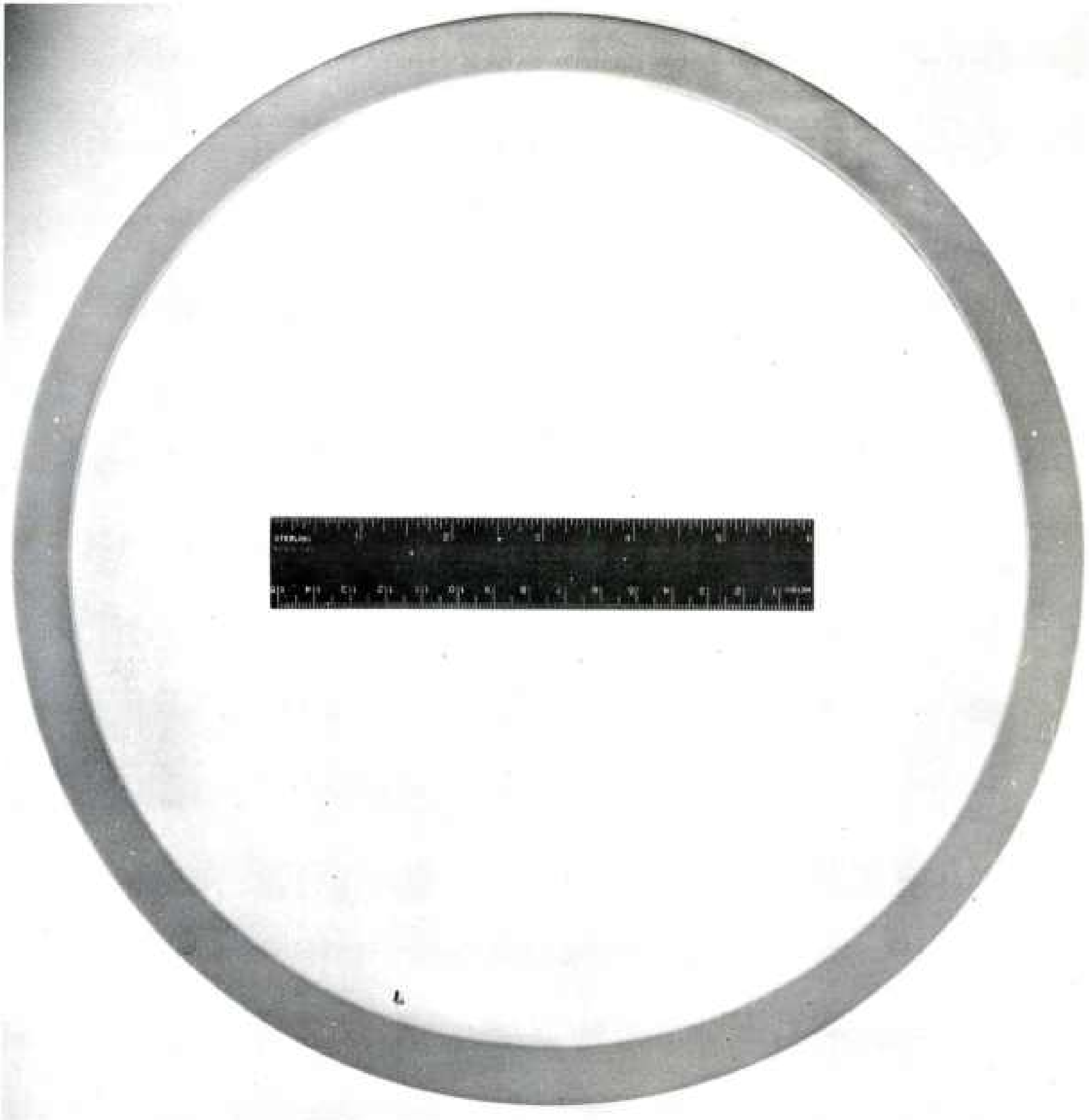

FIGURE 10 Fine blanking - Washer, Flat, PN 10892151

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FINE BLANKING SMALL CALIBER WEAPON PARTS

Report AOD-TR-78-001,
(AMS Code 3297.06.7305) Unclassified Report

The objective of this project was to investigate the feasibility of fine blanking small weapon components to close tolerances. Of particular concern was the applicability of the process to higher alloy materials. Eight parts representing a variety of part size, shape, thickness and material were produced as fine blankings. The parts blanked were generally acceptable. Fine blanking presses and dies are high cost items. Fine blanking is an effective and cost reducing process when properly utilized. High carbon alloy steels can be successfully fine blanked although die life is reduced. Fine blanking requires large production quantities to be cost effective.

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