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AN EXAMINATION OF ALLOY MEDALLION BLANKS MANUFACTURED BY POWDER METALLURGY TECHNIQUES

by

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PHYSICAL METALLURGY DIVISION

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SUMMARY OF RESULTS

The quality of "nickel silver", 85/15 brass, and 90/10 brass alloy medallion blanks manufactured by powder metallurgy techniques was assessed by carrying out the following tests: dimensional and weight constancy, density, porosity, microexamination and hardness.

The blanks were found to be of good, uniform quality.

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CONTENTS

Summary of Results. i

1 Introduction. 1

2 Experimental Procedure and Results. . . 1

2.1 Dimensional and Weight Checks. . 1

2.2 Density. 1

2.3 Porosity 1

2.4 Hardness 1

2.5 Microexamination 1

3 Discussion of Results 2

4 Conclusion. 3

1. INTRODUCTION

This report describes the properties of alloy medallion blanks produced by Godfrey Engineering Company Limited, Lachine, Quebec, using powder metallurgy techniques. The blanks were made in three different alloys, namely, "nickel silver", 85/15 brass, and 90/10 brass. The exact composition of the "nickel silver" was not given, but it was assumed to be 65% Cu-18% Ni-17% Zn.

2. EXPERIMENTAL PROCEDURE AND RESULTS

2.1 Dimensional and Weight Checks

Weight, diameter and thickness measurements are listed in Table 1. Thickness was measured at thirteen separate locations on samples No. 1 and 2 of each alloy, and at four locations on the other samples.

2.2 Density

Densities were calculated for all samples using the measurements in Table 1. In addition, density determinations were carried out on samples No. 1 and 2 of each alloy in accordance with Metal Powder Industries Federation (MPIF) Standard No. 8-50, using oil impregnation. Density results are given in Table 2.

2.3 Porosity

Percentage interconnected porosity was determined in accordance with MPIF Standard No. 8-50. Percentage total porosity was calculated using actual and true density figures. Porosity results are given in Table 2.

2.4 Hardness

Brinell hardness tests were performed on sample No. 3, of each alloy, using a 500 kg load and a 10 mm ball for 30 sec. Two impressions were made on each sample and Table 3 gives the average values.

2.5 Microexamination

A transverse section of one blank from each alloy was vacuum impregnated and mounted in a cold-setting plastic epoxide. The specimens were mounted within a steel ring to assist in keeping

them flat and to aid in edge retention during polishing. Conventional polishing methods were used.

Figure 1 is a photomicrograph of the "nickel silver" alloy illustrating the general porosity that was common to the three alloys.

A region of high density was observed at the centre-plane of the three blanks examined. This region is illustrated by Figure 2, in which it can be seen as a horizontal band of low porosity across the centre of the photomicrograph. This was probably a compaction phenomenon.

3. DISCUSSION OF RESULTS

The dimensions of the blanks (see Table 1) were consistent. The maximum dimensional variations detected in individual blanks were 0.002 in. on the diameter of the 85/15 brass and 0.003 in. on the thickness of the "nickel silver". The maximum dimensional differences between blanks of the same alloy were 0.004 in. and 0.008 in. on the diameter and thickness, respectively, of the 85/15 brass.

The weight variations (see also Table 1) were appreciable, the maximum differences between blanks being 0.90 g for the "nickel silver," 2.35 g for the 85/15 brass, and 1.38 g for the 90/10 brass.

The density and porosity results listed in Table 2 can be considered as normal, and do not exhibit any excessive variations between blanks of the same alloy. Good agreement was obtained between the density values determined by measurement and by oil impregnation. Where determined, the interconnected porosity proved to be a large percentage of the total porosity.

It should be noted that, as the design has to be impressed on the blanks by coining, it can be expected that the final density of the medallions will be significantly greater than that of the blanks.

The hardness of the blanks follows the expected trend - the "nickel silver" being harder than the other two alloys, which have similar hardness, and all being considerably softer than wrought annealed sheet of the same alloys. The low hardness is caused by the porosity.

4. CONCLUSION

The medallion blanks are of good, uniform quality.

JM:HMS/sg

TABLE 1

Weights and Dimensions of Sintered Medallion Blanks

Alloy	Sample No.	Weight (grams)	Diameters (in.)		Thickness (in.)	
			Measured	Av.	Range	Av.
Nickel Silver	1	20.3855	1.545, 1.544, 1.544	1.544	0.087 - 0.089	0.088
	2	19.8461	1.545, 1.544, 1.545	1.545	0.087 - 0.090	0.088
	3	19.9280	1.544, 1.544, 1.545	1.544	0.086 - 0.089	0.087
	4	20.2203	1.544, 1.544, 1.544	1.544	0.089 - 0.090	0.090
	5	19.4841	1.544, 1.544, 1.544	1.544	0.086 - 0.088	0.087
85/15 Brass	1	29.0781	1.591, 1.591, 1.589	1.590	0.126 - 0.128	0.126
	2	27.2378	1.591, 1.591, 1.591	1.591	0.123 - 0.124	0.123
	3	29.5876	1.591, 1.591, 1.591	1.591	0.130 - 0.131	0.130
	4	28.6736	1.593, 1.592, 1.592	1.592	0.125 - 0.125	0.125
	5	28.9495	1.590, 1.590, 1.590	1.590	0.127 - 0.128	0.128
	6	28.4272	1.590, 1.590, 1.591	1.590	0.124 - 0.125	0.124
90/10 Brass	1	29.1264	1.594, 1.595, 1.595	1.595	0.127 - 0.128	0.127
	2	29.7822	1.596, 1.595, 1.596	1.596	0.128 - 0.129	0.128
	3	28.7534	1.595, 1.595, 1.595	1.595	0.125 - 0.126	0.125
	4	28.4037	1.595, 1.596, 1.596	1.596	0.124 - 0.124	0.124
	5	29.5832	1.595, 1.595, 1.595	1.595	0.128 - 0.129	0.128
	6	28.5066	1.595, 1.595, 1.595	1.595	0.124 - 0.124	0.124

TABLE 2

Density and Porosity of Sintered Medallion Blanks

Alloy	Sample No.	Densities (g/cc)			% "True" Density*	% Total Porosity	% Interconnected Porosity
		Measurement	Oil Impreg.	Average			
"Nickel Silver "	1	7.55	7.49	7.52	86.1	13.8	13.1
	2	7.31	7.38	7.34	84.1	15.9	15.0
	3	7.45	-	-	85.3	14.7	-
	4	7.36	-	-	84.3	15.7	-
	5	7.30	-	-	83.6	16.4	-
85/15 Brass	1	7.09	7.12	7.10	81.1	18.9	16.4
	2	6.78	6.84	6.81	77.8	22.2	20.6
	3	6.98	-	-	79.8	20.2	-
	4	7.03	-	-	80.3	19.6	-
	5	6.98	-	-	79.8	20.2	-
	6	7.01	-	-	80.1	19.9	-
90/10 Brass	1	7.00	7.07	7.04	80.0	20.0	16.8
	2	6.97	7.12	7.04	80.0	20.0	15.7
	3	7.02	-	-	79.7	20.2	-
	4	6.98	-	-	79.3	20.7	-
	5	7.03	-	-	79.9	20.1	-
	6	7.00	-	-	79.5	20.4	-

* "True" densities, from ASM Metals Handbook, volume 1, 8th edition, 1961, are listed below.

Alloy	Density (g/cc)
"Nickel Silver "	8.73
85/15 Brass	8.75
90/10 Brass	8.80

TABLE 3

Hardness of Sintered Medallion Blanks

Alloy	Sample No.	Brinell Hardness
"Nickel Silver"	3	51.8
85/15 Brass	3	30.5
90/10 Brass	3	28.4

X200

Figure 1. "Nickel Silver" Alloy. Transverse section showing general porosity.

X100

Figure 2. "Nickel Silver" Alloy. Transverse section showing dense centre area.