File

DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

November 30, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2148.

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

(Copy No. 6.)

Bureau of Mines
Division of Metallic
Minerals

Physical Metallurgy
Research Laboratories

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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.

TABLE I. - Hardness of Knife Parts.

	Knife Submitted	Knife 1 of Investigation No. 1919	Knife 2 of Investigation No. 1919
Blade, Rockwell "C"	48-52	48-50	58
Can Opener, Rockwell "C"	44-48	48	47-51
Bottle Opener, Rockwell "C"	49-51	-	-
Leather Punch, Rockwell "C"	45	-	-
Springs, Rockwell "C"	49-53	41-43	50-56
Separator	77-81, Rockwell "B"	48-51, Rockwell "C"	90-93, Rockwell "B"
Handle, Rockwell "B"	73-80	69-76	36-42

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:

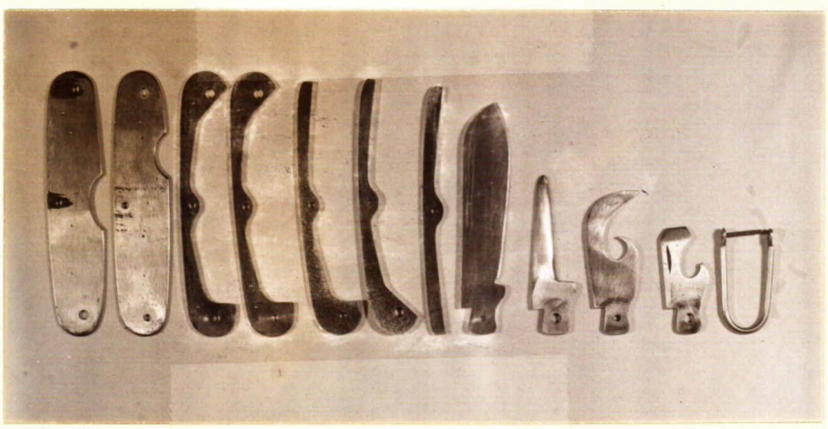
After 24 hours - Some rust was visible on the edges of can opener, bottle opener and leather punch, and some on the rivet attached to the clevis. Small pits had started to form

(Investigation, cont'd) -

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.

After 72 hours - 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.

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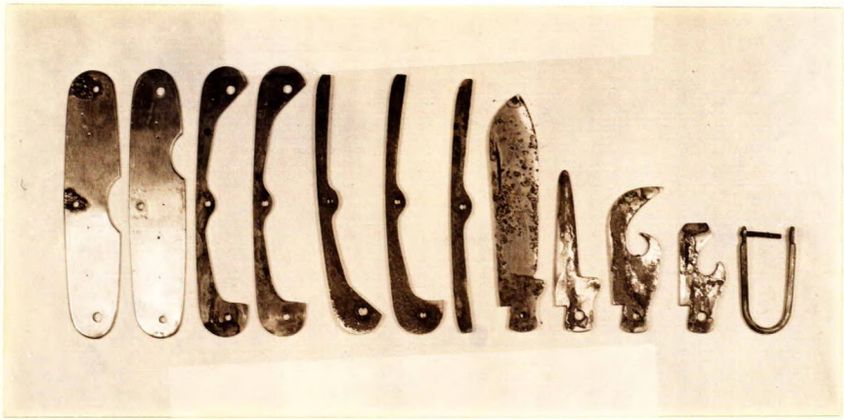
(Investigation, cont'd) -

Figure 2.



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

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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	-
Carbon -	-	0.06	0.94
Chromium -	-	18.34	15.04
Nickel -	68.80	9.34	Trace.
Silicon -	0.10	0.60	0.21
Manganese -	0.75	0.81	0.45
Iron -	1.25	-	-
Copper -	29.40	-	-
Molybdenum -	-	0.07	0.09
Vanadium -	-	Nil.	Nil.

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(Continued on next page)

(Investigation, cont'd) -

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.).

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

Elements	Parts				
	Blade	Can Opener	Springs	Handle	Separators
	- Per Cent -				
Carbon	0.34	0.34	0.36	0.35	0.15
Manganese	0.61	0.58	0.51	0.64	0.41
Silicon	0.21	0.10	0.09	0.09	0.09
Nickel	0.15	0.10	0.20	⊕⊕	0.23
Chromium	11.07	11.94	12.11	11.80	14.62
Molybdenum	0.08	0.06	0.07	⊕⊕	0.09
Vanadium					

⊕⊕ Insufficient sample for determination.

TABLE IV. - Analysis of Parts of Knife 2, Investigation No. 1919.

Elements	Parts				
	Blade	Can Opener	Springs	Handle	Separators
	- Per Cent -				
Carbon	0.55	0.56	0.54	0.63	0.06
Manganese	0.75	0.75	0.67	0.86	0.38
Silicon	0.23	0.19	⊕⊕	0.14	Nil.
Nickel	Nil.	Nil.	0.30	Nil.	Nil.
Chromium	0.04	0.29	Trace.	0.05	Nil.
Molybdenum	Trace.	Trace.	0.01	Trace.	Nil.
Vanadium	Nil.	Nil.	Nil.	Nil.	Nil.

⊕⊕ Insufficient sample for determination.

Comments:

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

(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.

3. 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.

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