PHOTOGRAPH THIS SHEET

AD A095541

DTIC ACCESSION NUMBER

LEVEL

Watertown Arsenal Labs, MA

INVENTORY

Rept. No. 344/42

DOCUMENT IDENTIFICATION

8 Sep. 36

DISTRIBUTION STATEMENT A
Approved for public release:
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRA&I
DTIC	TAB
UNANNOUNCED	
JUSTIFICATION	
(8 Sept. 1936)	
BY	
DISTRIBUTION /	
AVAILABILITY CODES	
DIST	AVAIL AND/OR SPECIAL
A	

Released

DISTRIBUTION STAMP

DTIC
ELECTE
S D
OCT 26 1981
D

DATE ACCESSIONED

UNANNOUNCED

81 9 23 233

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM 70A OCT 79

DOCUMENT PROCESSING SHEET

DISTRIBUTION OF REPORTS

REPORT NO. 344/42 TITLE _____

DATE DISTRIBUTED 10/2/36

6 copies + Extra

	Local	Other Ord. Work	Army	Navy	Private
Author	1 ✓	1	1	1	1
Lab File	1	1	1	1	1
Main Office File	1	1	1	1	1
Chief of Ordnance	1 ✓	..	2	2	
Technical Staff	-	-	1	1	
Springfield Armory		1 as directed in each case	1	1	
Watervliet Arsenal	..		1	1	
Rock Island Arsenal	..		1	1	..
Frankford Arsenal	..		1	1	
Picatinny Arsenal	..		1	1	
Aberdeen Proving Ground	..		1	1	
Chief, Bureau Ordnance	1 ✓	-	..	1	
Naval Gun Factory	..	..	..	1	..
Chief, Bureau C & R	-	..	..	1	
Int. Nickel Co	1 ✓			welding and as directed	
Local Circulation	1	1	1	1	as directed
Available for special circulation.	2	2	3	3	1
Other establishments requesting work.	..	2	..	..	..
Private Parties making for work	..	..	..	..	2

Report No. 344/12
Watertown Arsenal

Sept. 8, 1936

Anti-Galling Treatment of Monel

Object

To study anti-galling treatment of Monel Metal.

Reference

Ex. O. 345 A79.

Conclusions

Study of K Monel plated with Ag-Cd by the International Nickel Company showed no diffusion and therefore poorer adhesion would be expected as compared to that if diffusion had occurred.

Tinned surfaces of K Monel loose tin by galvanic corrosion.

Some non ferrous alloys such as the harder Al Bronzes might be considered as a substitute material for those parts now made of K Monel and subject to galling.

Introduction

The treatment which K Monel metal parts received did not appear to be satisfactory. This report collects available information regarding the treatment.

Historical

The following summarizes the correspondence pertaining to the process.

470.1/3487 7/9/35 To - International Nickel Co.
by Watertown Arsenal, P. R. Kosting

Details of process of spraying were requested.

470.1/3497 7/26/35 To - Watertown Arsenal
by International Nickel Co., H. J. F.

Messrs. Handy & Horman supply wire of 75 Ag 25 Cd for use in spray gun; the gauge of wire is controlled by melting point of alloy and varies between 12 and 18. The Monel Metal should be machined 0.003" undersize, sandblasted with 14-20 mesh sand or No. 30 to No. 40 steel grit, sprayed to 020" oversize, heat treated for 6 - 8 hours at 420° F in a reducing atmosphere, furnace cooled, wet grind or machine to size and polish. (It appears that this temperature is suitable for 50:50 Ag Cd alloy and that 900-950° F should be used for 75:25 Ag Cd alloy).

472.62/188 8/1/35 To - Watertown Arsenal
by General T. Schappat.

Arrangements should be made with International Nickel Company to apply coating.

470.1/3500 8/2/35 To - International Nickel Co.
by Watertown Arsenal, W. J. L.

Quotations requested for spraying, heat treating and finish machining leaving surfaces of monel metal.

470.1/3504 8/12/35 To - International Nickel Co.
by Colonel G. F. Jenks.

Request quotations.

470.1/3505 8/13/35 To - Watertown Arsenal
by International Nickel Co., C. A. C.

Quotations mailed.

470.1/3507 8/20/35 To - Watertown Arsenal
by International Nickel Co., C. A. C.

Quotations held up.

470.1/3514 Same as 3507

470.1/3532 9/26/35 To - Watertown Arsenal
by International Nickel Co., C. A. C.

Experimental study of spraying still underway and then production of coated articles will be started.

470.1/3565 11/12/35 To - Watertown Arsenal
By International Nickel Co., C. A. C.

Sprayed parts were returned. Machining should be done at high speed with very light feed using very sharp pointed tool without lubrication or coolant; careful treatment of edges should be exercised. All pieces should be thoroughly soaked in oil before test. Gouged metal had been repaired by soldering, which solder melted during heat treatment. The presence of traces of tin caused slight localized discolored embrittlement but should have no detrimental effects.

470.1/3571 11/27/35 To - Watertown Arsenal
by International Nickel Co., C. A. C.

There may be a tendency to gall between K Monel rollers and races. Cast silicon monel working against K Monel races would be an interesting study.

472.62/288 6/23/36 To - Watertown Arsenal
by S. L. C.

Breech operating cam and salvo latch cam on 1st slide 3"/50 cal. A.A. was repaired by trimming the spray metal which peeled off. The sprayed metal peeled off these parts in the 2nd and 3rd slides. On the 1st and 2nd slides, tin was applied where sprayed coating had failed but not on the 3rd slide which was shipped defective.

472.62/295 6/24/36 To - Ordnance Office
from Navy Department, Bureau of Ordnance.

The silver cadmium anti galling treatment for K Monel metal as developed by Navy was described. This treatment is to be applied to K Monel metal parts at the Naval Gun Factory as follows:

178478-1	Operating Cam Plate
-2	" " " shaft
178479-4	Salvo latch cam
178480-2	Cam plate retr. shaft

The process consists of spraying 16 ga. 75-25 Ag-Cd alloy wire on the K Monel surface cleaned with #30 steel grit.

The surface is not machined undersize: the thickness of coating applied is .005". The part is then heated to 735° F for 10 hours in pure dry hydrogen. The microstructure shown indicates some diffusion of the coating into the base metal.

The parts referred to in 472.62/288 and 472.62/295 when received by Watertown Arsenal from International Nickel Co., after spraying, had many over hanging edges which showed indications of brittleness. Machining was made difficult because no "base" lines had been indicated and it was difficult to refinish to size and not remove all the sprayed metal in certain cases. When assembled and tested, the coating peeled from these parts on the first slide as already mentioned and these bare parts were tinned and parts sent for proof test.

When K Monel plumb-hole specimens were tinned and placed in synthetic sea salt spray for 100 hours, some 60% of the tin was found to have been removed by corrosion. Hence the objection of the Navy Department to the use of tin.

When the International Nickel Company submitted plated samples for the original wear tests reported in W.A. 344/24 and 344/24-1, one with silver-solder coating was included. Upon diffusion heat treatment alloying with the base metal was evident. The coating was hard. If unlubricated, the coating failed by flaking when under load.

When the sprayed coating was developed, a sample was given to Watertown Arsenal for its information. In the salt

spray no corrosion occurred other than slight spotting apparently due to iron particles. The report of Mr. Carter 344/99, June 17, 1936 showed no diffusion or alloying action had occurred due to heat treatment. This was surprising because sufficient copper is present in the Monel to facilitate alloying.

Since little alloying occurred during the treatments given by the International Nickel Company, the only bonding between base metal and coating is mechanical interlocking. In discontinuous flat patches this bonding is not sufficient for Ordnance use. When the coating is continuous and can form a ring as around rods and shafts etc., the bonding is generally satisfactory.

If the coating is thin, then for those flat discontinuous surfaces improved bonding can be obtained by electroplating provided the surface is chemically clean and free of film where the coating is applied. This the Navy has evidently demonstrated. Difficulty will always be encountered in having different plating concerns keep the surface to be plated chemically clean 100% of the time.

Discussion

The preferred solution to the problem is of course to have the mating parts of different metals. Since the other metal must be galvanically neutral to Monel Metal the choice of metals is immediately limited to high Cr low C steels and to non ferrous alloys.

In the former group of alloys is "two score" or 18 Cr/2N: alloy and in the latter Be Copper and Al Bronze.

Sufficient information is not known regarding the 18/2 Cr Ni analyses but it certainly has possibilities of development. Watertown Arsenal report No. 315/22 shows that yield points 0.00% set above 100,000 lbs. per sq. in. are to be expected with $_{150}$ Rc hardness of 35 approximate. The metal is cathodic to copper alloys. Whether it is consistently cathodic to copper-nickel alloy is not known. Stainless alloys in general have poor wearing qualities.

Be copper castings and forgings are available. Casting with yield strength 0.00% set around 100,000 lbs. per sq. in. and $_{150}$ Rc above 35, are galvanically neutral to Monel Metal.

Al bronze castings are available with $_{150}$ Rc hardness of around 30 to 35 and yield points around 40,000 to 45,000 lbs. per sq. in.

The ductility of non ferrous alloys tends to be low. Whether too low for the purpose intended is problematical. Experience shows that aluminum bronzes can be substituted for steels with great success in places where it was believed a super-hard steel was required. Al bronze dies are being used with success in contact with polished 18/8, pickled steel, etc.

Whether the property accounting for failure in Ordnance is one of low transitional velocity of impact as suggested by H. Mann or a <u>combination</u> of <u>high</u> hardness with <u>high</u> ductility instead of high hardness with low ductility is not now known.

It is believed that experiment with Al bronzes is justified. Softer forgings and harder castings should both be tried.

S Monel casting is another alloy of interest but the fact that the International Nickel Company did not try it in their development and the fact that it is believed to have low transitional velocity of impact does not indicate that it is a better alloy for test than Al Bronze. K Monel surfaces hardened with S Monel over lay applied by welding methods may be a solution but machining difficulties are to be anticipated. The result of Navy Tests of samples submitted by the International Nickel Company will be awaited with interest.

Respectfully submitted,

Peter R. Kosting.