DEPARTMENT OF MINES AND RESOURCES BUREAU OF MINES CANADA

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File

November 30, 1946.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2148.

Corrosion Resistance, Composition, and Hardness of an Experimental Army Clasp Knife.

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Bureau of Mines Division of Metallic Minerals.

Physical Metallurgy

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Background:

A letter (File No. DIRD (P) 105-11/D5), dated August 20, 1946, was received from Major C. A. F. Clark, for Wing Commander J. M. Macoun, Acting Director, Inter-Service Research and Development (Clothing and Equipment), Department of National Defence, Army, Room 4503, New Army Building, Ottawa, requesting that the pocket knife enclosed with it be subjected to the tests outlined in our Report of Investigation No. 1919, dated August 18, 1945, and the results compared with those obtained for Samples 1 and 2 of that report.

INVESTIGATION:

Hardness.

Table I gives the hardness of the various parts of the knife submitted, and also, for comparison, the hardness values obtained on the same parts of Knives 1 and 2 as reported in Investigation No. 1919.

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	Knife	Tnvestigation	Investigation				
	Submitted	No. 1919	No. 1919				
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Blade, Rockwell ⁿ C ⁿ	48-52	48-50	58				
Can Opener, Rockwell "C"	44-48	48	47-51				
Bottle Opener, Rockwell "C"	49~51	e,					
Leather Punch, Rockwell "C"	45	*3	а а а а а а а а а а а а а а а а а а а				
Springs, Rockwell "C"	49-53	41-43	50-56				
Separator	77-81, Rockwøll "B"	48-51, Rockwell ^R C"	90-93, Rockwell "B"				
Handle, Rockwell "B"	73-80	69~76	36-42				

TABLE I. - Hardness of Knife Parts.

Corrosion Resistance.

All parts were cleaned and degreased by washing in trichlorethylene, and then were exposed in a salt spray cabinet at 95° F. using a 20 per cent salt (sodium chloride) solution. The results were:

After 24 hours -

Some rust was visible on the edges of can opener, bottle opener and leather punch, and some on the rivet attached to the clevis. Small pits had started to form (Investigation, cont'd) -

- Page 3 -

e

on the blade. A more general type of corrosion was visible on all surfaces of the springs. The handle and separators had very little corrosion except on the small areas which had been ground when dismantling the knife.

The corrosion of the various knife parts was in the same order as after 24 hours, but more advanced. The attack on the clevis (except the rivet), handle and separators was insignificant. The samples were removed from test. Their appearance before exposure in the salt spray is shown in Figure 1 and, after exposure, in Figure 2. Figure 1.



APPEARANCE OF KNIFE BEFORE EXPOSURE IN SALT SPRAY CABINET.

After 72 hours - (Investigation, cont'd) -

Figure 2.



APPEARANCE OF KNIFE AFTER EXPOSURE FOR 72 HOURS IN SALT SPRAY CABINET.

Chemical Composition.

All the various parts of the knife submitted were analysed spectrographically to determine what elements were present. From a comparison of the spectrographic films, it became apparent that there were only three materials in the knife. The clevis was made from one, the handle and separators from another, and the blade, springs, can opener, bottle opener and leather punch from a third. A sample of each of these three materials was then analysed chemically. The chemical analyses are given in Table II.

TABLE II. - Analysis of Knife Parts.

Element		Clevis	Handle and Separators	Blades Springs	
			Per Cent	158	
Carbon	em	-	0.06	0.94	
Chromium	-		18.34	15.04	
Nickel		68.80	9.34	Trace.	
Silicon	2002	0.10	0.60	0.21	
Manganese	-	0.75	0,81	0.45	
Iron	-	1.25		æ	
Copper	-	29.40	60	**	
Molybdenum	-	854	0.07	0.09	
Vanadium	das	-	Nil.	N11.	

(Continued on next page)

- Page 5 -

(Investigation, cont'd) -

Silicon

Chromium

Vanadlum

00

Molybdenum

Nickel

0.21

0,15

11.07

0.08

From this analysis it is apparent that the clevis was made of monel metal, the handle and separators of an 18-8 stainless steel, and the blades and springs of a high carbon chromium steel (Jessop #440 C, according to D.I.R.D.).

		Inve	stip	ation No	5, 1919	٥
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Elements	Blade;(lan Ope	nor:	Springs	Handlo	Separators
		14.9	Po	r Co	n t -	74 74
Carbon	0.34	0.34		0.36	0.35	0.15
Manganese	0.61	0,58	{	0,51	0.64	0.43

0.09

0°S0

0,07

15°11

0.09

(d) (d)

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11,80

0,09

0.23

0,09

14,62

TABLE III. ~ Analysis of Parts of Knife 1, Investigation No. 1919.

Insufficient sample for determination.

0.10

0.10

11.94

0.06

TABLE IV.	, en	Analysis	oî .	Par	ts o	f Kr	lfo	2,
£413,744,749,499,999,9142,749,944,822,223,272		Investig	<u>jati</u>	on]	No.	1919	5	-

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Elements	Blades	1 <u>2</u> Can Onener	2 F C S Springs	Handle:	Saparatora
					The start of the second s
		- P @	r Co	nt -	
Garbon	0.55	0,56	0,54	0.63	0.06
Manganoso	0.75	0,75	0.67	0.86	0.38
Silicon	0.23	0.19	60	0.14	Nil.
Nickel	Nil.	Nil,	0,30	Míl.	N11.
Chromium	0.04	0.80.	Trace.	0.05	N11.
Molybdenum	Trace	, Trace.	0.01	Trace.	Nil.
Vanadium	N11.	N11.	Nil.	Nîl,	Nil.
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Insufficient sample for determination.

Comments:

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1. The request for this investigation asked for a comparison between the present knife and Knives 1 and 2 of Investigation No. 1919. Knife 2 was nickel plated, however, and is difficult to compare. It also is felt that nickel plate would not be sufficiently serviceable on blades, etc., that are subject to grinding and other severe wear. The present comparison is therefore being confined chiefly - Page 6 -

(Comments, cont'd) -

to Knife 1 and the present knife.

2. It should be pointed out that the surface finish of Knife 1 and that of the present knife were very different. Knife 1 had a polished surface on most parts, whereas the present knife had a ground surface on all except the handle. Polishing the surface of the present knife undoubtedly would increase its corrosion resistance. Another great difference in these two knives was the carbon content. The high carbon content of the present knife would tend to decrease its corrosion resistance.

Conclusions:

On the basis of the experimental work done on these knives the following conclusions may be drawn:

1. The hardness of the various parts of the present knife appears to be in the same order as Knives 1 and 2 of Investigation No. 1919.

2. The corrosion resistance of the present knife appears to be as good and possibly slightly better than that of Knife 1 of Investigation No. 1919.

5. The corrosion resistance of the present knife might have been improved by polishing the surface. A steel with a lower carbon content would have better corrosion resistance.

GV:LB,